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Performing a AP-2.14Q Review of Technical Products and Data is not necessary for this products since the results of this calculation do no impact any other organization.

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Attachment II	76
Attachment III	3

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CONTENTS

TABLES

Page

TABLES (Continued)

Page

TABLES (continued)

Page

TABLES (Continued)

Page

TABLES (Continued)

Page

FIGURES

Page

FIGURES (Continued)

Page

1. PURPOSE

The purpose of this document is to review the criticality benchmark experiments previously selected (BSC2002a) for use in the criticality analyses of the codisposal viability for the various types of U.S. Department of Energy (DOE) spent nuclear fuel (SNF) and to perform evaluations of the critical limit (CL) for each DOE SNF group using the methodology described in the *Disposal Criticality Analysis Methodology Topical Report* (YMP 2000). The CL is derived from the bias and uncertainties associated with the employed criticality code (MCNP) and modeling process. The scope of the present calculation encompasses nine DOE-owned spent nuclear fuel types. These are: 1) Highly Enriched Uranium (HEU) Oxide SNF (Shippingport Pressurized Water Reactor [SPWR] SNF) (CRWMS M&O 2000c); 2) UZrH (TRIGA) SNF (CRWMS M&O 2000a); 3) Melt and Dilute Waste Form (Radulescu 2001a); 4) U-Zr/U-Mo Alloy (Enrico Fermi) SNF (CRWMS M&O 2000b); 5) Mixed Oxide (MOX) SNF (Fast Flux Test Facility [FFTF] SNF) (CRWMS M&O 1999a); 6) Th/U Oxide SNF (Shippingport Light Water Breeder Reactor [SLWBR] SNF) (CRWMS M&O 2000d); 7) Th/U Carbide SNF (Ft. St. Vrain [FSV] High Temperature Gas Reactor [HTGR] SNF) (Radulescu 2001b); 8) U-metal SNF (N-reactor SNF) (CRWMS M&O 2001), and 9) Three Mile Island (TMI) Waste Form. The current report also includes additional benchmarks on ^{233}U/Th LWBR SNF that have been recently evaluated (Putman 2003).

The results of this calculation will be used to validate the MCNP (CRWMS M&O 1998a) code's ability to accurately predict the effective neutron multiplication factor (k_{eff}) for a range of conditions spanned by various critical configurations representative of the potential configurations the DOE SNF stored in a codisposal waste package may take due to degradation.

This calculation is associated with the waste package design and is subject to the Quality Assurance Requirements and Description (QARD) (DOE 2003) per the activity evaluation under work package number NSN002 in the technical work plan TWP-MGR-MD-000031 REV 00 (BSC 2003a).

2. METHOD

As mentioned in *Disposal Criticality Analysis Methodology Topical Report* (YMP 2000), the criticality model applies the Monte Carlo method along with material cross-section data in evaluating the criticality potential of configurations of fissionable and other materials identified by the degradation analyses of the waste package. The accuracy of the method and cross-section data is established by evaluating benchmark critical experiments. For the waste package (WP) criticality evaluations, criticality is defined by the CL, which is the value of k_{eff} at which a waste package configuration is considered potentially critical. An essential element of validating the methods and models used for calculating effective neutron multiplication factors, k_{eff}, for a waste package is the determination of CL (YMP 2000, Section 3.5.3.2.5). CL values are established by applying the criticality model in evaluating critical experiments that are representative of the range of in-package and out-of-package configurations identified by the degradation analyses. The CL is derived from the bias and uncertainties associated with the criticality code and modeling process. The CL is characterized by statistical tolerance limits that account for biases and uncertainties associated with the criticality code calculating process.

A CL is associated with a specific type of codisposal waste package/waste form and its state (intact or various stages of degradation described by the Master Scenarios (YMP 2000, pp. 3-8 through 3-14). The CL is characterized by a representative set of benchmark criticality experiments. This set of criticality experiments also prescribes the basic range of applicability of the results. A CL function may be expressed as a regression-based function of neutronic and/or physical variable(s). In application, a CL function could also be a single value, reflecting a conservative result over the range of applicability for the waste form characterized.

The application of statistical methods to biases and uncertainties of k_{eff} values is determined by trending criticality code results for a set of benchmark critical experiments that will be the basis of establishing CLs for a waste form. This process involves obtaining data on various neutronic and/or physical parameters that are associated with the set of critical experiments used to model the code-calculated values for k_{eff}. These data, with the calculated values of k_{eff}, are the basis of the calculation of the CL function.

Figure 1 displays two general processes for establishing CL functions. These two processes are as follows: 1) regression-based methods reflecting criticality code results over a set of critical experiments that can be trended; and 2) random sample based methods that apply when trending is not an appropriate explanation of criticality code calculations.

The regression approach addresses the calculated values of k_{eff} as a trend of neutronic and/or physical parameters. That is, regression methods are applied to the set of k_{eff} values to identify trending with such parameters. The trends show the results of systematic errors or bias inherent in the calculational method used to estimate criticality. In some cases, a data set may be valid, but might not cover the full range of parameters used to characterize the waste form. The area (or areas) of applicability of a calculational method may be extended beyond the range of the experimental conditions of the data set over which the bias is established by making use of correlated trends in the bias.

If no trend is identified, a single value may be established for a CL that provides the desired statistical properties associated with the definition of this quantity. The data are treated as a random sample of data (criticality code values of k_{eff}) from the waste form population of interest and straightforward statistical techniques are applied to develop the CL. For purposes of differentiation, these techniques are described in YMP 2000 as "non-trending". The normal distribution tolerance limit (NDTL) method and the distribution free tolerance limit (DFTL) method, discussed in YMP (2000, pp. 3-56 and 3-57), are "non-trending" methods. Similar methods are also described in more detail in Dean (2001) under the denominations "single-sided tolerance limit" (Dean 2001, p. 11) and respectively "nonparametric statistical treatment" (Dean 2001, p. 14).

The regression or "trending" methods use statistical tolerance values based on linear regression techniques to establish a CL function. Trending in this context is linear regression of k_{eff} on the predictor variable(s)(YMP 2000, p. 3-52). Here the predictor variable(s) may be a parameter such as enrichment, or a parameter that indicates the distribution of neutrons within the system, such as the average energy of a neutron that causes either fission or absorption. Where multiple candidates are found for trending purposes, each regression model will be applied and the conservative model may be used to determine the value of the CL. The lower uniform tolerance band (LUTB) method,

discussed in YMP (2000, pp. 3-55 and 3-56), trends a single parameter against k_{eff}. Multiple regression methods that trend multiple parameters against k_{eff} may also be used to establish the tolerance-limit CL function. In either single or multiple situations, the regression trend that produces the lowest CL is defined to be the more conservative regression. The current calculation only uses single parameter regression methods.

In all calculations of CL functions, the concept described as the "no positive bias" (Lichtenwalter et al. 1997, p. 160) rule must be accommodated. This rule excludes benefits for raising the CL for cases in which the best estimate of the bias trend would result in a CL greater than 1.0. The treatment of this element is discussed below in the context of each method used to establish the basic CL function.

The critical limit is calculated by CLREG code using LUTB method (BSC 2002b) when a trending regression is identified as statistically significant. If no trend is identified, then the NDTL or the DFTL methods are implemented using Excel spreadsheets.

The method to perform the additional criticality calculations consists of using MCNP Version 4B2 (CRWMS M&O 1998a, CRWMS M&O 1998b) to calculate the effective neutron multiplication factor of the codisposal waste package. The calculations are performed using the continuous-energy cross section libraries, which are part of the qualified code system MCNP 4B2 (CRWMS M&O 1998a, CRWMS M&O 1998b). All calculations are performed with fresh fuel composition unless otherwise specified.

The detailed description of the calculations performed and of the exact flow of calculations involved in each method is presented in Section 5.

Control of the electronic management of data was accomplished in accordance with the controls specified by BSC 2003a.

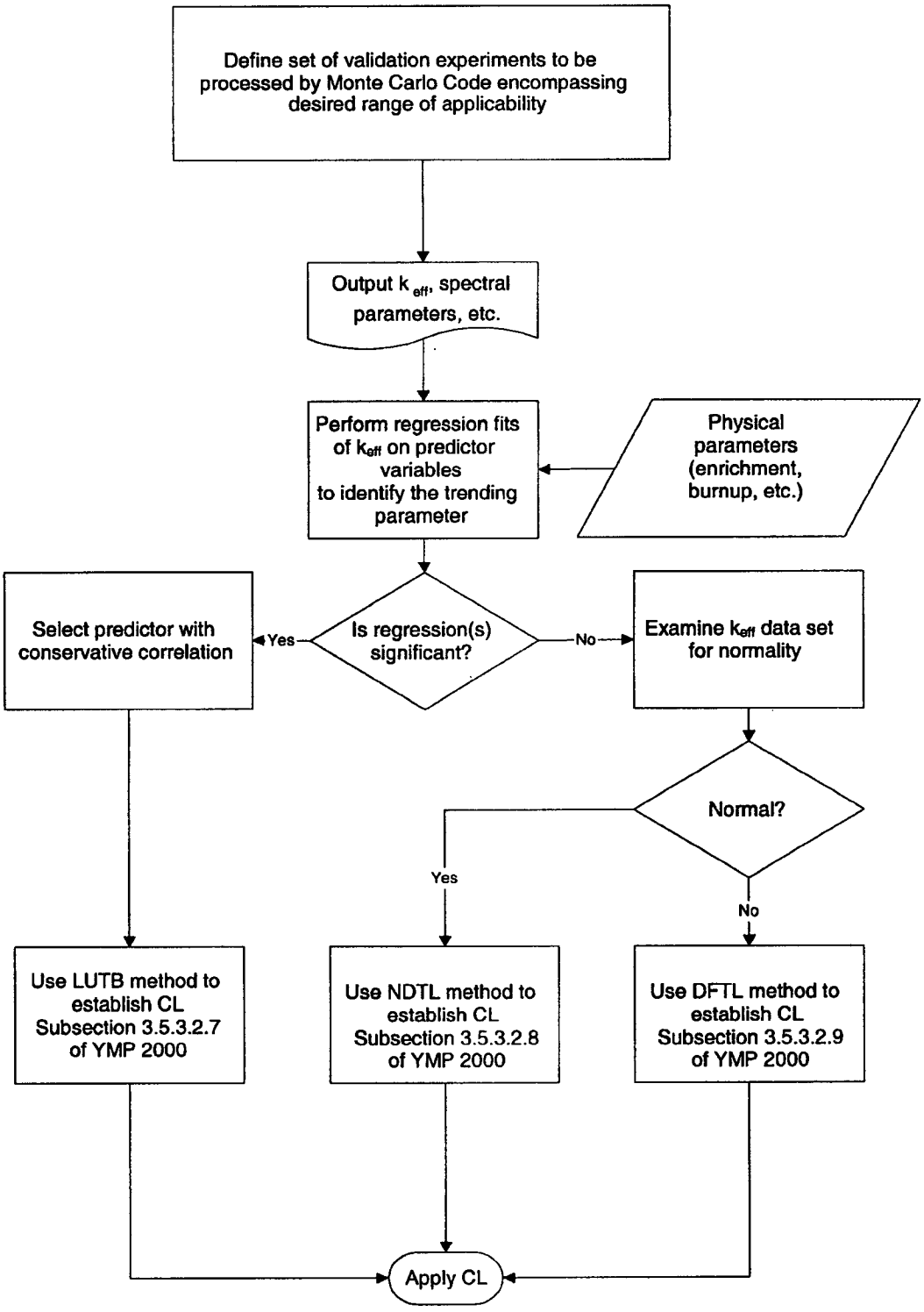


Figure 1. Process for Calculating Critical Limits

3. ASSUMPTIONS

No specific assumptions have been used in developing the current calculation.

4. USE OF COMPUTER SOFTWARE AND MODELS

4.1 SOFTWARE

The commercial off-the-shelf software MS EXCEL Version 97 SR-1 installed on a personal computer (PC) Dell Optiplex GX150 operating under Windows 98 operating system, was used for performing graphical representations and arithmetical manipulations in a spreadsheet type environment. The developed spreadsheet files are included in Attachment I and listed in Attachment III. The spreadsheets contain sufficient information to allow an independent check to reproduce or verify the results.

4.1.1 MCNP

The baselined MCNP code (CRWMS M&O 1998b) was used directly to calculate the k_{eff} of the additional critical benchmark experiments. The software specifications are as follow:

- Program Name: MCNP
- Version/Revision Number: Version 4B2LV
- Status/Operating System: Qualified/HP-UX B.10.20
- Computer Software Configuration Item Number: 30033 V4B2LV
- Computer Type: Hewlett Packard (HP) 9000 Series Workstations
- Computer processing unit number: Software is installed on the Framatome ANP workstation "gr1" whose CPU number is E 9000/785 2008515632 and "gr0" whose CPU number is E 9000/782 2002611431.

The MCNP software used is: (a) appropriate for the application of k_{eff} calculations, (b) used only within the range of validation as documented in CRWMS M&O (1998a) and Briesmeister (1997), and (c) obtained from the Software Configuration Management in accordance with appropriate procedures.

4.1.2 CLREG

The CLREG computer code (BSC 2002b) was used to calculate the critical limit for the benchmark experiments provided, and extend the range of applicability for the critical limit. The software specifications are as follows:

- Program Name: CLREG
- Version/Revision Number: V1.0
- Status/Operating System: Qualified/Windows 1998
- Software Tracking Number (STN) Number: 10528-1.0-00
- Computer Type: Personal Computer (PC) Dell Optiplex GX150

- Computer Processing Unit (CPU) number: Software is installed on two Framatome ANP PCs whose CPU numbers are CH06T01 and 1ZF8F01.

CLREG is a computer program that calculates sets of critical limits (critical limit functions) for waste packages under certain conditions. Each CL represents the value of k_{eff} at which a configuration is considered potentially critical. This value accounts for the criticality analysis method bias and uncertainty of the calculated k_{eff} values for a set of critical experiments that represent the waste package, as explained by linear regression trending. Also inherent in each CL value is the statistical property of confidence for lower prediction limits and lower tolerance limits. The input and output files for the CLREG calculations are documented in Attachment III such that an independent repetition of the software used could be performed. The CLREG software used was: (a) appropriate for the calculation of critical limits, (b) used only within the range of validation as documented in BSC (2002b), and (c) obtained from Software Configuration Management in accordance with appropriate procedures.

5. CALCULATION

This section describes the calculations performed to evaluate the CL for each DOE SNF group based on the k_{eff} calculated with the MCNP code for appropriately selected pools of criticality benchmark experiments (BSC 2002a). Section 5.1 describes the general inputs used in the present evaluation. These also include the additional criticality benchmark experiments and the nuclear cross-section data used with the criticality model. A detailed description of the flow of the calculations that materialize the application of the CL calculation method described in Section 2 is outlined in Section 5.2. The results of the calculations are presented in Section 6. The corresponding MCNP and CLREG input and output files and the supporting Excel spreadsheets for each DOE SNF group are listed in Attachment III and included in Attachment I.

5.1 INPUTS

5.1.1 Additional ^{233}U/Th Criticality Benchmark Experiments

This section describes the eight water–flooded ^{233}U/Th critical assemblies, designated SB-cores, which have been recently evaluated (Putman, 2003) and are used in the present calculation to increase the pool of applicable benchmarks for the DOE SNF group containing ^{233}U/Th. These cores were designed to provide nuclear parameter information for LWBR seed-and-blanket configurations. Seed fuel was made up of either $^{235}UO_2$- ZrO_2 or $^{233}UO_2$-ZrO_2 matrix, but neither matrix was used in the final LWBR design. Blanket fuel was made up of either a $^{232}ThO_2$ or $^{233}UO_2$-$^{232}ThO_2$ matrix, and both matrices were used in the final LWBR fuel design. The eight assemblies included five rectangular (SB-1, SB-2, SB-21/2, SB-3, and SB-4) and three hexagonal (SB-5, SB-6, SB-7) cores. The following table (Table 5-1) summarizes the lattice and core loading information.

Table 5-1. Summary of SB Core Lattices for ^{233}U/Th Critical Experiments

Core ID	Lattice	Geometry	Total No of Rods	Seed Region				Blanket Region			
				Fissile	Pitch (cm)	H/U	No of rods	Com-position	Pitch (cm)	H/Th	No of rods
SB-1	square	rectangular	1588	^{235}U	0.91948	37	576	ThO_2	1.8387	4.4	1012
SB-2	square	rectangular	1480	^{233}U	0.91948	38	340	ThO_2	1.8387	4.4	1140
SB-2 1/2	square	rectangular	288	^{233}U	0.91948	38	288	N/A	N/A	N/A	0
SB-3	square	rectangular	1288	^{233}U	0.91948	38	224	UO_2-ThO_2	1.8387	4.4	1064
SB-4	square	rectangular	1402	^{235}U	0.91948	37	376	UO_2-ThO_2	1.8387	4.4	1026
SB-5	triangular	hexagonal	1261	^{235}U	1.44805	107	217	ThO_2	1.4514	0.46	1044
SB-6	triangular	hexagonal	1261	^{233}U	1.44805	110	148	ThO_2	1.4514	0.46	1113
SB-7	triangular	hexagonal	1261	^{233}U	1.44805	110	115	UO_2-ThO_2	1.4514	0.45	1146

Source: Putman 2003, Table 1

These experiments used four fuel rod matrices: $^{235}UO_2$-ZrO_2 seed, $^{233}UO_2$-ZrO_2 seed, $^{232}ThO_2$ blanket and $^{233}UO_2$-$^{232}ThO_2$ blanket. Each rod consists of a fuel-pellet stack between zircaloy-2 plugs, all within a seamless zircaloy-2 tube, with welded zircaloy-2 end caps. Fuel pellets within a stack were flat-ended cylinders of identical composition and diameter, and varying lengths. Table 5-2 summarizes relevant dimensional information.

Table 5-2. SB Fuel Rod Average Dimensions

	Seed Region		Blanket Region	
	$^{235}UO_2$- ZrO_2	$^{233}UO_2$-ZrO_2	$^{232}ThO_2$	$^{233}UO_2$-$^{232}ThO_2$
Overall length (cm)	52.9082 (20.83 in.)	52.9082(20.83 in.)	52.9082(20.83 in.)	52.9082(20.83 in.)
Fuel pellet diameter (cm)	0.5367 (0.2113 in.)	0.5354 (0.2108 in.)	1.2408 (0.4885 in.)	1.2454 (0.4903 in.)
Clad inner diameter (cm)	0.5575 (0.2195 in.)	0.5575 (0.2195 in.)	1.2670 (0.4988 in)	1.2659 (0.4984 in.)
Clad outer diameter (cm)	0.6464 (0.2545 in.)	0.6464 (0.2545 in.)	1.4473 (0.5698 in.)	1.4463 (0.5694 in.)
Active fuel length (cm)	38.1 (15 in.)	38.1 (15 in.)	38.1 (15 in.)	38.1 (15 in.)

Source: Putman 2003, Table 2

The benchmark models developed in Putman (2003) are simplified representations of these experiments and have been adopted to be used in the present calculation. The MCNP benchmark model inputs (Putman, 2003, Appendix E) have been modified to include cross-section libraries that are consistent with the previous benchmark evaluations (BSC 2002a). A detailed presentation of the nuclear cross-section data used in the benchmark evaluations applicable to the present CL calculation is presented in the following section (Section 5.1.2). The corresponding MCNP input and output files used to evaluate the present benchmarks are listed in Attachment III and included in Attachment I.

5.1.2 Nuclear Cross-Section Data

Nuclear cross-section data are available from several source evaluations (data libraries). Utilizing the appropriate material cross-sections in a criticality calculation with MCNP is essential to

obtaining credible results (BSC 2003b). The cross sections for the various neutron interactions are used to determine the flow of the criticality calculation at each interaction site. The MCNP neutron interaction tables are processed from either the ENDF/B-V, LLNL, or LANL:T-2 evaluations. The sources for the neutron interaction tables are listed by material in Briesmeister (1997, Appendix G).

For a particular table, the cross sections for each reaction are given on one energy grid that is sufficiently dense that linear-linear interpolation between points reproduces the evaluated cross sections within a specified tolerance that is generally within 1% or less of the evaluated data (Briesmeister 1997, p. 2-18).

Neutron interaction table designations are included as part of the material composition input to MCNP. Each material composition is composed of one or more elements or isotopes designated by a ZAID identifier. The ZAID identifier takes the form "ZZZAAA.nnC" where *ZZZ* represents the atomic number of the element (*ZZZ* may be one or two digits), *AAA* represents the elemental isotope (*AAA* must be three digits incorporating leading zeros), *nn* represents the neutron interaction table designation, and C indicates continuous-energy reaction tables. A more complete description of the ZAID nomenclature is available in Briesmeister (1997, Appendix G).

Calculations involving transport through the resonance region should use the most detailed neutron interaction tables available unless there is a valid reason to do otherwise, such as the availability of more appropriate temperature dependent cross sections. Table 5-3 contains a listing of elements and isotopes selected for use in the criticality model for the codisposal waste package containing various DOE SNF or waste forms. The selected cross-section libraries have been used consistently in the analyses involving codisposal waste package containing DOE SNF (CRWMS M&O 2000c, CRWMS M&O 2000a, Radulescu 2001a, CRWMS M&O 2000b, CRWMS M&O 1999a, CRWMS M&O 2000d, Radulescu 2001b, CRWMS M&O 2001) and in the analyses of the applicable critical benchmark experiments (BSC 2002a). The cross-section libraries utilized in the additional ^{233}U/Th benchmark models described in Section 5.1.1 are consistent with the listing presented in Table 5-3. Table 5-3 is also partially consistent with the cross-section libraries utilized in BSC (2003b) for the waste package containing commercial SNF.

Table 5-3. Selected MCNP ZAIDs for Various Elements and Isotopes

Element	Isotope	Cross Section Library ZAID	Element	Isotope	Cross Section Library ZAID
Hydrogen	H-1	1001.50c	Molybdenum	Mo (natural)	42000.50c
	H-2	1002.55c		Mo-95	42095.50c
	H-3	1003.50c	Silver	Ag-107	47107.50c
Helium	He-3	2003.50c		Ag-109	47109.50c
	He-4	2004.50c	Cadmium	Cd (natural)	48000.50c
Lithium	Li-6	3006.50c	Tin	Sn (natural)	50000.35c
	Li-7	3007.55c	Cesium	Cs-133	55133.50c
Beryllium	Be-7	4007.35c		Cs-135	55135.50c
	Be-9	4009.50c	Barium	Ba-138	56138.50c
Boron	B-10	5010.50c	Gadolinium	Gd-152	64152.50c
	B-11	5011.56c		Gd-154	64154.50c
Carbon	C (natural)	6000.50c		Gd-155	64155.50c
	C-12	6012.50c		Gd-156	64156.50c
	C-13	6013.35c		Gd-157	64157.50c

Table 5-3. Selected MCNP ZAIDs for Various Elements and Isotopes

Element	Isotope	Cross Section Library ZAID	Element	Isotope	Cross Section Library ZAID
Nitrogen	N-14	7014.50c		Gd-158	64158.50c
	N-15	7015.55c		Gd-160	64160.50c
Oxygen	O-16	8016.50c	Hafnium	Hf (natural)	72000.50c
Fluorine	F-19	9019.50c	Tantalum	Ta-181	73181.50c
Sodium	Na-23	11023.50c	Tungsten	W (natural)	74000.55c
Magnesium	Mg (natural)	12000.50c		W-182	74182.55c
Aluminum	Al-27	13027.50c		W-183	74183.55c
Silicon	Si (natural)	14000.50c		W-184	74184.55c
Phosphorous	P-31	15031.50c		W-186	74186.55c
Sulfur	S-32	16032.50c	Gold	Au-197	79197.50c
Chlorine	Cl (natural)	17000.50c	Lead	Pb (natural)	82000.50c
Argon	Ar (natural)	18000.59c	Thorium	Th-232	90232.50c
Potassium	K (natural)	19000.50c	Uranium	U-233	92233.50c
Calcium	Ca (natural)	20000.50c		U-234	92234.50c
Titanium	Ti (natural)	22000.50c		U-235	92235.50c
Vanadium	V (natural)	23000.50c		U-236	92236.50c
Chromium	Cr (natural)	24000.50c		U-237	92237.50c
Manganese	Mn-55	25055.50c		U-238	92238.50c
Iron	Fe (natural)	26000.55c	Plutonium	Pu-238	94238.50c
Cobalt	Co-59	27059.50c		Pu-239	94239.55c
Nickel	Ni (natural)	28000.50c		Pu-240	94240.50c
Copper	Cu (natural)	29000.50c		Pu-241	94241.50c
Gallium	Ga (natural)	31000.50c		Pu-242	94242.50c
Zirconium	Zr (natural)	40000.56c	Americium	Am-241	95241.50c
Niobium	Nb-93	41093.50c			

5.1.3 Selected Criticality Benchmark Experiments for CL Calculation

This section provides a brief overview of the data used in the present CL calculation. The results of the MCNP calculations for each case from the subsets of selected criticality benchmark experiments included in (BSC 2002a) have been used as inputs for the present analysis and CL calculation. The number of cases in each subset has been summarized in the following table (Table 5-4). The additional benchmark cases evaluated in the present report have been also included. Detailed values of the benchmark and calculated k_{eff} that have been used as input in the present CL calculations are included in the full tables presented in Attachment II.

Table 5-4. Summary of Subsets of Critical Benchmark Experiments Used as Input

DOE SNF Group Placed in Codisposal waste package	Subset Applicable for Intact Moderated Configurations No of Benchmark Cases[a]	Subset Applicable for Intact Non-moderated Configurations No of Benchmark Cases[a]	Subset Applicable for Degraded Moderated Configurations No of Benchmark Cases[a]	Subset Applicable for Degraded Non-moderated Configurations No of Benchmark Cases[a]
HEU Oxide (Shippingport-PWR) DOE-Owned SNF	77	69	197	47
UZrH (TRIGA) DOE-Owned SNF	108	111	273	47

Table 5-4. Summary of Subsets of Critical Benchmark Experiments Used as Input

DOE SNF Group Placed in Codisposal waste package	Subset Applicable for Intact Moderated Configurations No of Benchmark Cases[a]	Subset Applicable for Intact Non-moderated Configurations No of Benchmark Cases[a]	Subset Applicable for Degraded Moderated Configurations No of Benchmark Cases[a]	Subset Applicable for Degraded Non-moderated Configurations No of Benchmark Cases[a]
Melt and Dilute Waste Form	37	13	103	13
U-alloy (Enrico Fermi) DOE-Owned SNF	63	13	103	13
MOX (FFTF) DOE-Owned SNF	32	75	385	48
Graphite/Carbide (Fort Saint Vrain HTGR) DOE-Owned Fuel	65+8 (additional benchmarks)	93	108	139
Th/U (Shippingport LWBR) DOE-Owned SNF	67+8 (additional benchmarks)	98	81	140
U-metal (N reactor) DOE-owned SNF	25	-	37	-
LEU Oxide (TMI) Core Debris Waste Form	51	-	49	-

NOTE: [a]See corresponding tables in Attachment II for a full listing of cases including benchmark and calculated k_{eff} values.

5.2 DETAILED DESCRIPTION AND FLOW OF CL CALCULATIONS

For each DOE SNF group to be disposed, a number of subsets (Table 5-4) of criticality benchmark experiments have been formed based on the anticipated range of parameters of the intact and degraded configurations of the codisposal waste package. For the critical benchmark experiments that were slightly super or subcritical, an adjustment to the k_{eff} value calculated with MCNP (k_{calc}) was done as suggested in Dean (2001, p.8). This adjustment is done by normalizing the (k_{calc}) value to the experimental value (k_{exp}). This normalization does not affect the inherent bias in the calculation due to very small differences in k_{eff}. To normalize, the following formula applies:

$$k_{norm}=k_{calc}/k_{exp} \quad (1)$$

Unless otherwise mentioned, the normalized k_{eff} values (k_{norm}) have been used in all subsequent calculations of the critical limit (CL).

Each subset of normalized k_{eff} values is first tested for trending against available neutronic or physical parameters (e.g., average energy of a neutron causing fission (AENCF), enrichment, H/X,) using the build-in regression analysis tool from Excel. 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 the MCNP output. The H/X ratio is the ratio of mole of hydrogen to mole of fissile materials (U-235 and/or Pu-239). Trending in this context is linear regression of k_{eff} on the

predictor variable(s)(YMP 2000, p. 3-52). If trending is identified for one subset, the CLREG code is used to calculate CL function using LUTB method (BSC 2002c).

The linear regression fitted equation is in the form $y(x) = a + bx + \varepsilon$, where ε is the random error component (residuals). The trending is checked using well-established indicators or goodness-of-fit tests concerning the regression parameters. As a first indicator, the coefficient of determination (r^2) that is available as a result of using linear regression statistic (Scheaffer, 1990, p. 390) can be used to evaluate the linear trending. It represents the proportion of the sum of squares of deviations of the y values about their mean that can be attributed to a linear relation between y and x.

Another assessment of the adequacy of the linear model can be done by checking the goodness-of-fit against a null hypothesis on the slope (b) (Scheaffer, 1990, p. 382). The slope test requires calculating the test statistic "T" as follows in Equation 2 along with the statistical parameters in Equations 3 and 4 (Scheaffer, 1990, p. 382 and p. 371).

$$T = b\sqrt{\frac{(n-2)S_{xx}}{SS_E}} \tag{2}$$

where

b is the slope of the fitted linear regression equation

$$S_{xx} = \sum_{i=1,n}(x_i - \bar{x})^2 \tag{3}$$

and

$$SS_E = \sum_{i=1,n}(y_i - a - bx_i)^2 \tag{4}$$

The test statistic is compared to the Student's t-distribution ($t_{\alpha/2,n-2}$) with 95% confidence and n-2 degrees of freedom (Schaeffer, 1990, p. 659), where n is the initial number of points in the subset. Given a null hypothesis of "no statistically significant trend exists (slope is zero)", the hypothesis would be accepted if $|T| < t_{\alpha/2,n-2}$, and rejected otherwise. Unless the data is exceptional, the linear regression results will have a non-zero slope. By only accepting linear trends that the data supports with 95% confidence, trends due to the randomness of the data are eliminated (BSC 2003b). A good indicator of this statistical process is evaluation of the P-value probability (calculated by the regression tool in Excel) that gives a direct estimation of the probability of having a linear trending due only to chance.

The last step employed as part of the regression analysis is determining whether or not the final requirements of the simple linear regression model are satisfied (Schaeffer, 1990, p.377, p.401). The error component (residuals) need to be normally distributed with mean zero, and these requirements were verified for the present calculation by calculating the mean of the residuals and applying a normality test on the residuals.

If the subset shows no trending, according to the methodology summarized in Figure 1, the subset is tested for normality using an omnibus normality test. For pools of data between 10 to 50 points the Shapiro-Wilk's normality test is used. The steps required to apply the test and the necessary test statistics are described in detail in Dean (2001, p.10) and have been explicitly implemented in Excel worksheets. For pools of data over 50 points the Anderson-Darling test is used (D'Agostino 1986, p. 372) that tests the goodness-of-fit to a normal distribution constructed with the subset sample average and standard deviation. The required steps to apply the test and specific test statistics are implemented using Excel worksheets (Attachment I and III).

Given that the k_{eff} values produced by the criticality code for the benchmark experiments are shown to be normally distributed, the CL can be calculated using NDTL (YMP 2000, p. 3-56) as:

$$CL = k_{ave} - k(\gamma, P, df) * S_P \quad (5)$$

where: k_{ave} is the average of the k_{eff} values, unless k_{ave} is greater than unity (1.0), in which instance the appropriate value for k_{ave} should be 1.0 to disallow positive bias; k (γ, P, df) is a multiplier (Natrella 1963, pp. 1-14 and 1-15) in which γ is the confidence level, P is the proportion of the population covered, and df is the number of degrees of freedom. The S_P term is the square root of the sum of the inherent variance of the critical experiment data set plus the average of the criticality code variances for the critical experiment data set (Lichtenwalter et al. 1997, p. 159). Dean (2001, p.11) recommends that the lower tolerance limits (CL), at a minimum, should be calculated with a 95% confidence that 95% of the data lies above CL. This is quantified by using the multipliers provided in Table 5-5 (Dean 2001, Table 2.1; Natrella 1963, pp.1-14 and 1-15).

Table 5-5. Multiplier used in calculating CL using NDTL

Number of experiments (n)	Multiplier k (γ, P, df) for γ=95%; P=95% and df=n
10	2.911
11	2.815
12	2.736
13	2.670
14	2.614
15	2.566
16	2.523
17	2.486
18	2.453
19	2.423
20	2.396
21	2.371
22	2.350
23	2.329

Table 5-5. Multiplier used in calculating CL using NDTL

Number of experiments (n)	Multiplier k (γ, P, df) for γ=95%; P=95% and df=n
24	2.309
25	2.292
30	2.220
35	2.166
40	2.126
45	2.092
50	2.065

Source: Dean 2001, Table 2.1

If the data does not have a normal statistical distribution, a non-parametric statistical treatment must be used as described in YMP (2000, p. 3-57) as the distribution-free tolerance limit (DFTL). A more specific description of the method is presented in (Dean 2001, p.14), resulting in the determination of the degree of confidence that a fraction of the true population of data lies above the smallest value observed. The more data are available in the sample, the higher the degree of confidence. Non-parametric techniques do not require reliance upon distributions, but are rather an analysis of ranks. Therefore, the k_{eff} values in a sample are ranked from the smallest to the largest.

For a desired population fraction of 95% and a rank order of 1 (the smallest k_{eff} value in data sample), the following equation determines the percent confidence that the specified fraction of the population is above the lowest observed value:

$$\beta = 1 - q^n = 1 - 0.95^n \quad (6)$$

For non-parametric data analysis, Dean (2001, p. 14) suggests that CL be determined by:

CL= Smallest k_{eff} value – Uncertainty for smallest k_{eff} – Non-parametric Margin (NPM) (7)

where: Non-parametric margin (NPM) is added to account for small sample size.

Dean (2001, p.15) recommends a set of values based on the confidence level (β) calculated above. The values are presented in Table 5-6.

Table 5-6. Non-parametric margins

Degree of confidence (β) for 95% of population	Non-parametric margin
>90%	0.0
>80%	0.01
>70%	0.02

Table 5-6. Non-parametric margins

>60%	0.03
>50%	0.04
>40%	0.05
≤40%	Additional data needed.

Source: Dean 2001, Table 2.2

If the smallest k_{eff} value is greater than 1, then the non-parametric CL becomes:

$$CL = 1 - S_P - NPM \quad (8)$$

where: S_P is the square root of the pooled variance.

All calculations described above have been applied, where appropriate, to each subset of k_{eff} data for the set of criticality benchmarks selected for each DOE SNF group. The actual calculations are performed using Excel spreadsheets that are included in Attachment III.

6. RESULTS

This section documents the MCNP results for the additional ^{233}U/Th benchmarks and the CL results for each subset of the criticality benchmark experiments that have been evaluated in the present calculation. The CL results represent either CL functions (where parameter trending was identified) calculated with CLREG code or CL values calculated with applicable "non-trending" methods described in Section 2. Representative plots of the calculated k_{eff} for the benchmarks and the calculated CL are included for each subset of k_{eff} values.

The outputs of the MCNP and CLREG code runs have been found to be reasonable compared to the developed inputs. All results obtained using MCNP and CLREG computer codes are suitable for their intended use. This document may be affected by technical product input information that requires confirmation. Any changes to the document that may occur, as a result of completing the confirmation activities will be reflected in subsequent revisions. The status of the technical product information quality may be confirmed by review of the DIRS database.

6.1 MCNP RESULTS FOR THE ADDITIONAL BENCHMARKS

The results obtained with MCNP for the benchmark models representing the SB LWBR cores are presented in Table 6-1.

Table 6-1. MCNP calculated k_{eff} values for ^{233}U/Th benchmarks

Experiment	Case name	Benchmark values[a]		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiments with SB cores (LWBR) (8 cases)	SB1m	1.002	0.019	0.9995	0.0006	0.0702
	SB2m	1.002	0.019	0.9971	0.0006	0.0950

Table 6-1. MCNP calculated k_{eff} values for ^{233}U/Th benchmarks

Experiment	Case name	Benchmark values[a]		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	SB25m	1.000	0.019	0.9980	0.0006	0.0676
	SB3m	1.002	0.019	0.9952	0.0005	0.0793
	SB4m	1.002	0.019	0.9998	0.0005	0.0670
	SB5m	1.002	0.019	0.9966	0.0005	0.0573
	SB6m	1.002	0.019	0.9903	0.0006	0.0788
	SB7m	1.002	0.019	0.9951	0.0005	0.0953

Source: [8]Putman 2003, p.35

The above results have been added to the pool of k_{eff} data that are applicable to the calculation of CL for the intact moderated configurations of the codisposal waste package containing Shippingport LWBR and Ft. St. Vrain HTGR (Table II-21, Table II-25).

6.2 CL RESULTS

The CL results have been grouped based on the benchmark subsets selected as being applicable for each category of configurations of the codisposal waste package (Table 5-4). For each subset, the results of the trending analysis are presented, and if a valid trending is identified, the CL function (LUTB method calculated with CLREG code) is included in corresponding figures from Sections 6.2.1 to 6.2.9 together with the k_{eff} values of each subset. If the data show no trending, the subset is tested for normality. The CL obtained either by NDTL method (if the subset is found to follow a normal distribution) or DFTL method is included in corresponding figures with the pool of k_{eff} data for each subset that shows no trending (Sections 6.2.1 to 6.2.9).

The results of the linear trending analysis for each subset are summarized in separate tables at the end of each of the following Sections (Sections 6.2.1 to Section 6.2.9) and comprise the number of k_{eff} points (n), the calculated intercept (a), the slope (b), the square of the correlation coefficient known as coefficient of determination (r^2), the test statistic (T) described by Eq. (2), the tabulated value of $t_{\alpha/2,n-2}$ (with α=0.05 - Scheaffer, 1990, p.659), and the probability (P-value) that the observed trending is due to chance. All above values have been calculated with the regression tool available in Excel and are included in the spreadsheets attached to this document (Attachment I and III). For the purpose of these evaluations, the goodness-of-fit test for the linear model was judged to be passed when the coefficient of determination was greater than 0.1, the P-value was smaller than 0.001 and the residuals were found to be normally distributed with a mean of 0.

6.2.1 Calculated CL Applicable for Configurations of Codisposal Waste Package Containing Shippingport PWR DOE SNF

The results of the trending parameter analysis for the critical benchmark subset representative for moderated intact configurations of the codisposal waste package containing Shippingport PWR SNF are presented in Table 6-2.

Table 6-2. Trending Parameter Results for the Critical Benchmark Subset Representative for Moderated Intact Configurations of the Codisposal WP Containing Shippingport PWR SNF

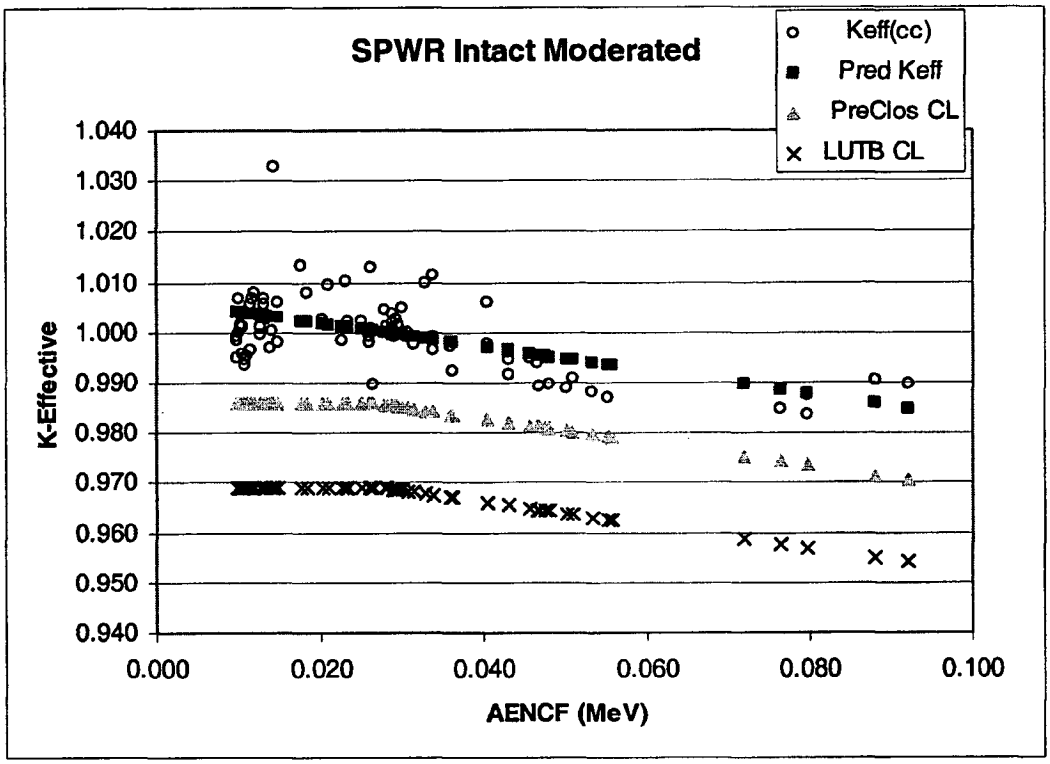
Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	77	1.0064	-0.2336	0.3500	-6.3542	1.960	1.5E-8	Passed	Yes

Source: Calculated in spreadsheet "SPWR_int_mod.xls", Attachment III

The value calculated with CLREG (file "SPWR_intact_thermalOut.csv" and spreadsheet "SPWR_int_mod.xls", Attachment III) for the CL function (LUTB) for the benchmarks applicable to intact-moderated configurations of Shippingport PWR DOE SNF (Figure 2) is:

$CL = 0.969$ for $0 < AENCF < 0.0278$

$CL = -0.2336 * (AENCF) + 0.9755$ for $0.0278 < AENCF < 0.0922$



NOTE: Pre-closure CL (PreClos CL) is calculated by CLREG using simplified statistical assumptions and is not used in the present calculation.

Figure 2. Critical Limit Applicable for Shippingport PWR DOE SNF (intact moderated configurations)

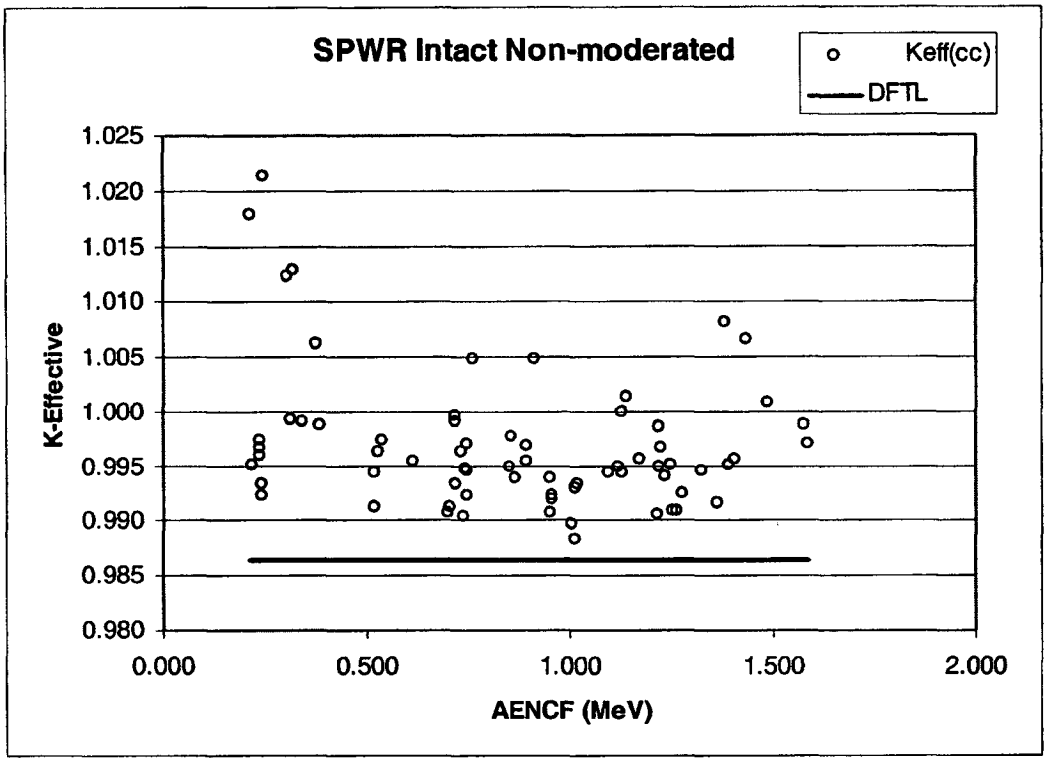
The results of the trending parameter analysis for the critical benchmark subset representative for non-moderated intact configurations of the codisposal waste package containing Shippingport PWR SNF are presented in Table 6-3.

Table 6-3. Trending Parameter Results for the Critical Benchmark Subset Representative for Non-moderated Intact Configurations of the Codisposal WP Containing SPWR SNF

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	69	1.0008	-0.0045	0.0778	-2.3772	1.960	0.0203	Failed	No

Source: Calculated in spreadsheet "SPWR_int_nonmod.xls", Attachment III

The CL value calculated with DFTL method for this subset (normality test failed) is 0.9864 (Figure 3). The normality test results and the CL calculation are detailed in the spreadsheet: "SPWR_int_nonmod.xls", Attachment III.



NOTE: DFTL in the figure represents the CL calculated using DFTL method

Figure 3. Critical Limit Applicable for Shippingport PWR DOE SNF (intact non-moderated configurations)

The results of the trending parameter analysis for the critical benchmark subset representative for moderated degraded configurations of the codisposal waste package containing Shippingport PWR (SPWR) SNF are presented in Table 6-4.

Table 6-4. Trending Parameter Results for the Critical Benchmark Subset Representative for Moderated Degraded Configurations of the Codisposal WP Containing SPWR SNF

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	197	1.0056	-0.0868	0.0299	-2.4494	1.960	0.0152	Failed	No

Table 6-4. Trending Parameter Results for the Critical Benchmark Subset Representative for Moderated Degraded Configurations of the Codisposal WP Containing SPWR SNF

H/X	197	1.0028	3.55E-06	0.0165	1.8070	1.960	0.0723	Failed	No

Source: Calculated in spreadsheet "SPWR_deg_mod.xls", Attachment III.

The CL value calculated with DFTL method for this subset (normality test failed) is 0.9807 (Figure 4). The normality test results and the CL calculation are detailed in the spreadsheet: "SPWR_deg_mod.xls", Attachment III.

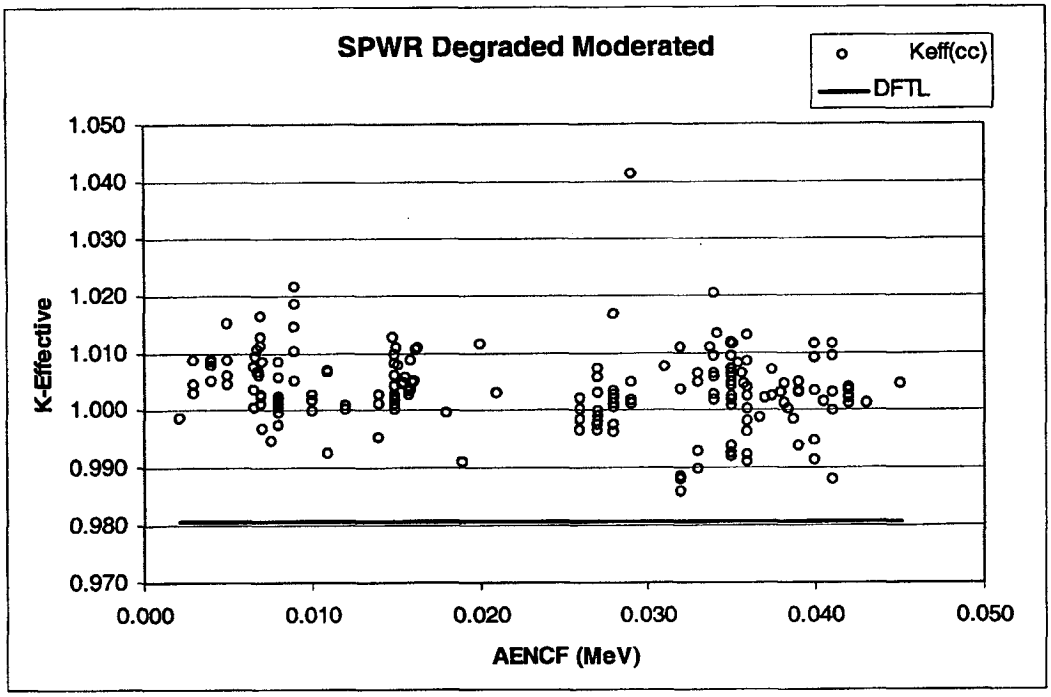


Figure 4. Critical Limit Applicable for Shippingport PWR DOE SNF (degraded moderated configurations)

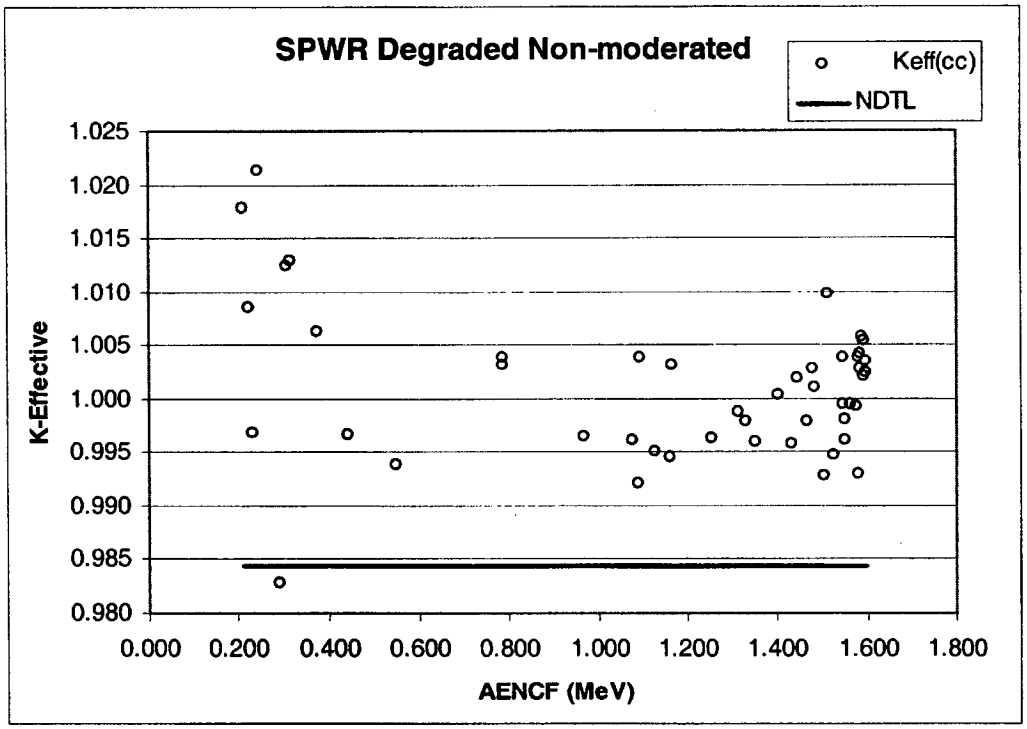
The results of the trending parameter analysis for the critical benchmark subset representative for non-moderated degraded configurations of the codisposal waste package containing Shippingport PWR SNF are presented in Table 6-5.

Table 6-5. Trending Parameter Results for the Critical Benchmark Subset Representative for Non-moderated Degraded Configurations of the Codisposal WP Containing SPWR SNF

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	47	1.0053	-0.0038	0.0743	-1.9001	1.960	0.0638	Failed	No

Source: Calculated in spreadsheet "SPWR_deg_nonmod.xls", Attachment III.

The CL value calculated with NDTL method for this subset (normality test passed) is 0.9843 (Figure 5). The normality test results and the CL calculation are detailed in the spreadsheet: "SPWR_deg_nonmod.xls", Attachment III.



NOTE: NDTL in the figure represents the CL calculated using NDTL method

Figure 5. Critical Limit Applicable for Shippingport PWR DOE SNF (degraded non-moderated configurations)

Table 6-6 presents a summary of the results of the analyses performed on the subsets of critical benchmark experiments applicable to the codisposal waste package containing Shippingport PWR SNF and the calculated CL values

Table 6-6. Critical Limits for Benchmark Subsets Representative for Intact and Degraded Configurations of the Codisposal WP Containing SPWR SNF

Subset	Trend Parameter	Test for Normality	Applied Calculational Method	CL or CL Function
Intact Moderated	AENCF	Passed	CLREG code (LUTB)	CL = 0.969 for 0 < AENCF < 0.0278 CL = -0.2336 * AENCF + 0.9755 for 0.0278 < AENCF < 0.0922
Intact Non-moderated	None	Failed	DFTL	CL = 0.9864
Degraded Moderated	None	Failed	DFTL	CL = 0.9807
Degraded Non-Moderated	None	Passed	NDTL	CL = 0.9843

6.2.2 Calculated CL Applicable for Configurations of Codisposal Waste Package Containing TRIGA DOE SNF

The results of the trending parameter analysis for the critical benchmark subset representative for moderated intact configurations of the codisposal waste package containing TRIGA DOE SNF are presented in Table 6-7.

Table 6-7. Trending Parameter Results for the Critical Benchmark Subset Representative for Moderated Intact Configurations of the Codisposal WP Containing TRIGA DOE SNF

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	108	1.0120	-0.3315	0.4566	-9.4373	1.960	1.04E-15	Passed	Yes
H/U235	81	0.9945	2.56E-05	0.1321	3.4679	1.960	8.52E-04	Passed	Yes

Source: Calculated in spreadsheet "TRIGA_int_mod.xls", Attachment III

The value calculated with CLREG for the strongest correlation (file "TRIGA_intact_thermalOut.csv" and spreadsheet "TRIGA_int_mod.xls", Attachment III) for the CL function (LUTB) for the benchmarks applicable to intact-moderated configurations of TRIGA DOE SNF (Figure 6) is:

$$CL = 0.9668 \quad \text{for } 0 < AENCF < 0.0404$$
$$CL = -0.3315 * (AENCF) + 0.9788 \quad \text{for } 0.0404 < AENCF < 0.0922$$

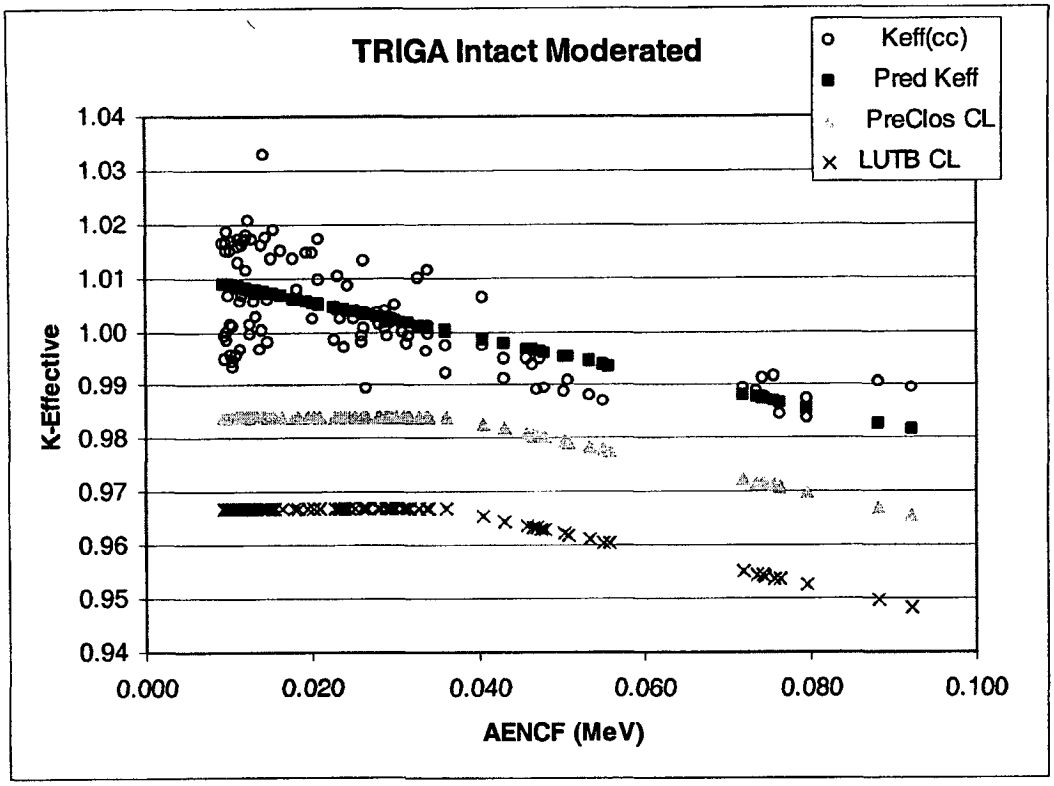


Figure 6. Critical Limit Applicable for TRIGA DOE SNF (intact moderated configurations)

The results of the trending parameter analysis for the critical benchmark subset representative for non-moderated intact configurations of the codisposal waste package containing TRIGA DOE SNF are presented in Table 6-8.

Table 6-8. Trending Parameter Results for the Critical Benchmark Subset Representative for Non-moderated Intact Configurations of the Codisposal WP Containing TRIGA SNF

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	111	0.9947	0.0040	0.0244	1.6523	1.960	0.1014	Failed	No

Source: Calculated in spreadsheet "TRIGA_int_nonmod.xls", Attachment III

The CL value calculated with DFTL method for this subset (normality test failed) is 0.9721 (Figure 7). The normality test results and the CL calculation are detailed in the spreadsheet: "TRIGA_int_nonmod.xls", Attachment III.

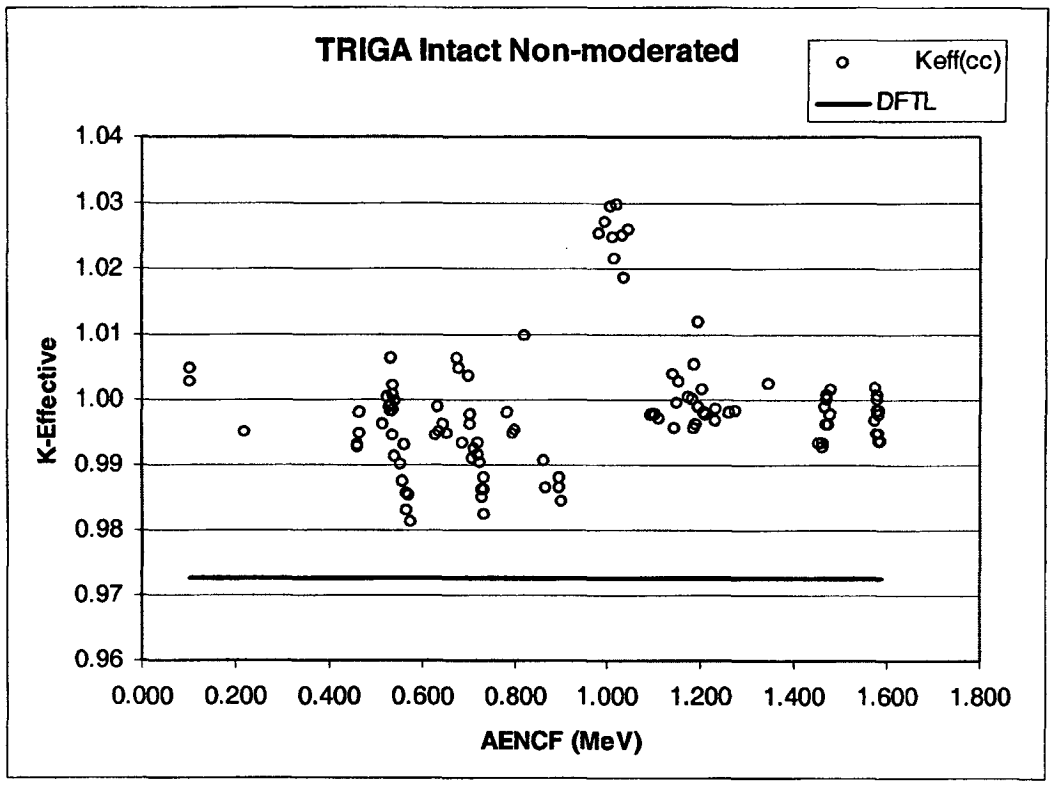


Figure 7. Critical Limit Applicable for TRIGA DOE SNF (intact non-moderated configurations)

The results of the trending parameter analysis for the critical benchmark subset representative for moderated degraded configurations of the codisposal waste package containing TRIGA DOE SNF are presented in Table 6-9.

Table 6-9. Trending Parameter Results for the Critical Benchmark Subset Representative for Moderated Degraded Configurations of the Codisposal WP Containing TRIGA SNF

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	273	1.0046	-0.0055	9.10E-05	-0.1571	1.960	0.8753	Failed	No
H/X	273	1.0045	-1.82E-07	3.31E-05	-0.0947	1.960	0.9246	Failed	No

Source: Calculated in spreadsheet "TRIGA_deg_mod.xls", Attachment III

The CL value calculated with DFTL method for this subset (normality test failed) is 0.9796 (Figure 8). The normality test results and the CL calculation are detailed in the spreadsheet: "TRIGA_deg_mod.xls", Attachment III.

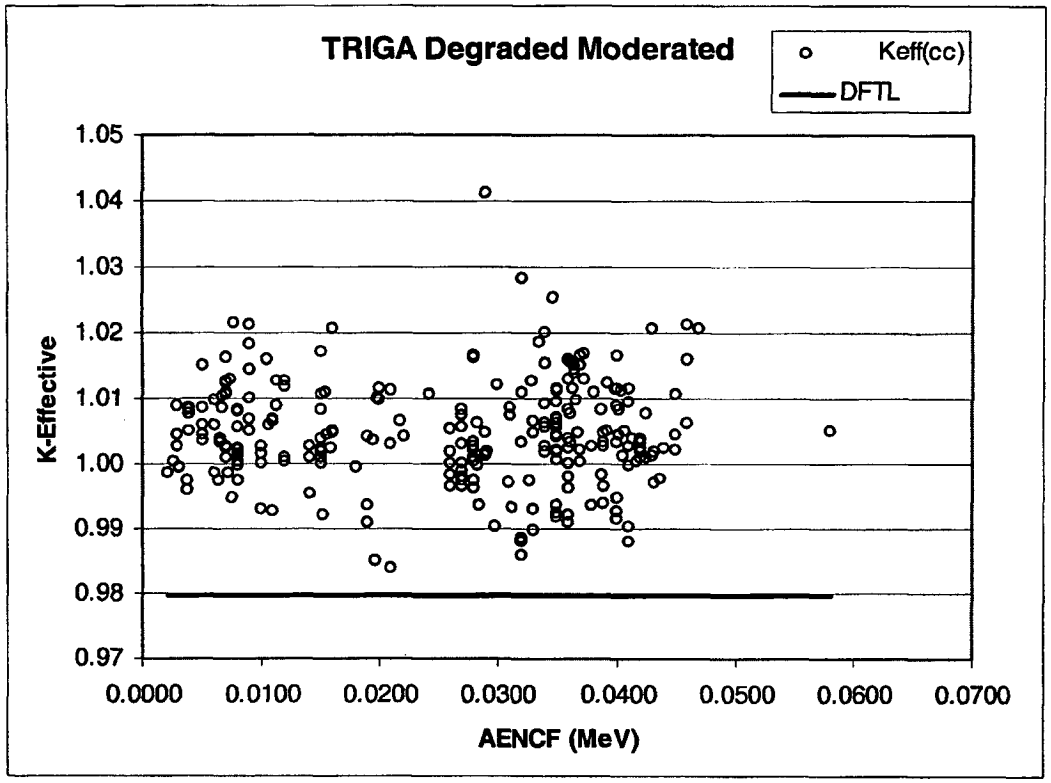


Figure 8. Critical Limit Applicable for TRIGA DOE SNF (degraded moderated configurations)

The results of the trending parameter analysis for the critical benchmark subset representative for non-moderated degraded configurations of the codisposal waste package containing TRIGA DOE SNF are presented in Table 6-10.

Table 6-10. Trending Parameter Results for the Critical Benchmark Subset Representative for Non-moderated Degraded Configurations of the Codisposal WP Containing TRIGA SNF

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	47	1.0053	-0.0038	0.0743	-1.9001	1.960	0.0638	Failed	No

Source: Calculated in spreadsheet "TRIGA_deg_nonmod.xls", Attachment III.

The CL value calculated with NDTL method for this subset (normality test passed) is 0.9843 (Figure 9). The normality test results and the CL calculation are detailed in the spreadsheet: "TRIGA_deg_nonmod.xls", Attachment III.

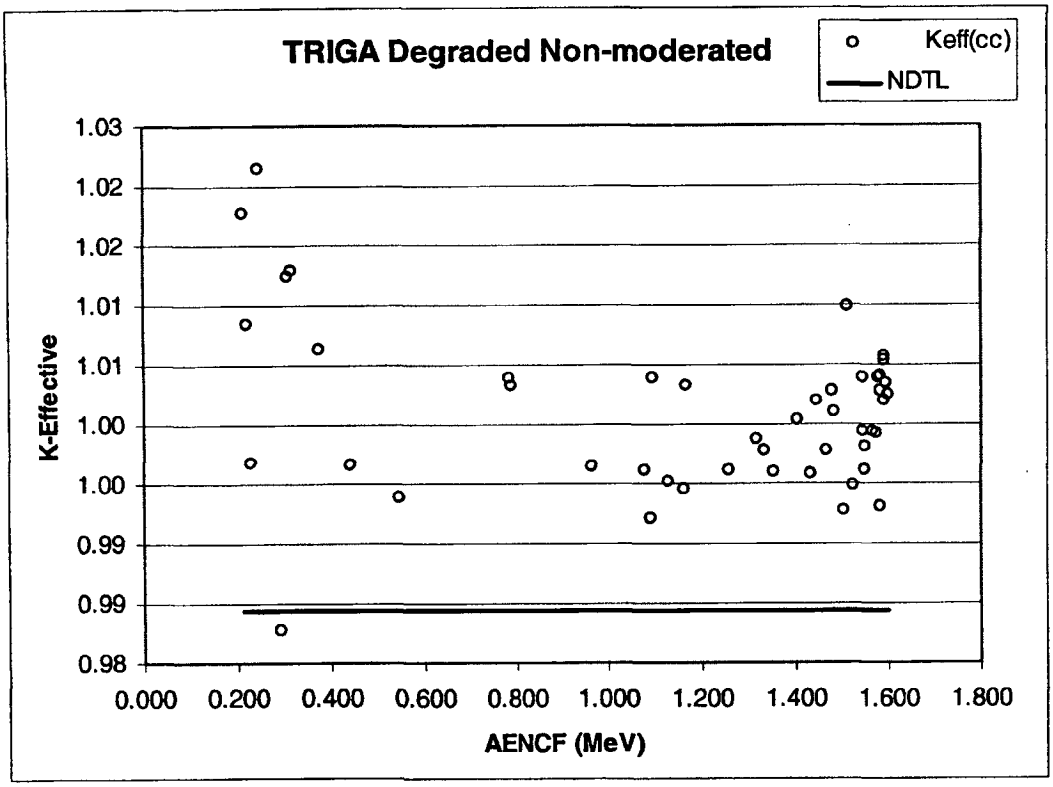


Figure 9. Critical Limit Applicable for TRIGA DOE SNF (degraded non-moderated configurations)

Table 6-11 presents a summary of the results of the analyses performed on the subsets of critical benchmark experiments applicable to the codisposal waste package containing TRIGA SNF and the calculated CL values

Table 6-11. Critical Limits for Benchmark Subsets Representative for Intact and Degraded Configurations of the Codisposal WP Containing TRIGA SNF

Subset	Trend Parameter	Test for Normality	Applied Calculational Method	CL or CL Function
Intact Moderated	AENCF	N/A	CLREG code (LUTB)	CL = 0.9668 for 0 < AENCF < 0.0404 CL = -0.3315 * AENCF + 0.9788 for 0.0404 < AENCF < 0.0922
Intact Non-moderated	None	Failed	DFTL	CL = 0.9721
Degraded Moderated	None	Failed	DFTL	CL = 0.9796
Degraded Non-moderated	None	Passed	NDTL	CL= 0.9843

6.2.3 Calculated CL Applicable for Configurations of Codisposal Waste Package Containing Melt and Dilute Waste Form

The results of the trending parameter analysis for the critical benchmark subset representative for moderated intact configurations of the codisposal waste package containing Melt and Dilute waste form are presented in Table 6-12.

Table 6-12. Trending Parameter Results for the Critical Benchmark Subset Representative for Moderated Intact Configurations of the Codisposal WP Containing Melt and Dilute Waste Form

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	37	0.9996	-0.0076	0.0166	-0.7677	1.960	0.4478	Failed	No
Enr (U235/U)	37	0.9946	1.53E-04	0.0519	1.3844	1.960	0.1750	Failed	No
H/U235	31	0.9979	2.42E-05	0.1246	2.0321	1.960	0.0514	Failed	No

Source: Calculated in spreadsheet "MD_int_mod.xls", Attachment III.

The CL value calculated with NDTL method for this subset (normality test passed) is 0.9870 (Figure 10). The normality test results and the CL calculation are detailed in the spreadsheet: "MD_int_mod.xls", Attachment III.

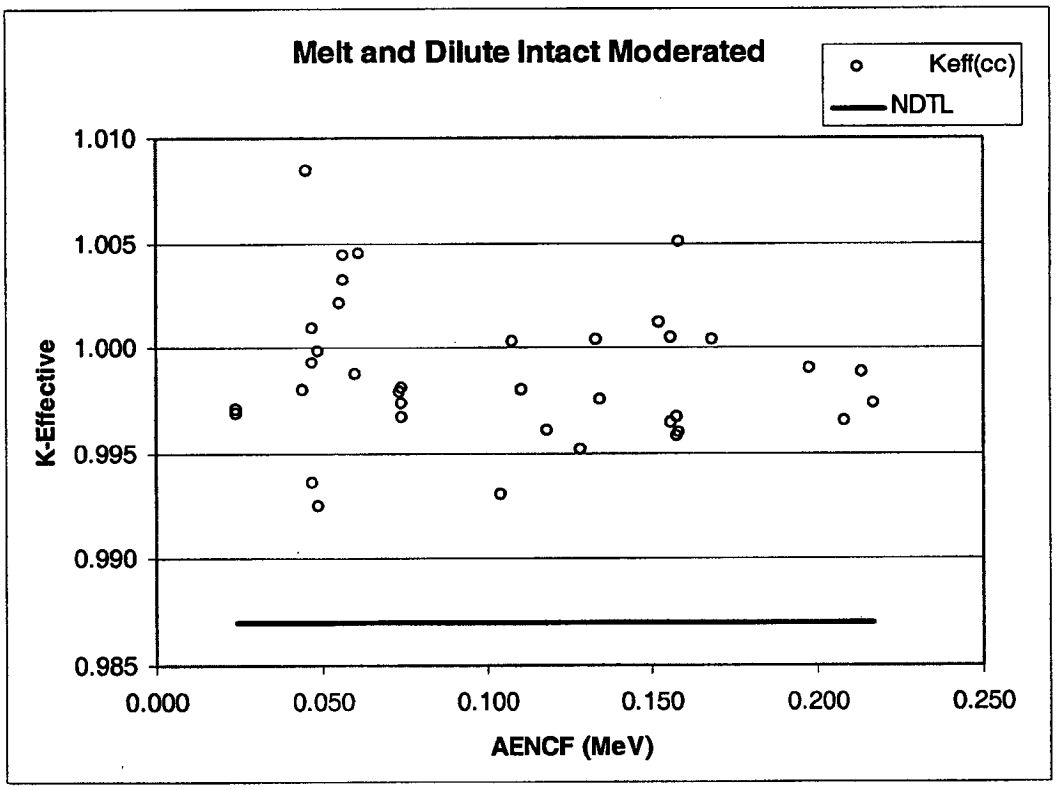


Figure 10. Critical Limit Applicable for Melt and Dilute Waste Form (intact moderated configurations)

The results of the trending parameter analysis for the critical benchmark subset representative for non-moderated intact configurations of the codisposal waste package containing Melt and Dilute waste form are presented in Table 6-13.

Table 6-13. Trending Parameter Results for the Critical Benchmark Subset Representative for Non-moderated Intact Configurations of the Codisposal WP Containing Melt and Dilute Waste Form

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	13	1.0132	-0.0063	0.0325	-0.6082	2.201	0.5554	Failed	No

Source: Calculated in spreadsheet "MD_int_nonmod.xls", Attachment III.

The CL value calculated with NDTL method for this subset (normality test passed) is 0.9872 (Figure 11). The normality test results and the CL calculation are detailed in the spreadsheet: "MD_int_nonmod.xls", Attachment III.

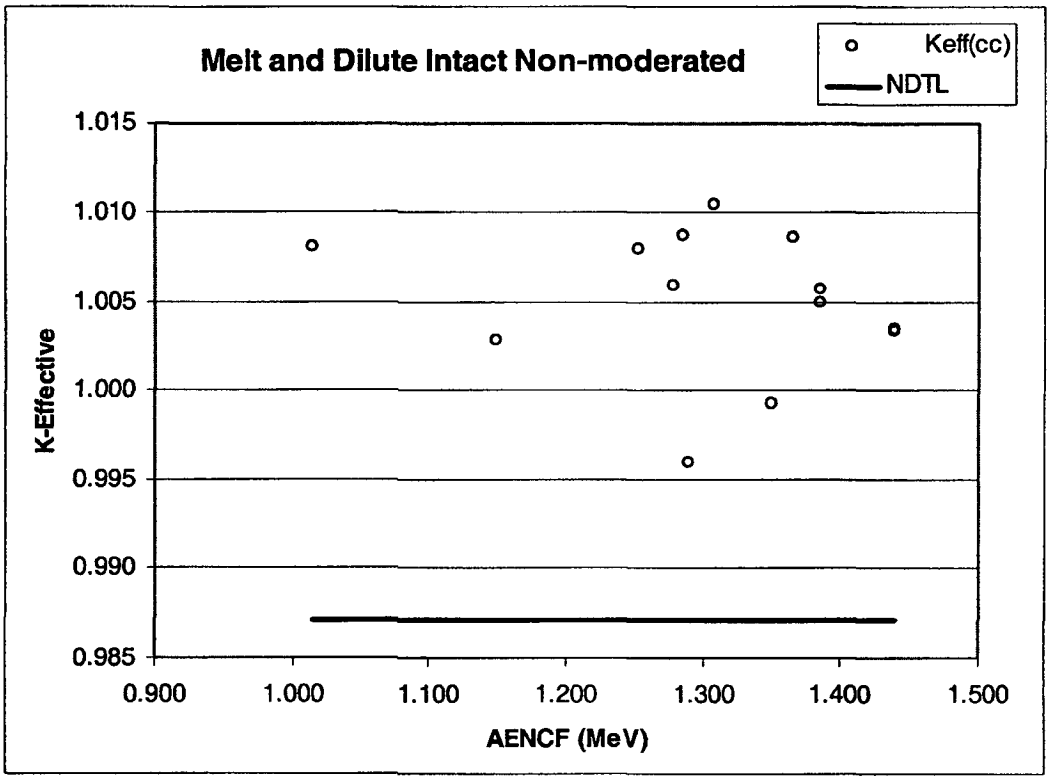


Figure 11. Critical Limit Applicable for Melt and Dilute Waste Form (intact non-moderated configurations)

The results of the trending parameter analysis for the critical benchmark subset representative for moderated degraded configurations of the codisposal waste package containing Melt and Dilute waste form are presented in Table 6-14.

Table 6-14. Trending Parameter Results for the Critical Benchmark Subset Representative for Moderated Degraded Configurations of the Codisposal WP Containing Melt and Dilute Waste Form

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	103	1.0018	-0.0218	0.0369	-1.9659	1.960	0.0521	Failed	No
Enr (U235/U)	103	1.0048	-2.5E-04	0.1300	-3.8842	1.960	1.84E-04	Failed	No
H/U235	103	0.9984	3.93E-06	0.0664	2.6792	1.960	0.0086	Failed	No

Source: Calculated in spreadsheet "MD_deg_mod.xls", Attachment III

The CL value calculated with DFTL method for this subset (normality test failed) is 0.9659 (Figure 12). The normality test results and the CL calculation are detailed in the spreadsheet: "MD_deg_mod.xls", Attachment III.

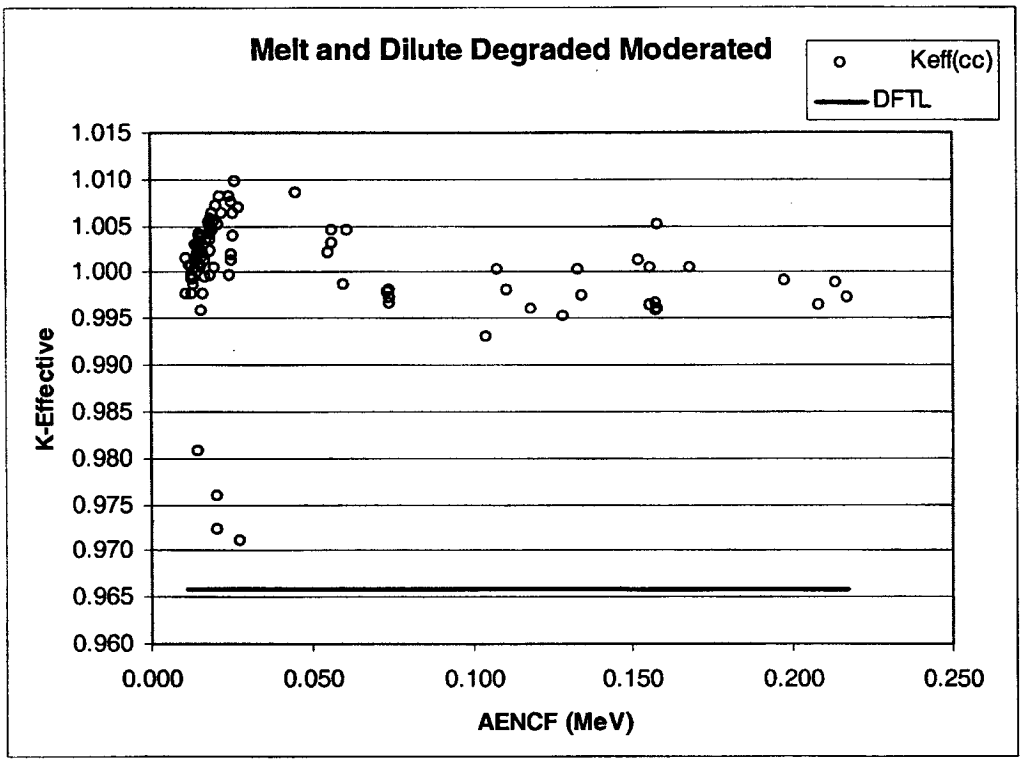


Figure 12. Critical Limit Applicable for Melt and Dilute Waste Form (degraded moderated configurations)

The results of the trending parameter analysis for the critical benchmark subset representative for non-moderated degraded configurations of the codisposal waste package containing Melt and Dilute waste form are presented in Table 6-15.

Table 6-15. Trending Parameter Results for the Critical Benchmark Subset Representative for Non-moderated Degraded Configurations of the Codisposal WP Containing Melt and Dilute Waste Form

Trend Parameter	N	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	13	1.0132	-6.26E-03	0.0325	-0.6082	2.201	0.5554	Failed	No

Source: Calculated in spreadsheet "MD_deg_nonmod.xls", Attachment III.

The CL value calculated with NDTL method for this subset (normality test passed) is 0.9872 (Figure 13). The normality test results and the CL calculation are detailed in the spreadsheet: "MD_deg_nonmod.xls", Attachment III.

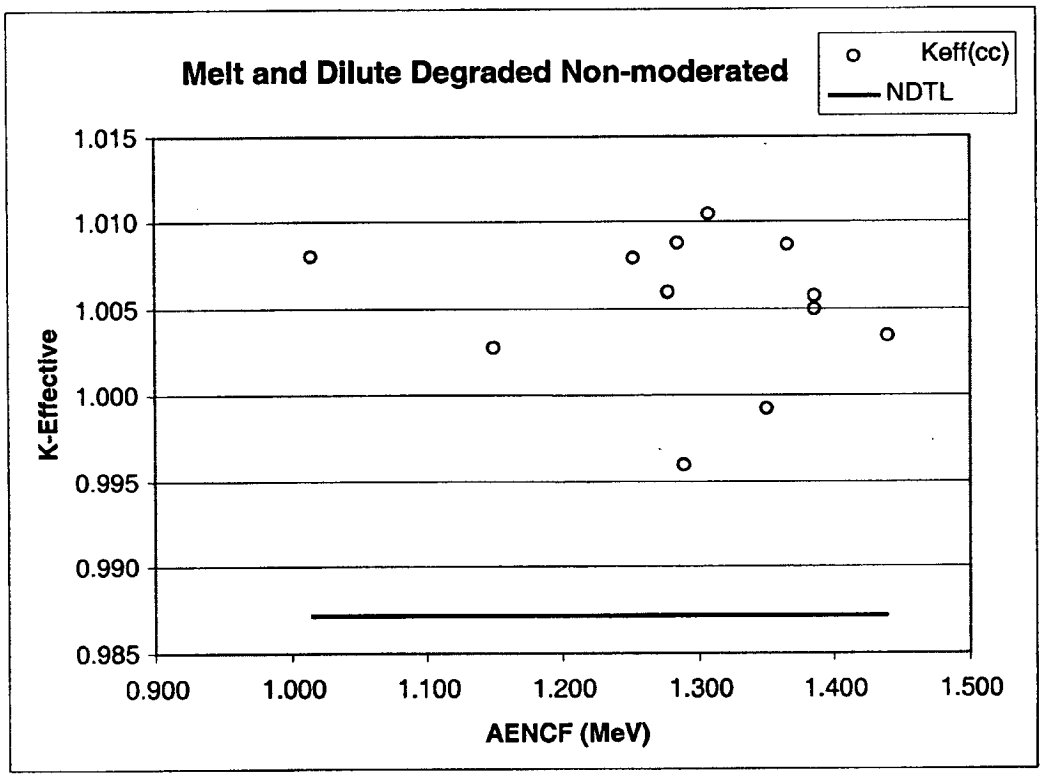


Figure 13. Critical Limit Applicable for Melt and Dilute Waste Form (degraded non-moderated configurations)

Table 6-16 presents a summary of the results of the analyses performed on the subsets of critical benchmark experiments applicable to the codisposal waste package containing Melt and Dilute waste form and the calculated CL values.

Table 6-16. Critical Limits for Benchmark Subsets Representative for Intact and Degraded Configurations of the Codisposal WP Containing Melt and Dilute Waste Form

Subset	Trend Parameter	Test for Normality	Applied Calculational Method	CL or CL Function
Intact Moderated	None	Passed	NDTL	CL = 0.9870
Intact Non-moderated	None	Passed	NDTL	CL = 0.9872
Degraded Moderated	None	Failed	DFTL	CL = 0.9659
Degraded Non-moderated	None	Passed	NDTL	CL = 0.9872

6.2.4 Calculated CL Applicable for Configurations of Codisposal Waste Package Containing Enrico Fermi DOE SNF

The results of the trending parameter analysis for the critical benchmark subset representative for moderated intact configurations of the codisposal waste package containing Enrico Fermi DOE SNF are presented in Table 6-17.

Table 6-17. Trending Parameter Results for the Critical Benchmark Subset Representative for Moderated Intact Configurations of the Codisposal WP Containing Enrico Fermi SNF

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	63	1.0005	-0.0214	0.0376	-1.5430	1.960	0.1280	Failed	No
Enr (U235/U)	63	0.9990	-3.4E-06	2.24E-04	-0.1169	1.960	0.9073	Failed	No
H/U235	57	0.9976	1.51E-05	0.0697	2.0295	1.960	0.0473	Failed	No

Source: Calculated in spreadsheet "EF_int_mod.xls", Attachment III.

The CL value calculated with DFTL method for this subset (normality test failed) is 0.9751 (Figure 14). The normality test results and the CL calculation are detailed in the spreadsheet: "EF_int_mod.xls", Attachment III.

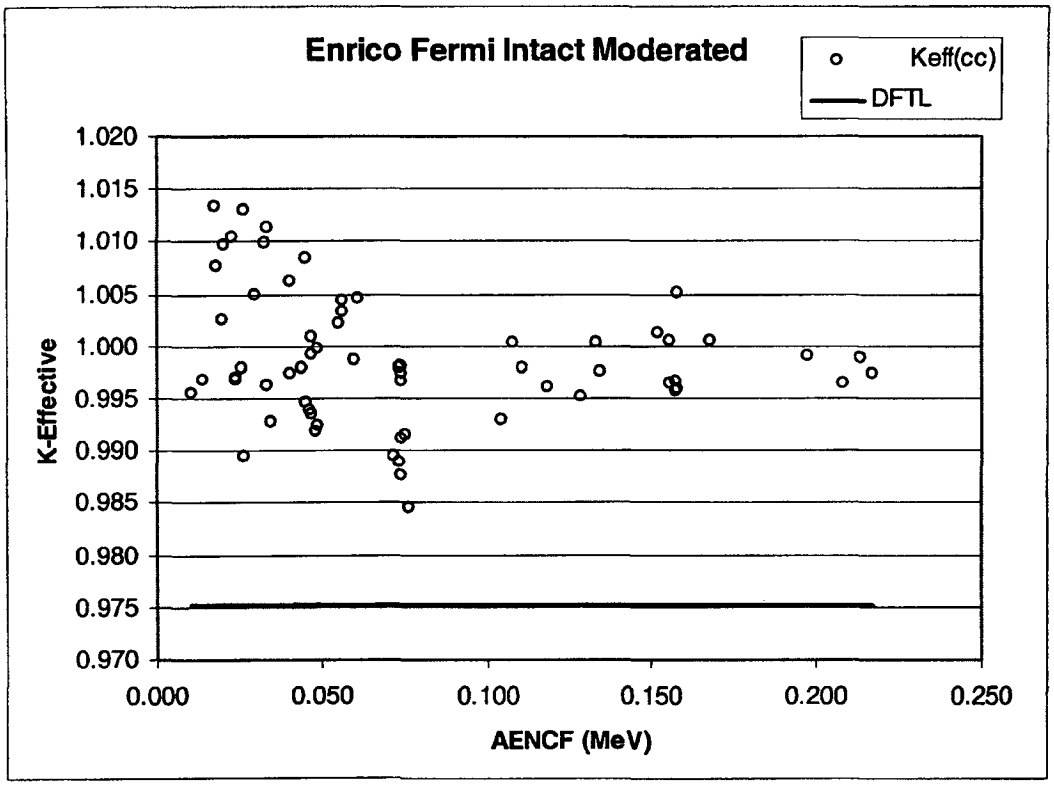


Figure 14. Critical Limit Applicable for Enrico Fermi DOE SNF (intact moderated configurations)

The results of the trending parameter analysis for the critical benchmark subset representative for non-moderated intact configurations of the codisposal waste package containing Enrico Fermi DOE SNF are presented in Table 6-18.

Table 6-18. Trending Parameter Results for the Critical Benchmark Subset Representative for Non-moderated Intact Configurations of the Codisposal WP Containing Enrico Fermi SNF

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	13	1.0132	-6.26E-03	0.0325	-0.6082	2.201	0.5554	Failed	No

Source: Calculated in spreadsheet "EF_int_nonmod.xls", Attachment III.

The CL value calculated with NDTL method for this subset (normality test passed) is 0.9872 (Figure 15). The normality test results and the CL calculation are detailed in the spreadsheet: "EF_int_nonmod.xls", Attachment III.

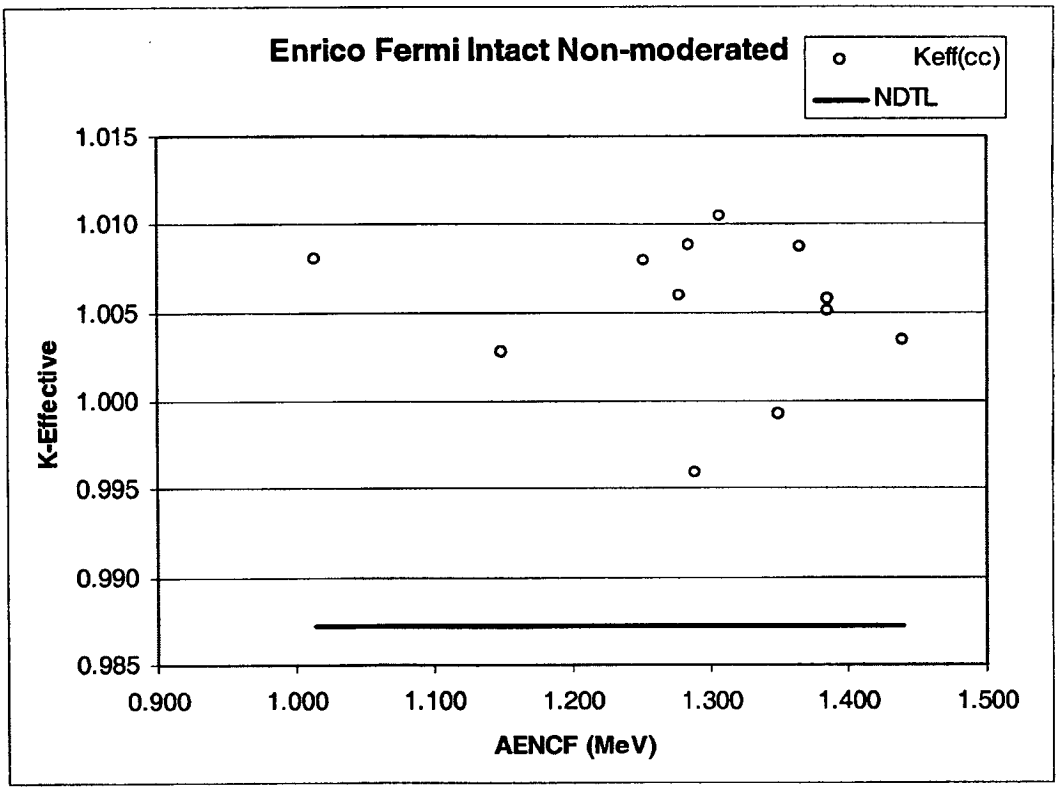


Figure 15. Critical Limit Applicable for Enrico Fermi DOE SNF (intact non-moderated configurations)

The results of the trending parameter analysis for the critical benchmark subset representative for moderated degraded configurations of the codisposal waste package containing Enrico Fermi DOE SNF are presented in Table 6-19.

Table 6-19. Trending Parameter Results for the Critical Benchmark Subset Representative for Moderated Degraded Configurations of the Codisposal WP Containing Enrico Fermi SNF

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	103	1.0018	-0.0218	0.0369	-1.9659	1.960	0.0521	Failed	No
Enr (U235/U)	103	1.0048	-2.5E-04	0.1300	-3.8842	1.960	1.84E-04	Failed	No
H/U235	103	0.9984	3.93E-06	0.0664	2.6792	1.960	8.618E-03	Failed	No

Source: Calculated in spreadsheet "EF_deg_mod.xls", Attachment III

The CL value calculated with DFTL method for this subset (normality test failed) is 0.9659 (Figure 16). The normality test results and the CL calculation are detailed in the spreadsheet: "EF_deg_mod.xls", Attachment III.

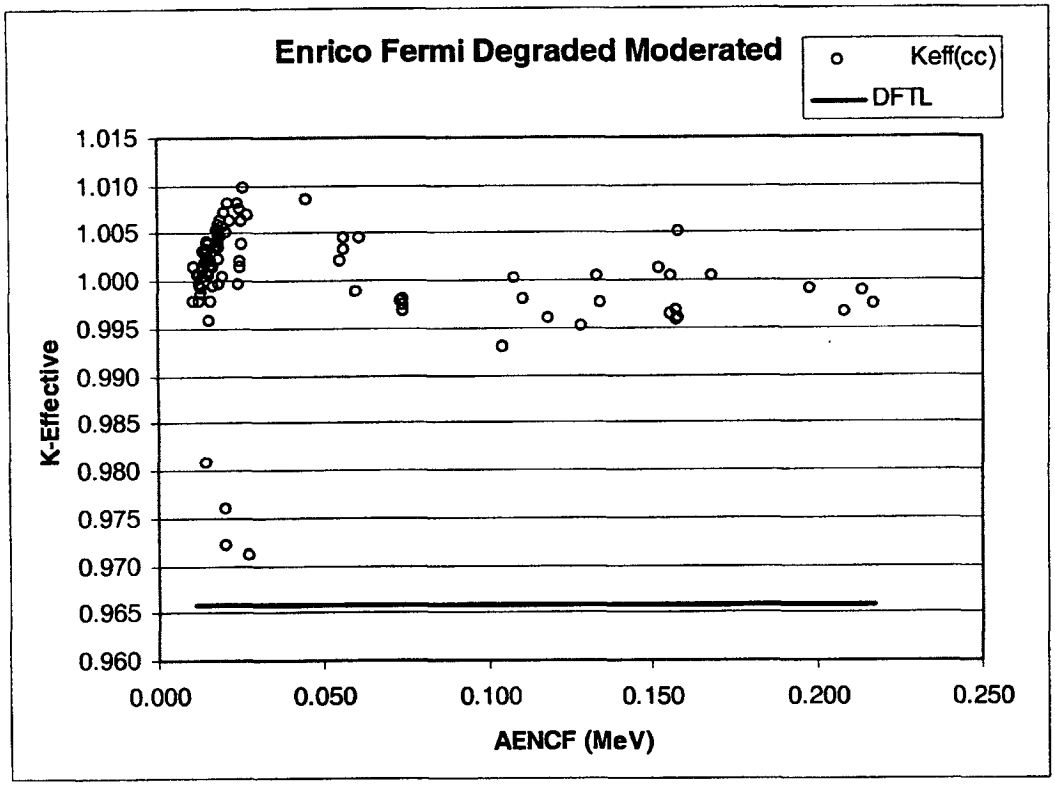


Figure 16. Critical Limit Applicable for Enrico Fermi DOE SNF (degraded moderated configurations)

The results of the trending parameter analysis for the critical benchmark subset representative for non-moderated intact configurations of the codisposal waste package containing Enrico Fermi DOE SNF are presented in Table 6-20.

Table 6-20. Trending Parameter Results for the Critical Benchmark Subset Representative for Non-moderated Degraded Configurations of the Codisposal WP Containing Enrico Fermi SNF

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	13	1.0132	-6.26E-03	0.0325	-0.6082	2.201	0.5554	Failed	No

Source: Calculated in spreadsheet "EF_deg_nonmod.xls", Attachment III.

The CL value calculated with NDTL method for this subset (normality test passed) is 0.9872 (Figure 17). The normality test results and the CL calculation are detailed in the spreadsheet: "EF_deg_nonmod.xls", Attachment III.

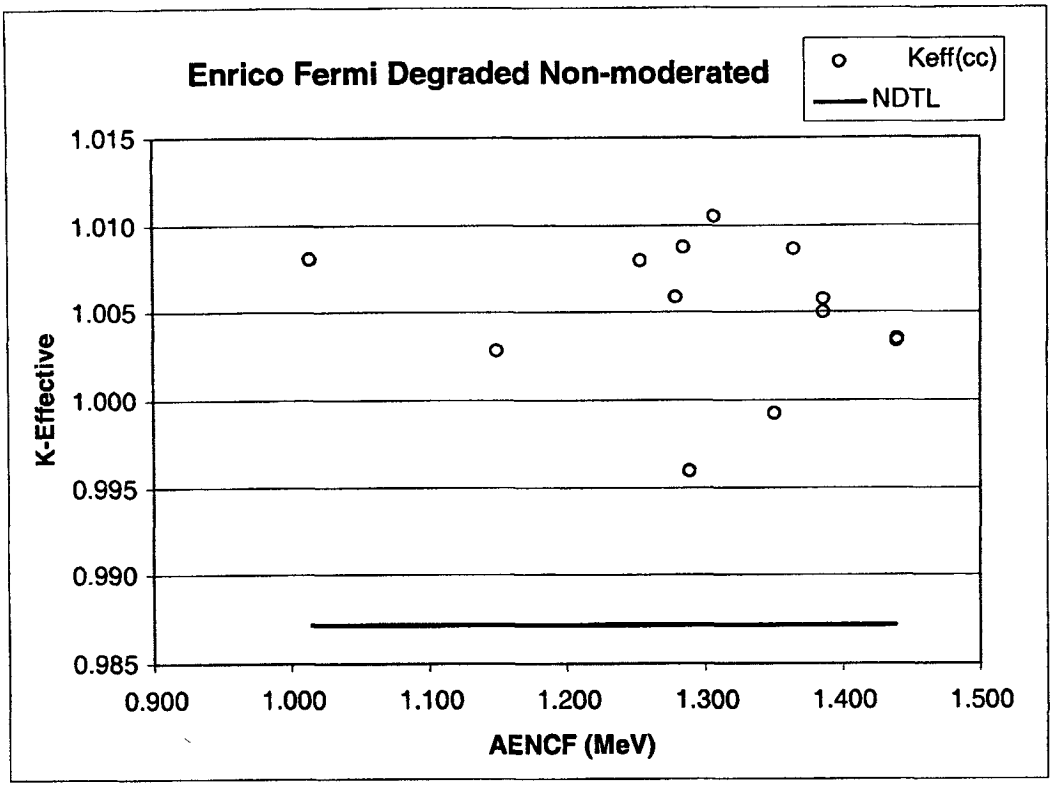


Figure 17. Critical Limit Applicable for Enrico Fermi DOE SNF (degraded non-moderated configurations)

Table 6-21 presents a summary of the results of the analyses performed on the subsets of critical benchmark experiments applicable to the codisposal waste package containing Enrico Fermi DOE SNF and the calculated CL values.

Table 6-21. Critical Limits for Benchmark Subsets Representative for Intact and Degraded Configurations of the Codisposal WP Containing Enrico Fermi SNF

Subset	Trend Parameter	Test for Normality	Applied Calculational Method	CL or CL Function
Intact Moderated	None	Failed	DFTL	CL = 0.9751
Intact Non-moderated	None	Passed	NDTL	CL = 0.9872
Degraded Moderated	None	Failed	DFTL	CL = 0.9659
Degraded Non-Moderated	None	Passed	NDTL	CL = 0.9872

6.2.5 Calculated CL Applicable for Configurations of Codisposal Waste Package Containing FFTF DOE SNF

The results of the trending parameter analysis for the critical benchmark subset representative for moderated intact configurations of the codisposal waste package containing FFTF DOE SNF are presented in Table 6-22.

Table 6-22. Trending Parameter Results for the Critical Benchmark Subset Representative for Moderated Intact Configurations of the Codisposal WP Containing FFTF SNF

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	32	1.0045	-0.0382	0.1454	-2.2591	1.960	0.0313	Failed	No

Source: Calculated in spreadsheet "FFTF_int_mod.xls", Attachment III

The CL value calculated with DFTL method for this subset (normality test failed) is 0.9786 (Figure 18). The normality test results and the CL calculation are detailed in the spreadsheet: "FFTF_int_mod.xls", Attachment III.

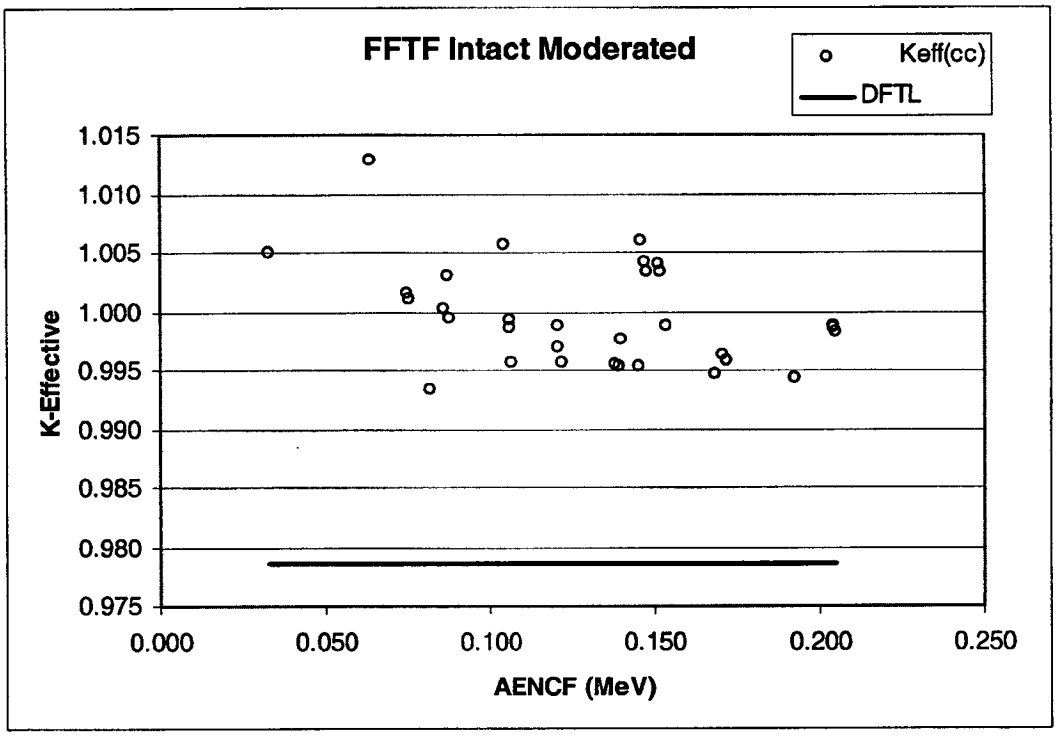


Figure 18. Critical Limit Applicable for FFTF DOE SNF (intact moderated configurations)

The results of the trending parameter analysis for the critical benchmark subset representative for non-moderated intact configurations of the codisposal waste package containing FFTF DOE SNF are presented in Table 6-23.

Table 6-23. Trending Parameter Results for the Critical Benchmark Subset Representative for Non-moderated Intact Configurations of the Codisposal WP Containing FFTF SNF

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	75	1.0175	-0.0108	0.3972	-6.93547	1.960	1.37E-09	Passed	Yes

Source: Calculated in spreadsheet "FFTF_int_nonmod.xls", Attachment III

The value calculated with CLREG (file "FFTF_intact_fastOut.csv" and spreadsheet "FFTF_int_nonmod.xls", Attachment III) for the CL function (LUTB) for the benchmarks applicable to intact-non-moderated configurations of FFTF DOE SNF (Figure 19) is:

$CL = 0.965$ for $0 < AENCF < 1.64$

$CL = -0.0108 * AENCF + 0.9823$ for $AENCF > 1.64$

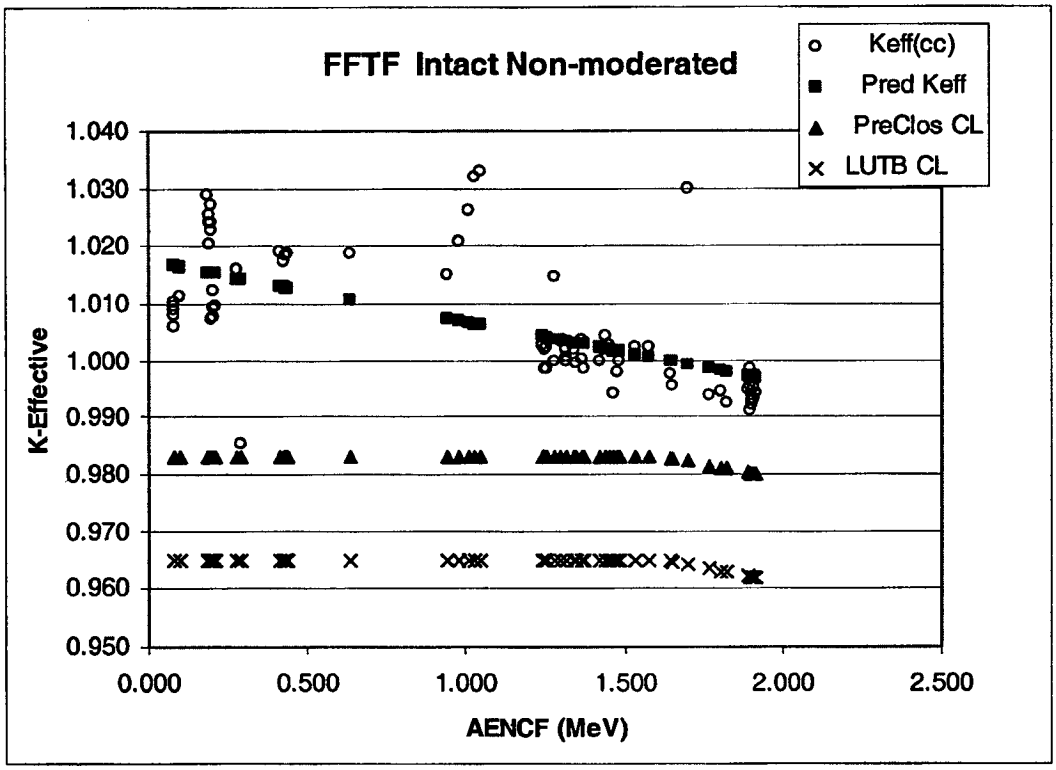


Figure 19. Critical Limit Applicable for FFTF DOE SNF (intact non-moderated configurations)

The results of the trending parameter analysis for the critical benchmark subset representative for moderated degraded configurations of the codisposal waste package containing FFTF DOE SNF are presented in Table 6-24.

Table 6-24. Trending Parameter Results for the Critical Benchmark Subset Representative for Moderated Degraded Configurations of the Codisposal WP Containing FFTF SNF

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	385	1.0142	-0.2456	0.3944	-15.7944	1.960	1.24E-43	Passed	Yes
H/Pu239	378	1.0064	5.04E-06	0.1145	6.9736	1.960	1.4E-11	Failed	No
Enr (Pu239/Pu)	385	0.9785	3.39E-04	0.2430	11.0881	1.960	5.76E-25	Failed	No

Source: Calculated in spreadsheet "FFTF_deg_mod.xls", Attachment III

The value calculated with CLREG (file "FFTF_degraded_thermalOut.csv" and spreadsheet "FFTF_deg_mod.xls", Attachment III) for the CL function (LUTB) for the benchmarks applicable to degraded-moderated configurations of FFTF DOE SNF (Figure 20) is:

$CL = 0.9769$ for $0 < AENCF < 0.056$
$CL = -0.2456*AENCF+0.9911$ for $AENCF > 0.056$

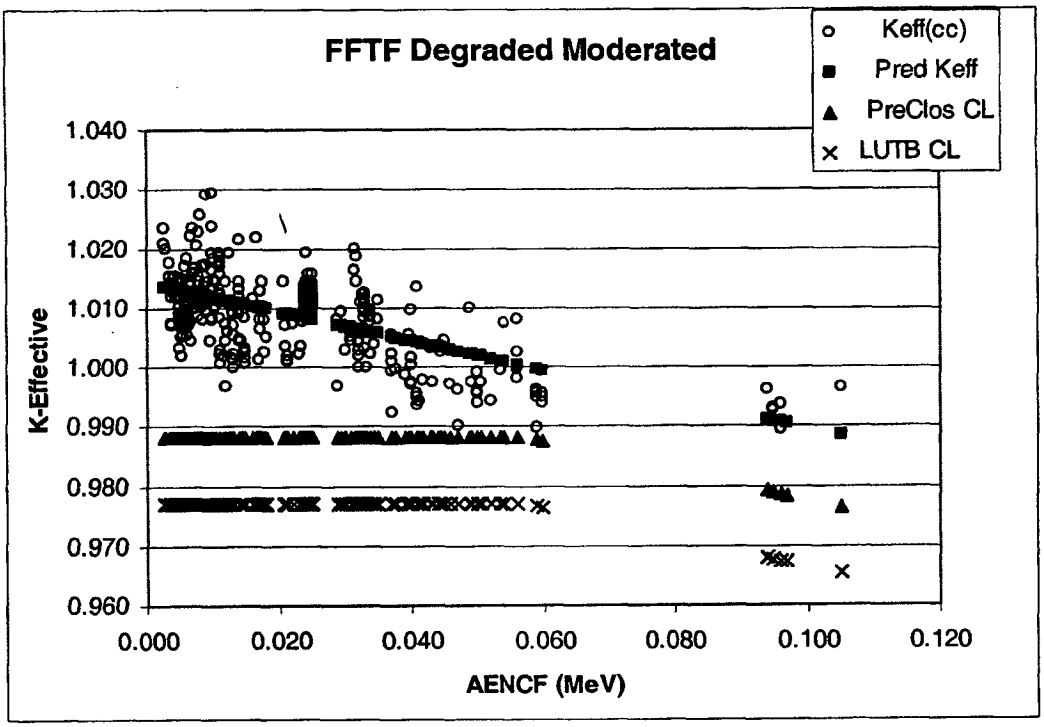


Figure 20. Critical Limit Applicable for FFTF DOE SNF (degraded moderated configurations)

The results of the trending parameter analysis for the critical benchmark subset representative for non-moderated degraded configurations of the codisposal waste package containing FFTF DOE SNF are presented in Table 6-25.

Table 6-25. Trending Parameter Results for the Critical Benchmark Subset Representative for Non-moderated Degraded Configurations of the Codisposal WP Containing FFTF SNF

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	48	1.0075	-4.16E-03	0.1352	-2.6820	1.960	0.0101	Failed	No

Source: Calculated in spreadsheet "FFTF_deg_nonmod.xls", Attachment III.

The CL value calculated with NDTL method for this subset (normality test passed) is 0.9872 (Figure 21). The normality test results and the CL calculation are detailed in the spreadsheet: "FFTF_deg_nonmod.xls", Attachment III.

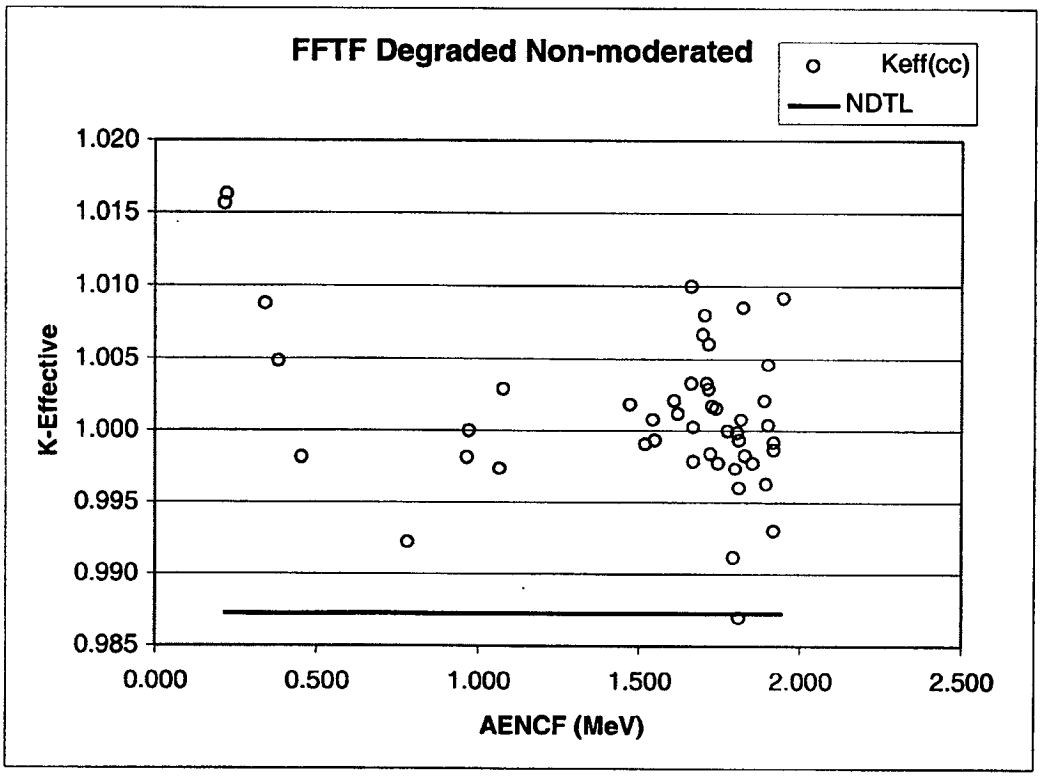


Figure 21. Critical Limit Applicable for FFTF DOE SNF (degraded non-moderated configurations)

Table 6-26 presents a summary of the results of the analyses performed on the subsets of critical benchmark experiments applicable to the codisposal waste package containing Enrico Fermi DOE SNF and the calculated CL values.

Table 6-26. Critical Limits for Benchmark Subsets Representative for Intact and Degraded Configurations of the Codisposal WP Containing FFTF SNF

Subset	Trend Parameter	Test for Normality	Applied Calculational Method	CL or CL Function
Intact Moderated	None	Failed	DFTL	CL = 0.9786
Intact Non-moderated	AENCF	N/A	CLREG code (LUTB)	CL = 0.965 for 0 < AENCF < 1.64 CL = -0.0108 * AENCF + 0.9823 for AENCF > 1.64
Degraded Moderated	AENCF	N/A	CLREG code (LUTB)	CL = 0.9769 for 0 < AENCF < 0.056 CL = -0.2456 * AENCF+0.9911 for AENCF> 0.056
Degraded Non-Moderated	None	Passed	NDTL	CL = 0.9872

6.2.6 Calculated CL Applicable for Configurations of Codisposal Waste Package Containing Ft. St. Vrain HTGR DOE SNF

The results of the trending parameter analysis for the critical benchmark subset representative for moderated intact configurations of the codisposal waste package containing Ft. St. Vrain (HTGR) DOE SNF are presented in Table 6-27.

Table 6-27. Trending Parameter Results for the Critical Benchmark Subset Representative for Moderated Intact Configurations of the Codisposal WP Containing HTGR DOE SNF

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	73	1.0099	-0.0226	0.35	-6.1832	1.960	3.55E-08	Passed	Yes
H/X	71	0.9982	1.19E-04	0.2537	4.8430	1.960	7.6E-06	Passed	Yes

Source: Calculated in spreadsheet "FSV_int_mod.xls", Attachment III

The strongest correlation (in this case, the trending parameter is AENCF) was used for calculating the CL function. The value calculated with CLREG (file "FSVrain_intact_thermalOut.csv" and spreadsheet "FSV_int_mod.xls", Attachment III) for the CL function (LUTB) for the benchmarks applicable to intact-moderated configurations of Ft. St. Vrain HTGR DOE SNF (Figure 22) is:

CL = 0.9575 for 0 < AENCF < 0.386
CL = -0.0226 * AENCF + 0.9674 for 0.386 < AENCF < 0.8015

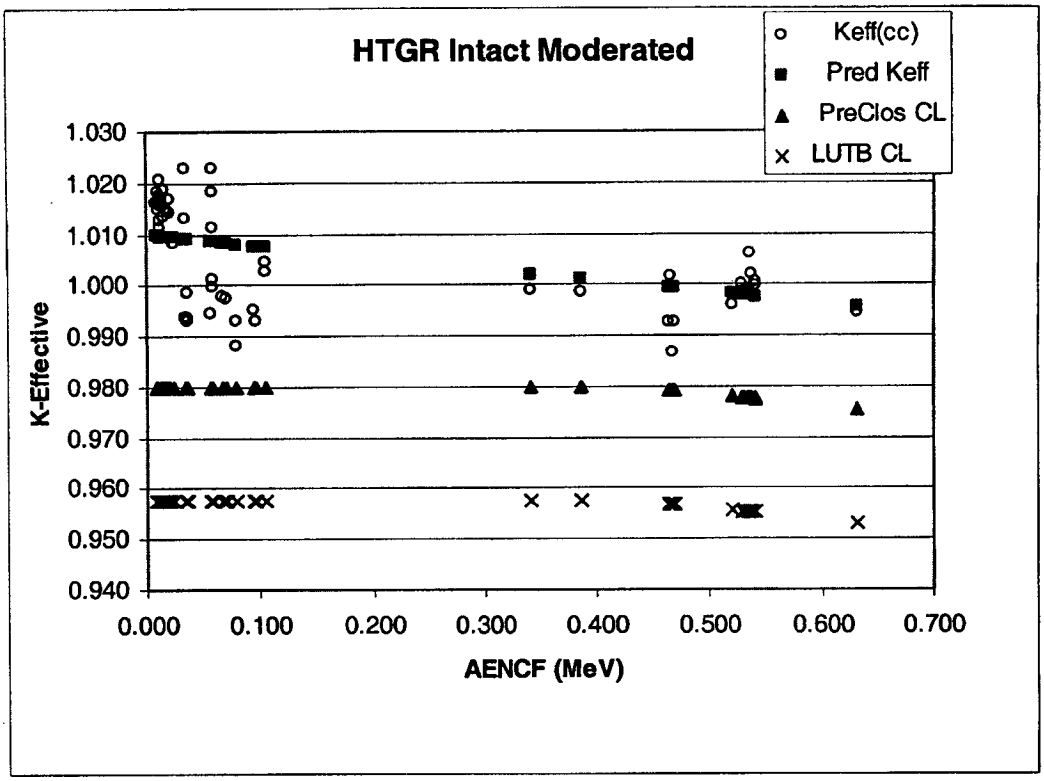


Figure 22. Critical Limit Applicable for FSV HTGR DOE SNF (intact moderated configurations)

The results of the trending parameter analysis for the critical benchmark subset representative for non-moderated intact configurations of the codisposal waste package containing Ft. St. Vrain (HTGR) DOE SNF are presented in Table 6-28.

Table 6-28. Trending Parameter Results for the Critical Benchmark Subset Representative for Non-moderated Intact Configurations of the Codisposal WP Containing HTGR DOE SNF

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	93	1.0004	-3.47E-03	0.0633	- 2.4800	1.960	0.01498	Failed	No
H/X	64	0.9963	1.98E-04	0.0530	1.8621	1.960	0.0673	Failed	No

Source: Calculated in spreadsheet "FSV_int_nonmod.xls", Attachment III

The CL value calculated with DFTL method for this subset (normality test failed) is 0.9816 (Figure 23). The normality test results and the CL calculation are detailed in the spreadsheet: "FSV_int_nonmod.xls", Attachment III.

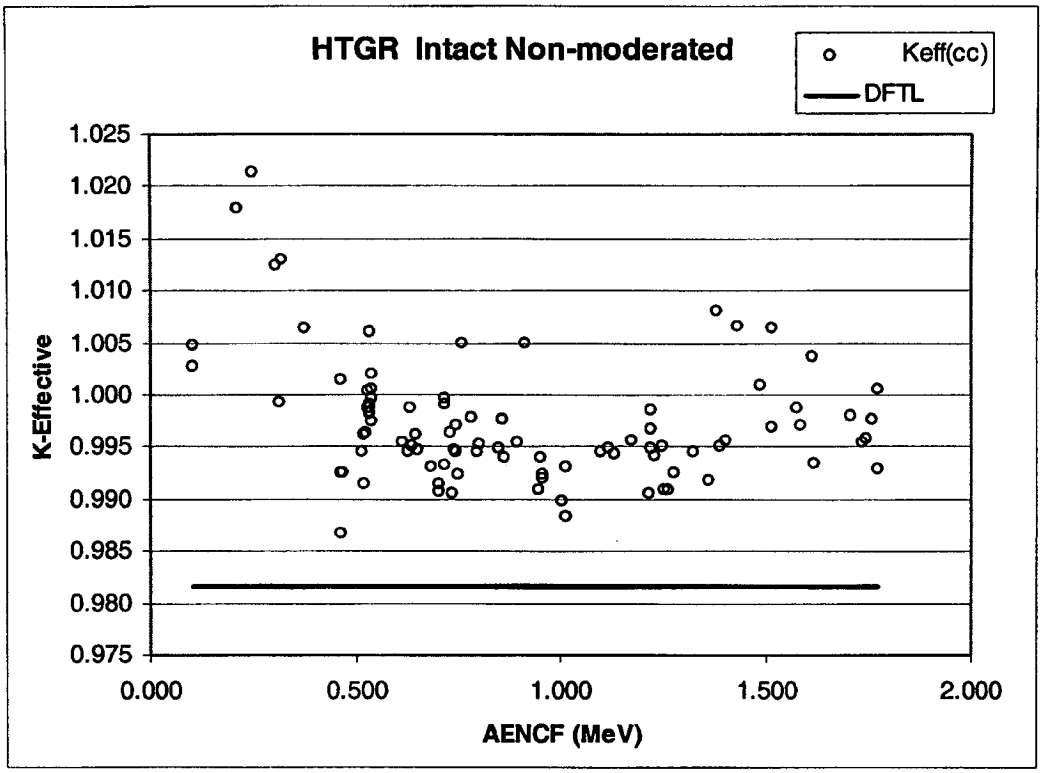


Figure 23. Critical Limit Applicable for FSV HTGR DOE SNF (intact non-moderated configurations)

The results of the trending parameter analysis for the critical benchmark subset representative for moderated degraded configurations of the codisposal waste package containing Ft. St. Vrain (HTGR) DOE SNF are presented in Table 6-29.

Table 6-29. Trending Parameter Results for the Critical Benchmark Subset Representative for Moderated Degraded Configurations of the Codisposal WP Containing HTGR DOE SNF

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	108	1.0079	-0.0183	0.2098	-5.3049	1.960	6.22E-07	Passed	Yes
H/X	103	1.0064	-4.14E-06	0.0245	-1.5911	1.960	0.1147	Failed	No

Source: Calculated in spreadsheet "FSV_deg_mod.xls", Attachment III

The value calculated with CLREG (file "FSVrain_degraded_thermalOut.csv" and spreadsheet "FSV_deg_mod.xls", Attachment III) for the CL function (LUTB) for the benchmarks applicable to intact-moderated configurations of Ft. St. Vrain HTGR DOE SNF (Figure 24) is:

$CL = 0.9608$ for $0 < AENCF < 0.4625$

$CL = -0.0183 * AENCF + 0.9687$ for $0.4625 < AENCF < 0.8015$

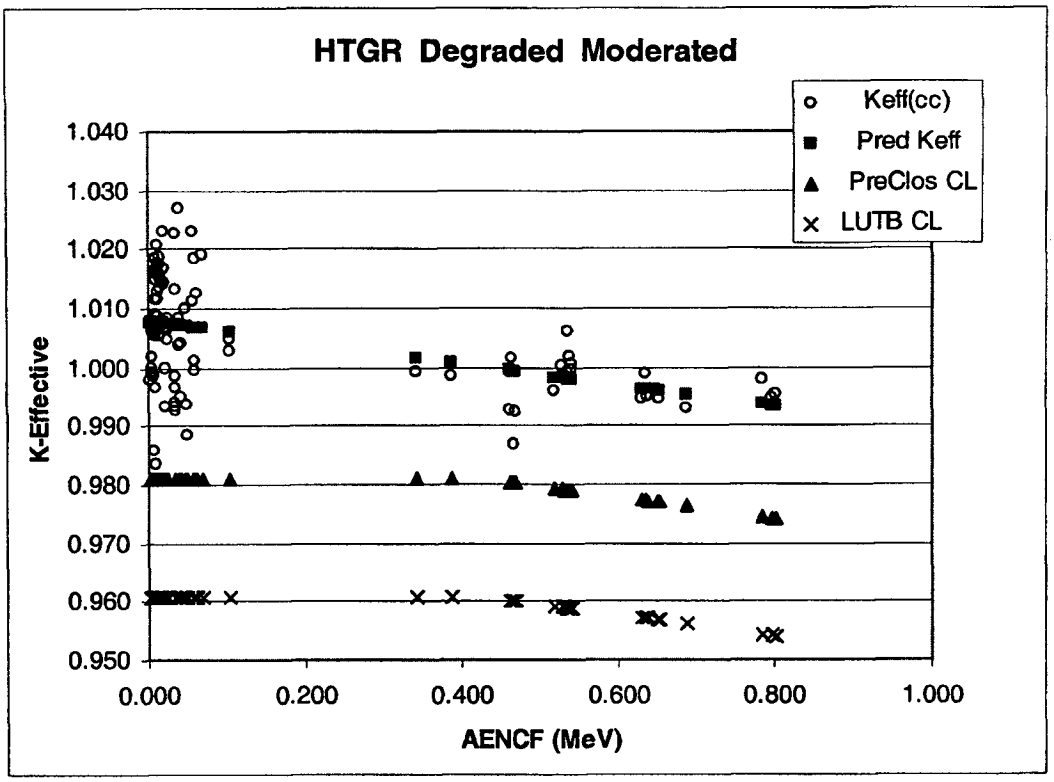


Figure 24. Critical Limit Applicable for FSV HTGR DOE SNF (degraded moderated configurations)

The results of the trending parameter analysis for the critical benchmark subset representative for non-moderated degraded configurations of the codisposal waste package containing Ft. St. Vrain (HTGR) DOE SNF are presented in Table 6-30.

Table 6-30. Trending Parameter Results for the Critical Benchmark Subset Representative for Non-moderated Degraded Configurations of the Codisposal WP Containing HTGR DOE SNF

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	139	0.9906	5.317E-03	0.1297	4.5176	1.960	1.34E-05	Failed	No
H/X	100	0.9968	-2.94E-04	0.2742	-6.1970	1.960	1.4E-08	Failed	No

Source: Calculated in spreadsheet "FSV_deg_nonmod.xls", Attachment III

The CL value calculated with DFTL method for this subset (normality test failed) is 0.9723 (Figure 25). The normality test results and the CL calculation are detailed in the spreadsheet: "FSV_deg_nonmod.xls", Attachment III.

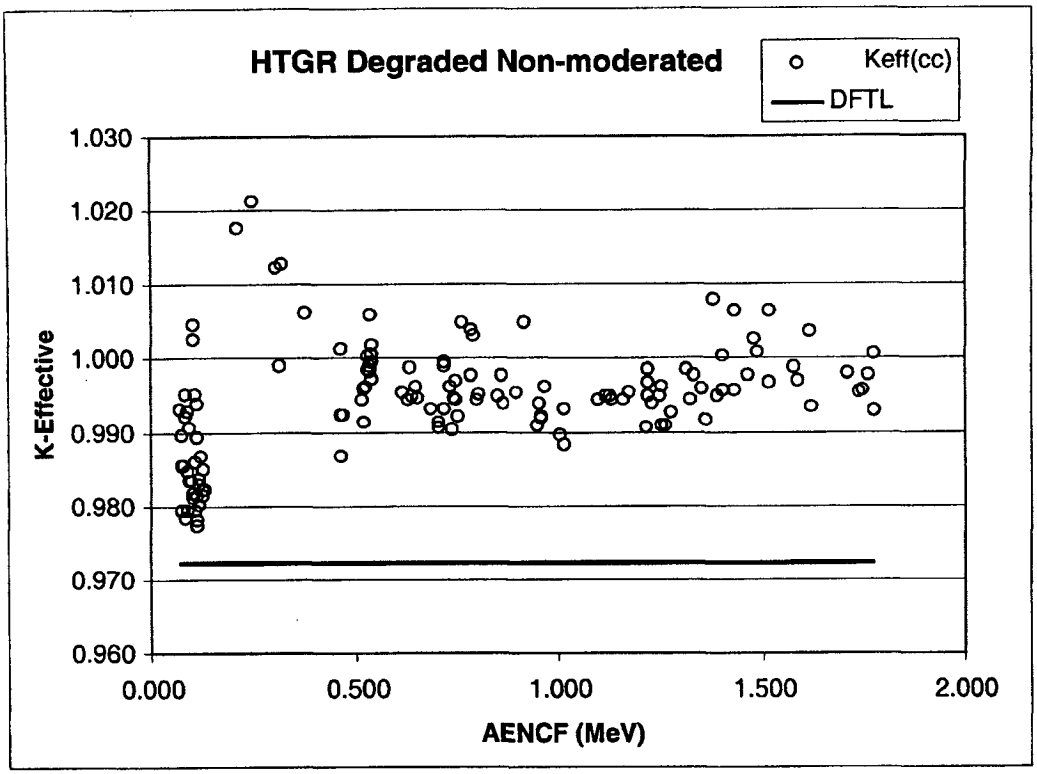


Figure 25. Critical Limit Applicable for FSV HTGR DOE SNF (degraded non-moderated configurations)

Table 6-31 presents a summary of the results of the analyses performed on the subsets of critical benchmark experiments applicable to the codisposal waste package containing HTGR DOE SNF and the calculated CL values.

Table 6-31. Critical Limits for Benchmark Subsets Representative for Intact and Degraded Configurations of the Codisposal WP Containing HTGR DOE SNF

Subset	Trend Parameter	Test for Normality	Applied Calculational Method	CL or CL Function
Intact Moderated	AENCF	N/A	CLREG code (LUTB)	CL = 0.9575 for 0 < AENCF < 0.386 CL = -0.0226 * AENCF + 0.9674 for 0.386 < AENCF < 0.8015
Intact Non-moderated	None	Failed	DFTL	CL = 0.9816
Degraded Moderated	AENCF	N/A	CLREG code (LUTB)	CL = 0.9608 for 0 < AENCF < 0.4625 CL = -0.0183 * AENCF + 0.9687 for 0.4625 < AENCF < 0.8015
Degraded Non-Moderated	None	Failed	DFTL	CL = 0.9723

6.2.7 Calculated CL Applicable for Configurations of Codisposal Waste Package Containing Shippingport LWBR DOE SNF

The results of the trending parameter analysis for the critical benchmark subset representative for moderated intact configurations of the codisposal waste package containing Shippingport LWBR DOE SNF are presented in Table 6-32.

Table 6-32. Trending Parameter Results for the Critical Benchmark Subset Representative for Moderated Intact Configurations of the Codisposal WP Containing Shippingport LWBR DOE SNF

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	75	0.9998	-4.87E-03	0.0237	-1.3309	1.960	0.1874	Failed	No
H/X	64	0.9984	1.07E-05	0.0185	1.0821	1.960	0.2834	Failed	No

Source: Calculated in spreadsheet "SLWBR_int_mod.xls", Attachment III

The CL value calculated with DFTL method for this subset (normality test failed) is 0.9751 (Figure 26). The normality test results and the CL calculation are detailed in the spreadsheet: "SLWBR_int_mod.xls", Attachment III.

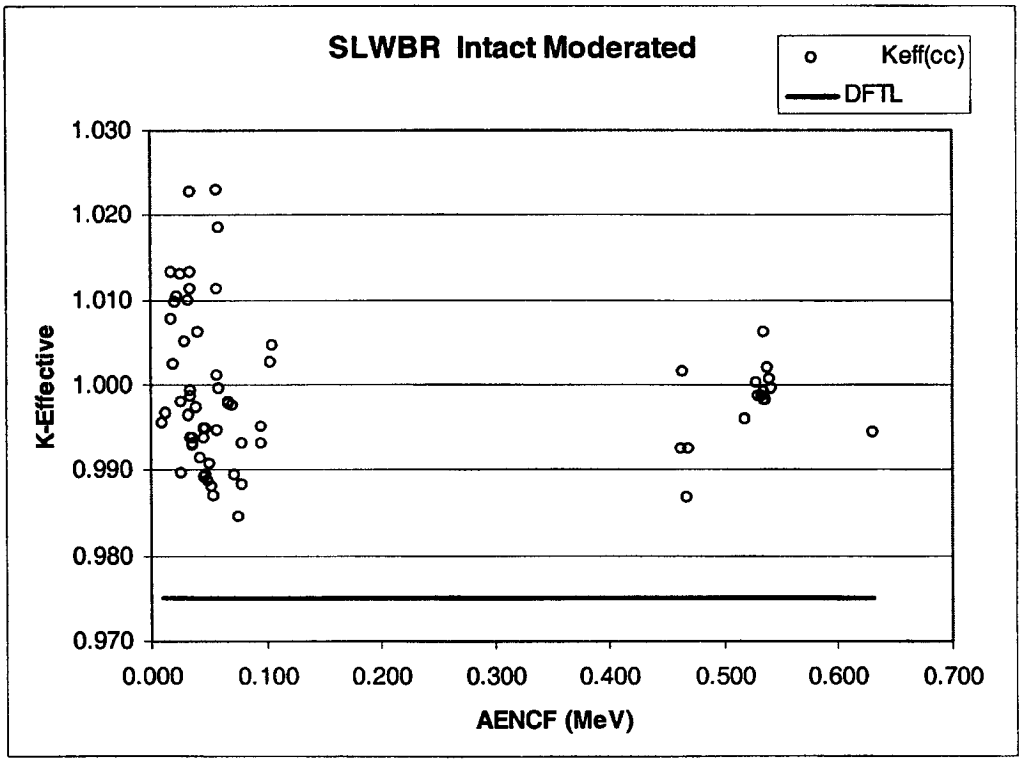


Figure 26. Critical Limit Applicable for Shippingport LWBR DOE SNF (intact moderated configurations)

The results of the trending parameter analysis for the critical benchmark subset representative for non-moderated intact configurations of the codisposal waste package containing Shippingport LWBR DOE SNF are presented in Table 6-33.

Table 6-33. Trending Parameter Results for the Critical Benchmark Subset Representative for Non-moderated Intact Configurations of the Codisposal WP Containing Shippingport LWBR SNF

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	98	0.9996	-2.75E-03	0.0441	-2.1039	1.960	0.0380	Failed	No
H/X	69	0.9962	1.5E-04	0.0344	1.5446	1.960	0.1272	Failed	No

Source: Calculated in spreadsheet "SLWBR_int_nonmod.xls", Attachment III

The CL value calculated with DFTL method for this subset (normality test failed) is 0.9816 (Figure 27). The normality test results and the CL calculation are detailed in the spreadsheet: "SLWBR_int_mod.xls", Attachment III.

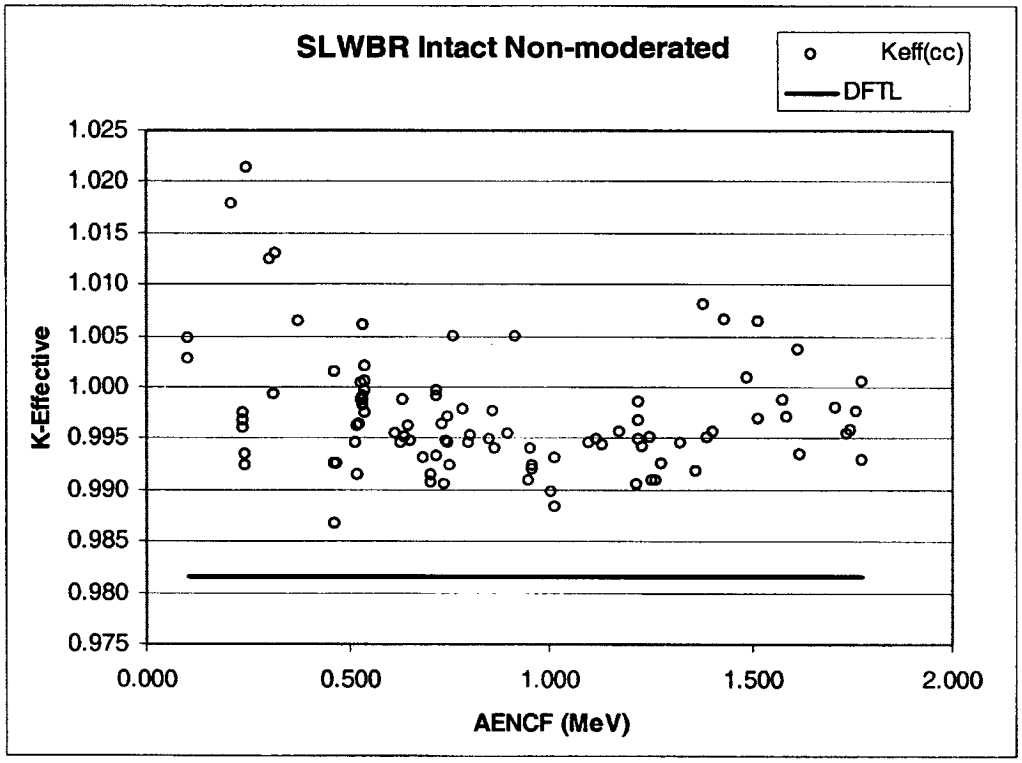


Figure 27. Critical Limit Applicable for Shippingport LWBR DOE SNF (intact non-moderated configurations)

The results of the trending parameter analysis for the critical benchmark subset representative for moderated degraded configurations of the codisposal waste package containing Shippingport LWBR DOE SNF are presented in Table 6-34.

Table 6-34. Trending Parameter Results for the Critical Benchmark Subset Representative for Moderated Degraded Configurations of the Codisposal WP Containing Shippingport SLWBR SNF

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	81	1.0042	-0.0115	0.1205	-3.2902	1.960	1.497E-03	Failed	No
H/X	78	1.0024	-1.02E-06	2.304E-03	-0.4189	1.960	0.6765	Failed	No

Source: Calculated in spreadsheet "SLWBR_deg_mod.xls", Attachment III

The CL value calculated with DFTL method for this subset (normality test failed) is 0.9748 (Figure 28). The normality test results and the CL calculation are detailed in the spreadsheet: "SLWBR_deg_mod.xls", Attachment III.

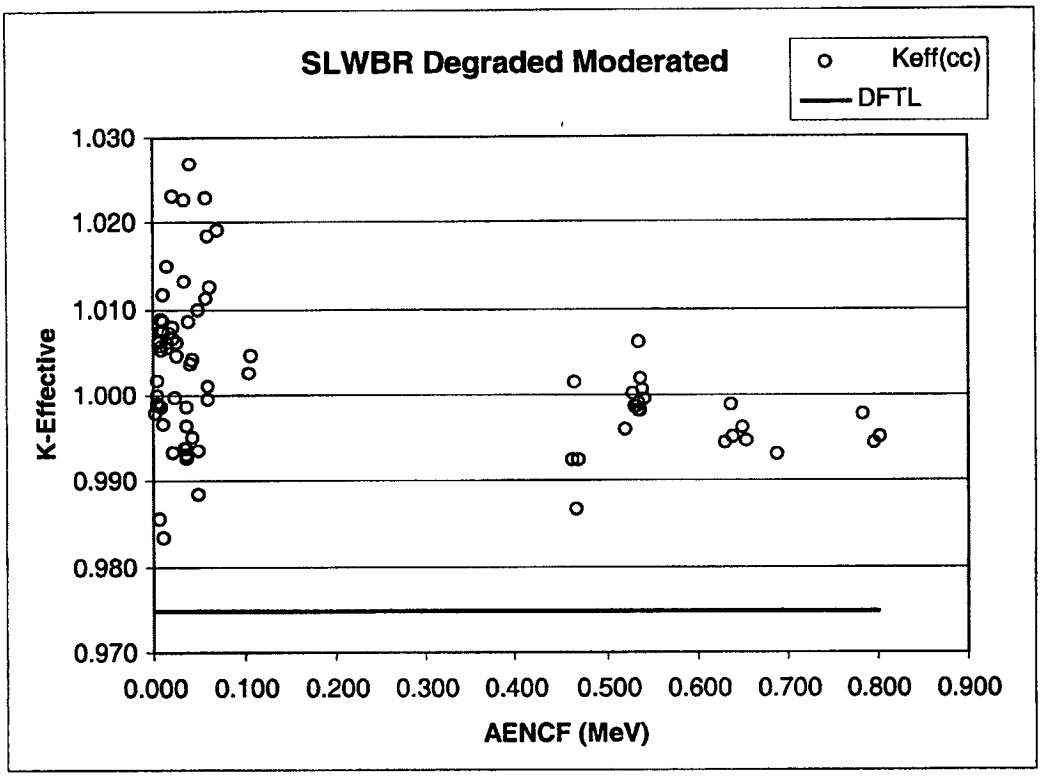


Figure 28. Critical Limit Applicable for Shippingport LWBR DOE SNF (degraded moderated configurations)

The results of the trending parameter analysis for the critical benchmark subset representative for non-moderated degraded configurations of the codisposal waste package containing Shippingport LWBR DOE SNF are presented in Table 6-35.

Table 6-35. Trending Parameter Results for the Critical Benchmark Subset Representative for Non-moderated Degraded Configurations of the Codisposal WP Containing Shippingport SLWBR SNF

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	140	0.9905	5.478E-03	0.1393	4.7250	1.960	5.6E-06	Failed	No
H/X	97	0.9968	-2.9E-04	0.2747	-5.9983	1.960	3.6E-08	Failed	No

Source: Calculated in spreadsheet "SLWBR_deg_nonmod.xls", Attachment III

The CL value calculated with DFTL method for this subset (normality test failed) is 0.9723 (Figure 29). The normality test results and the CL calculation are detailed in the spreadsheet: "SLWBR_deg_nonmod.xls", Attachment III.

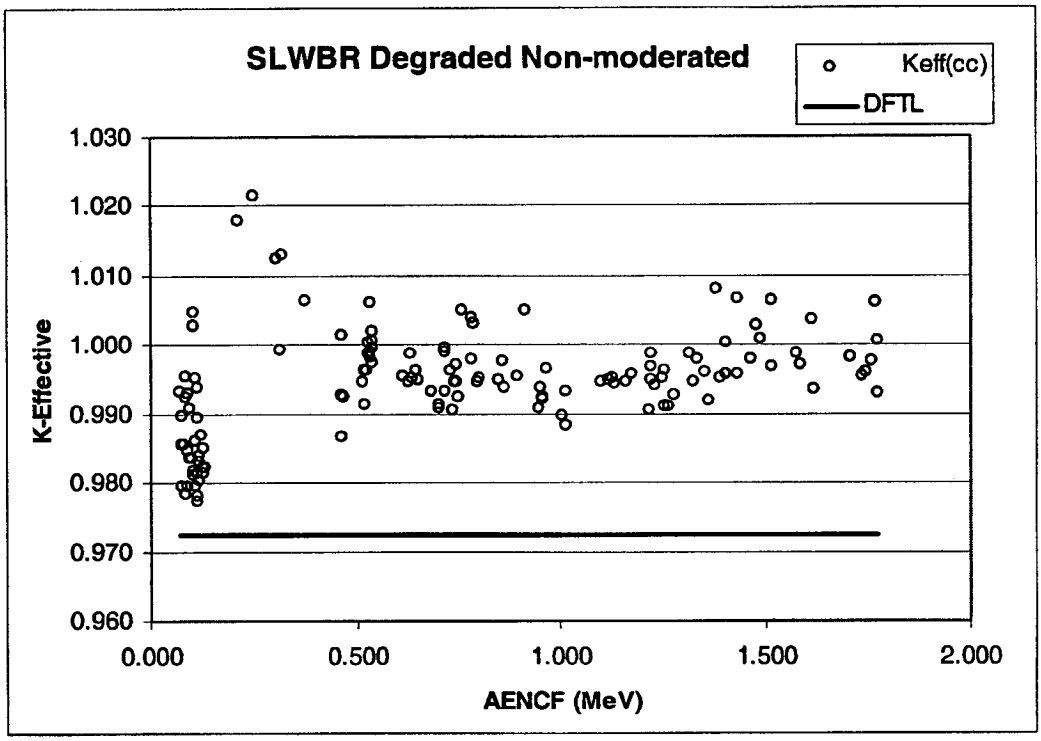


Figure 29. Critical Limit Applicable for Shippingport LWBR DOE SNF (degraded non-moderated configurations)

Table 6-36 presents a summary of the results of the analyses performed on the subsets of critical benchmark experiments applicable to the codisposal waste package containing Shippingport LWBR DOE SNF and the calculated CL values.

Table 6-36. Critical Limits for Benchmark Subsets Representative for Intact and Degraded Configurations of the Codisposal WP Containing Shippingport LWBR SNF

Subset	Trend Parameter	Test for Normality	Applied Calculational Method	CL or CL Function
Intact Moderated	None	Failed	DFTL	CL = 0.9751
Intact Non-moderated	None	Failed	DFTL	CL = 0.9816
Degraded Moderated	None	Failed	DFTL	CL = 0.9748
Degraded Non-Moderated	None	Failed	DFTL	CL = 0.9723

6.2.8 Calculated CL Applicable for Configurations of Codisposal Waste Package Containing N-reactor DOE SNF

The results of the trending parameter analysis for the critical benchmark subset representative for moderated intact configurations of the codisposal waste package containing N-reactor DOE SNF are presented in Table 6-37.

Table 6-37. Trending Parameter Results for the Critical Benchmark Subset Representative for Moderated Intact Configurations of the Codisposal WP Containing N-reactor SNF

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	25	0.9866	0.0765	0.3775	3.7349	2.069	0.0011	Passed	Yes
Enr (U235/U)	25	1.0140	-0.0057	0.2062	-2.4441	2.069	0.0226	Failed	No

Source: Calculated in spreadsheet "NReactor_int_mod.xls", Attachment III

The value calculated with CLREG (file "Nreactor_intact_thermalOut.csv" and spreadsheet "NReactor_int_mod.xls", Attachment III) for the CL function (LUTB) for the benchmarks applicable to intact-moderated configurations of N-reactor DOE SNF (Figure 30) is:

$CL = 0.0765 * AENCF + 0.9434$ for $0 < AENCF < 0.175$
$CL = 0.9568$ for $AENCF > 0.175$

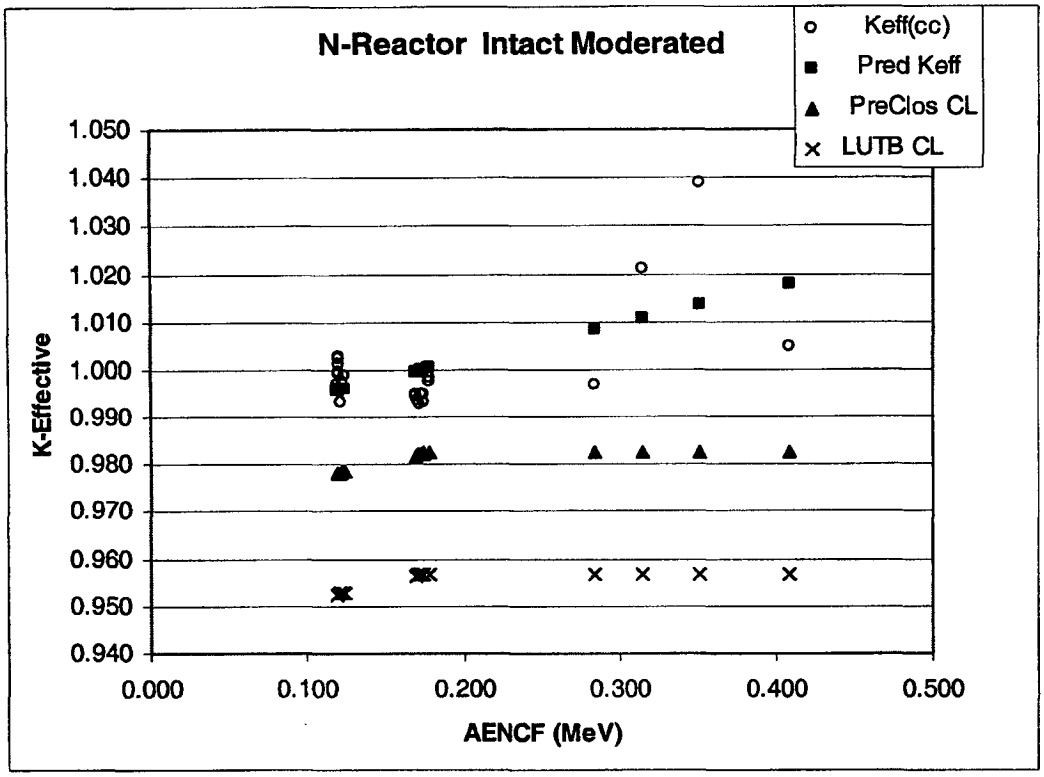


Figure 30. Critical Limit Applicable for N-reactor DOE SNF (intact moderated configurations)

The results of the trending parameter analysis for the critical benchmark subset representative for moderated degraded configurations of the codisposal waste package containing N-reactor DOE SNF are presented in Table 6-38.

Table 6-38. Trending Parameter Results for the Critical Benchmark Subset Representative for Moderated Degraded Configurations of the Codisposal WP Containing N-reactor SNF

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	37	1.0012	-0.0215	0.1478	-2.4635	1.960	0.0188	Failed	No
Enr (U235/U)	37	1.0017	-1.25E-03	0.2261	-3.1975	1.960	2.938E-03	Failed	No
H/U235	31	0.9956	4.66E-06	0.1148	1.9394	1.960	0.0622	Failed	No

Source: Calculated in spreadsheet "NReactor_deg_mod.xls", Attachment III

The CL value calculated with DFTL method for this subset (normality test failed) is 0.9748 (Figure 31). The normality test results and the CL calculation are detailed in the spreadsheet: "NReactor_deg_mod.xls", Attachment III.

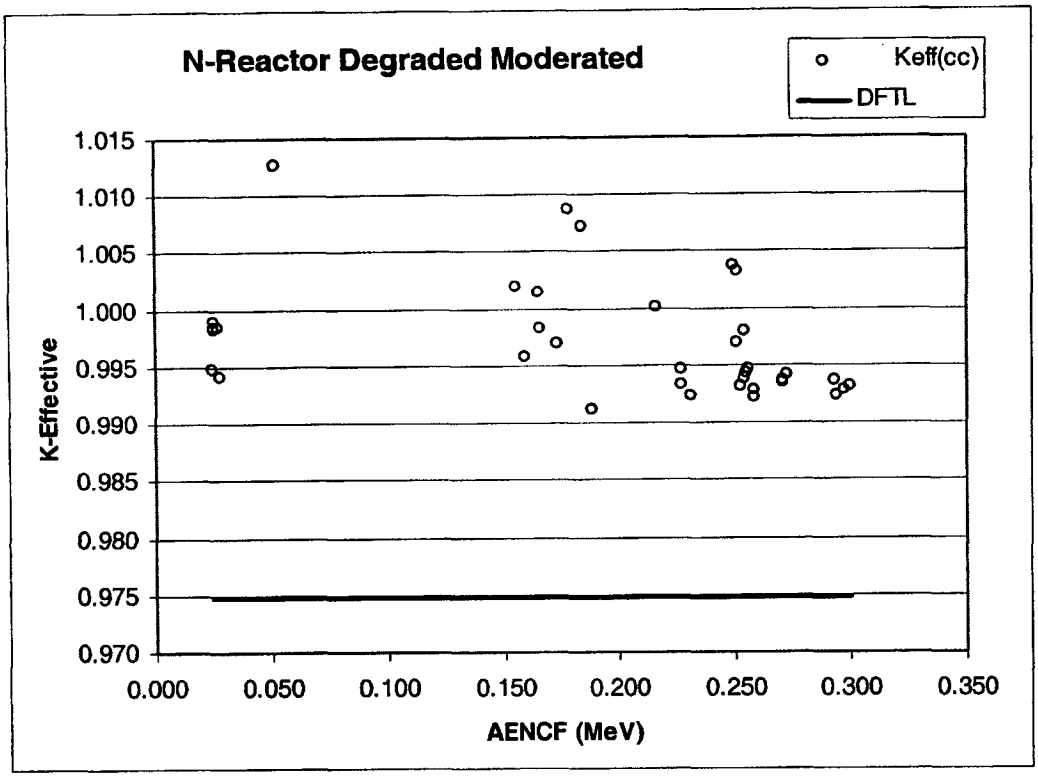


Figure 31. Critical Limit Applicable for N-reactor DOE SNF (degraded moderated configurations)

Table 6-39 presents a summary of the results of the analyses performed on the subsets of critical benchmark experiments applicable to the codisposal waste package containing N-reactor DOE SNF and the calculated CL values.

Table 6-39. Critical Limits for Benchmark Subsets Representative for Intact and Degraded Configurations of the Codisposal WP Containing N-reactor SNF

Subset	Trend Parameter	Test for Normality	Applied Calculational Method	CL or CL Function
Intact Moderated	AENCF	N/A	CLREG (LUTB)	CL = 0.0765 * AENCF + 0.9434 for 0 < AENCF < 0.175 CL = 0.9568 for AENCF > 0.175
Degraded Moderated	None	Failed	DFTL	CL = 0.9748

6.2.9 Calculated CL Applicable for Configurations of Codisposal Waste Package Containing Three- Mile Island (TMI) Waste Form

The results of the trending parameter analysis for the critical benchmark subset representative for moderated intact configurations of the codisposal waste package containing TMI waste form are presented in Table 6-40.

Table 6-40. Trending Parameter Results for the Critical Benchmark Subset Representative for Moderated Intact Configurations of the Codisposal WP Containing TMI Waste Form

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	51	0.9991	-3.38E-03	8.43E-04	-0.2034	1.960	0.8397	Failed	No
Enr (U235/U)	41	0.9901	2.839E-03	0.1758	2.8847	1.960	0.0064	Failed	No

Source: Calculated in spreadsheet "TMI_int_mod.xls", Attachment III

The CL value calculated with DFTL method for this subset (normality test failed) is 0.9724 (Figure 32). The normality test results and the CL calculation are detailed in the spreadsheet: "TMI_int_mod.xls", Attachment III.

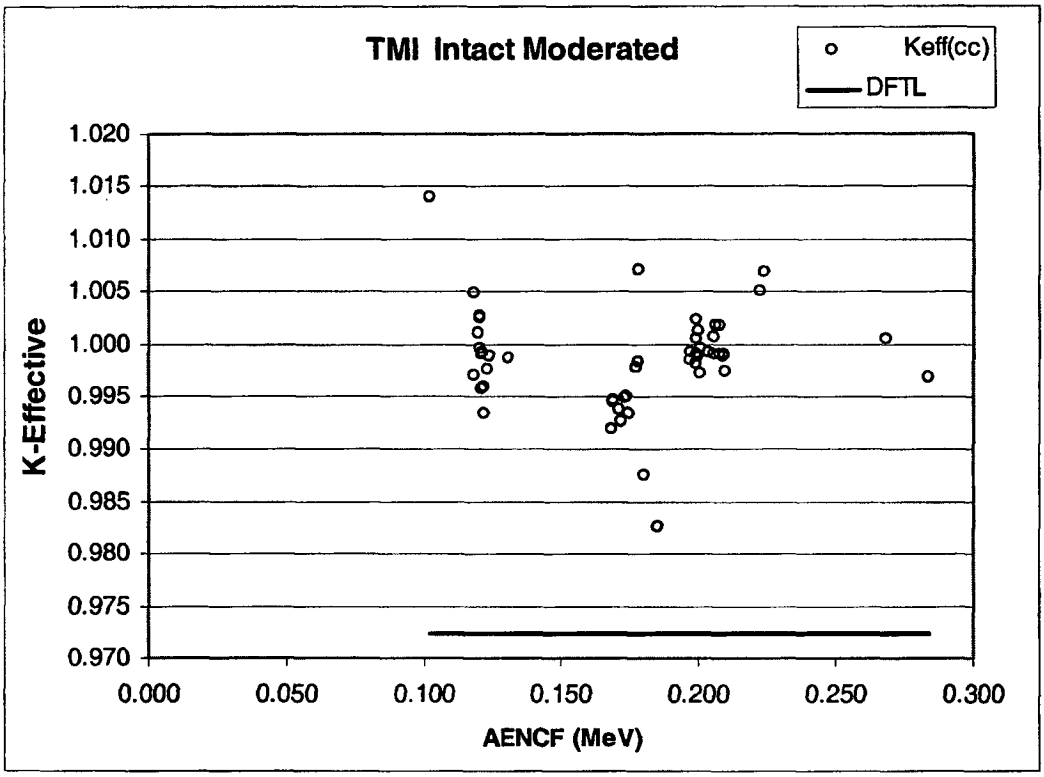


Figure 32. Critical Limit Applicable for TMI Waste Form (intact moderated configurations)

The results of the trending parameter analysis for the critical benchmark subset representative for moderated intact configurations of the codisposal waste package containing TMI waste form are presented in Table 6-41.

Table 6-41. Trending Parameter Results for the Critical Benchmark Subset Representative for Moderated Degraded Configurations of the Codisposal WP Containing TMI Waste Form

Trend Parameter	n	Intercept	Slope	r^2	T	$t_{0.025,n-2}$	P-value	Goodness-of-fit Tests	Valid Trend
AENCF	49	1.0021	-0.0252	0.3139	-4.6373	1.960	2.83E-05	Passed	Yes
Enr (U235/U)	49	0.9968	2.62E-04	0.0277	1.1568	1.960	0.2532	Failed	No
H/U235	43	0.9955	6.18E-06	0.2276	3.4758	1.960	1.218E-03	Failed	No

Source: Calculated in spreadsheet "TMI_deg_mod.xls", Attachment III

The value calculated with CLREG (file "TMI_degraded_thermalOut.csv" and spreadsheet "TMI_deg_mod.xls", Attachment III) for the CL function (LUTB) for the benchmarks applicable to intact-moderated configurations of TMI waste form (Figure 33) is:

$CL = 0.9776$ for $0.0142 < AENCF < 0.05186$

$CL = -0.0252 * AENCF + 0.9789$ for $0.05186 < AENCF < 0.3$

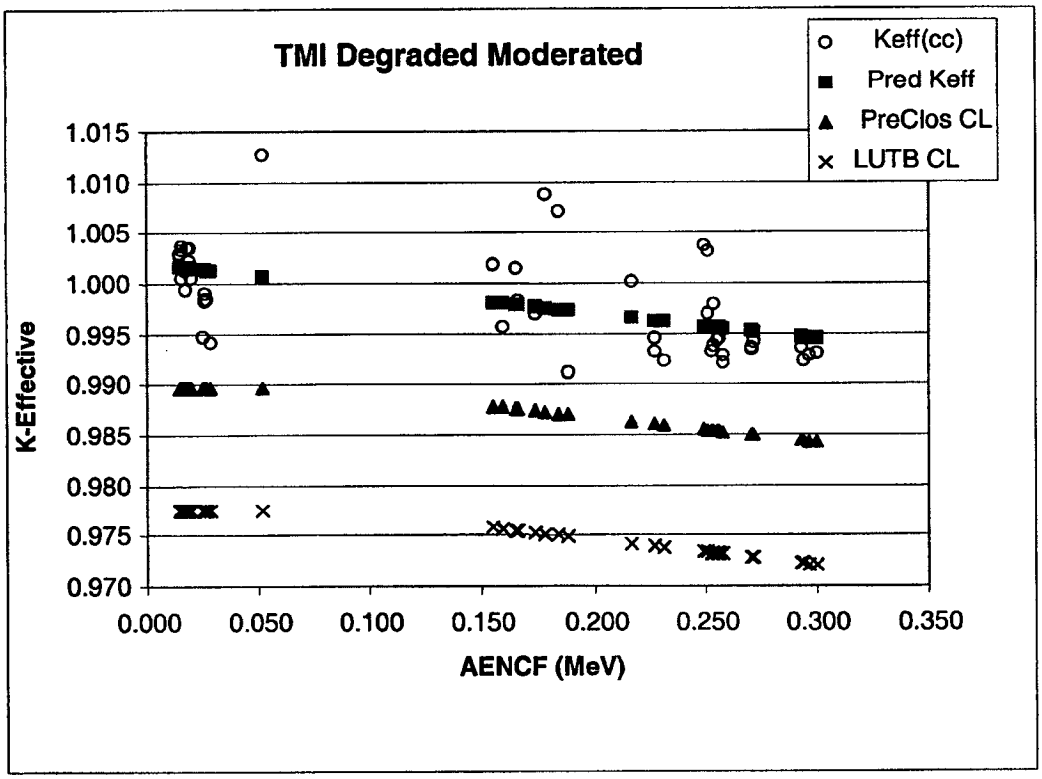


Figure 33. Critical Limit Applicable for TMI Waste Form (degraded moderated configurations)

Table 6-42 presents a summary of the results of the analyses performed on the subsets of critical benchmark experiments applicable to the codisposal waste package containing TMI waste form and the calculated CL values.

Table 6-42. Critical Limits for Benchmark Subsets Representative for Intact and Degraded Configurations of the Codisposal WP Containing TMI Debris

Subset	Trend Parameter	Test for Normality	Applied Calculational Method	CL or CL Function
Intact Moderated	None	Failed	DFTL	CL = 0.9724
Degraded Moderated	AENCF	N/A	CLREG code (LUTB)	CL= 0.9776 for 0.0142 < AENCF < 0.05186 CL = -0.0252 * AENCF + 0.9789 for 0.05186 < AENCF < 0.3

6.3 SUMMARY OF RESULTS

A summary of the results of the analysis of the critical benchmark data and the calculated CL functions or values are presented in the following table (Table 6-43).

Table 6-43. Summary of the Calculated CL values applicable for intact and degraded configurations of the codisposal WP containing various DOE SNF types

DOE SNF Group	Subset	Trend Parameter	Test for Normality	Applied Calculational Method	CL or CL Function
Shipping port PWR	Intact Moderated	AENCF	N/A	CLREG code (LUTB)	CL = 0.969 for 0 < AENCF < 0.0278 CL = -0.2336 * AENCF + 0.9755 for 0.0278 < AENCF < 0.0922
	Intact Non-moderated	None	Failed	DFTL	CL = 0.9864
	Degraded Moderated	None	Failed	DFTL	CL = 0.9807
	Degraded Non-Moderated	None	Passed	NDTL	CL= 0.9843
TRIGA	Intact Moderated	AENCF	N/A	CLREG code (LUTB)	CL = 0.9668 for 0 < AENCF < 0.0404 CL = -0.331* AENCF + 0.9788 for 0.0404 < AENCF < 0.0922
	Intact Non-moderated	None	Failed	DFTL	CL = 0.9721
	Degraded Moderated	None	Failed	DFTL	CL = 0.9796
	Degraded Non-Moderated	None	Passed	NDTL	CL= 0.9843
Melt & Dilute	Intact Moderated	None	Passed	NDTL	CL = 0.9870

Table 6-43. Summary of the Calculated CL values applicable for intact and degraded configurations of the codisposal WP containing various DOE SNF types

DOE SNF Group	Subset	Trend Parameter	Test for Normality	Applied Calculational Method	CL or CL Function
	Intact Non-moderated	None	Passed	NDTL	CL = 0.9872
	Degraded Moderated	None	Failed	DFTL	CL = 0.9659
	Degraded Non-moderated	None	Passed	NDTL	CL = 0.9872
Enrico Fermi	Intact Moderated	None	Failed	DFTL	CL = 0.9751
	Intact Non-moderated	None	Passed	NDTL	CL = 0.9872
	Degraded Moderated	None	Failed	DFTL	CL = 0.9659
	Degraded Non-Moderated	None	Passed	NDTL	CL = 0.9872
FFTF	Intact Moderated	None	Failed	DFTL	CL = 0.9786
	Intact Non-moderated	AENCF	N/A	CLREG code (LUTB)	CL = 0.965 for 0 < AENCF < 1.64 CL = -0.0108 * AENCF + 0.9823 for AENCF > 1.64
	Degraded Moderated	AENCF	N/A	CLREG code (LUTB)	CL = 0.9769 for 0 < AENCF < 0.056 CL = -0.2456 * AENCF+0.9911 for AENCF> 0.056
	Degraded Non-Moderated	None	Passed	NDTL	CL = 0.9872
FSV HTGR	Intact Moderated	AENCF	None	CLREG code (LUTB)	CL = 0.9575 for 0 < AENCF < 0.386 CL = -0.0226 * AENCF + 0.9674 for 0.386 < AENCF < 0.8015
	Intact Non-moderated	None	Failed	DFTL	CL = 0.9816
	Degraded Moderated	AENCF	N/A	CLREG code (LUTB)	CL = 0.9608 for 0 < AENCF < 0.4625 CL = -0.0183 * AENCF + 0.9687 for 0.4625 < AENCF < 0.8015
	Degraded Non-Moderated	None	Failed	DFTL	CL = 0.9723
Shipping port	Intact Moderated	None	Failed	DFTL	CL = 0.9751

Table 6-43. Summary of the Calculated CL values applicable for intact and degraded configurations of the codisposal WP containing various DOE SNF types

DOE SNF Group	Subset	Trend Parameter	Test for Normality	Applied Calculational Method	CL or CL Function
LWBR	Intact Non-moderated	None	Failed	DFTL	CL = 0.9816
	Degraded Moderated	None	Failed	DFTL	CL = 0.9748
	Degraded Non-Moderated	None	Failed	DFTL	CL = 0.9723
N-reactor	Intact Moderated	AENCF	N/A	CLREG code (LUTB)	CL = 0.0765 * AENCF + 0.9434 for 0 < AENCF < 0.175 CL = 0.9568 for AENCF > 0.175
	Degraded Moderated	None	Failed	DFTL	CL = 0.9748
TMI	Intact Moderated	None	Failed	DFTL	CL = 0.9724
	Degraded Moderated	AENCF	N/A	CLREG code (LUTB)	CL= 0.9776 for 0.0142 < AENCF < 0.05186 CL = -0.0252 * AENCF + 0.9789 for 0.05186 < AENCF < 0.3

7. REFERENCES

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8. ATTACHMENTS

Attachment I: One Compact Disk (CD) containing MCNP and CLREG input and output files and the Excel spreadsheets used in the calculation process.

Attachment II: Contains tables with k_{eff} values for each benchmark experiment used as input for this calculation. The tables describe, for each subset of benchmark experiments applicable to a certain DOE SNF group, the benchmark k_{eff} value and its uncertainty and the corresponding MCNP calculated k_{eff} value and uncertainty (76 pages).

Attachment III: Description of MCNP, CLREG files and Excel spreadsheets contained in Attachment I (3 pages).

ATTACHMENT II

This attachment provides the detailed k_{eff} values for all benchmark experiments used as input in CL calculation. The experiments are grouped in subsets that are applicable to a specific configuration class within each DOE SNF fuel group. The data are listed in individual tables for each subset.

k_{eff} Values for Benchmark Experiments Applicable to Configurations of the Codisposal Waste Package Containing HEU Oxide (Shippingport PWR) DOE SNF

Table II-1. k_{eff} Values for Benchmarks Applicable to Intact Moderated Configurations for Shippingport PWR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment HEU-MET-THERM-006 (23 cases)	spert1	1.0000	0.004	0.99792	0.00184	0.0147
	spert2	1.0000	0.004	0.99952	0.0019	0.0126
	spert3	1.0000	0.004	1.00676	0.00114	0.0117
	spert4	1.0000	0.004	0.99542	0.00173	0.011
	spert5	1.0000	0.004	1.00104	0.00162	0.0105
	spert6	1.0000	0.004	1.00133	0.00168	0.0102
	spert7	1.0000	0.004	0.99923	0.00163	0.0097
	spert8	1.0000	0.004	0.99843	0.00154	0.0098
	spert9	1.0000	0.004	1.00003	0.00143	0.0099
	spert10	1.0000	0.004	1.00608	0.00177	0.0147
	spert11	1.0000	0.004	1.00565	0.00163	0.0115
	spert12	1.0000	0.004	1.00676	0.00156	0.0101
	spert13	1.0000	0.004	1.03289	0.00181	0.0143
	spert14	1.0000	0.004	0.99451	0.00158	0.0106
	spert15	1.0000	0.004	0.99355	0.00107	0.0106
	spert16	1.0000	0.004	1.00791	0.00175	0.012
	spert17	1.0000	0.004	1.00569	0.00188	0.0131
	spert18	1.0000	0.004	1.00028	0.00198	0.014
	spert19	1.0000	0.004	0.99482	0.00148	0.0097
	spert20	1.0000	0.004	0.99652	0.00158	0.0114
	spert21	1.0000	0.004	1.00113	0.00186	0.0126
	spert22	1.0000	0.004	1.00272	0.00194	0.0133
	spert23	1.0000	0.004	1.00695	0.0011	0.0132
Experiment HEU-COMP-THERM-003 (15 cases)	hct3-1	1.0000	0.0044	0.99381	0.00136	0.0467
	hct3-2	1.0000	0.0044	0.99746	0.00144	0.0404
	hct3-3	1.0000	0.0044	0.99637	0.00144	0.0337
	hct3-4	1.0000	0.0044	0.99796	0.00148	0.0259
	hct3-5	1.0000	0.0044	1.00253	0.00137	0.0202
	hct3-6	1.0000	0.0044	1.00616	0.00152	0.0405
	hct3-7	1.0000	0.0044	1.01132	0.00143	0.0339

Table II-1. k_{eff} Values for Benchmarks Applicable to Intact Moderated Configurations for Shippingport PWR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	hct3-8	1.0000	0.0044	1.00988	0.00155	0.0329
	hct3-9	1.0000	0.0044	1.01309	0.00154	0.0263
	hct310	1.0000	0.0044	1.00962	0.0014	0.0209
	hct311	1.0000	0.0044	1.0133	0.0014	0.0177
	hct312	1.0000	0.0044	0.98956	0.00133	0.0265
	hct313	1.0000	0.0044	0.99677	0.00119	0.0139
	hct314	1.0000	0.0044	1.005	0.00157	0.03
	hct315	1.0000	0.0044	1.00775	0.00142	0.0183
Experiment HEU-COMP-THERM-005 (1 case)	hct5-1	1.0000	0.0094	0.98455	0.00128	0.0764
Experiment HEU-COMP-THERM-006 (3 cases)	hct6-t1	1.0000	0.0058	0.98952	0.00137	0.072
	hct6-t2	1.0000	0.002	1.0104	0.0013	0.0232
	hct6-t3	1.0000	0.0048	0.99557	0.00095	0.0104
Experiment HEU-COMP-THERM-007 (3 cases)	hct7-4	1.0000	0.0035	0.99932	0.00164	0.0339
	hct7-5	1.0000	0.0041	0.99492	0.00156	0.0458
	hct7-6	1.0000	0.0043	0.99487	0.00154	0.0475
Experiment HEU-COMP-THERM-008 (2 cases)	hct8-1	1.0000	0.0055	0.99042	0.00106	0.0882
	hct8-2	1.0000	0.0056	0.98954	0.00112	0.0922
Experiment HEU-COMP-THERM-010 (21cases)	hct101	1.0000	0.005	0.98716	0.00118	0.0797
	hct102	1.0000	0.005	0.98361	0.00115	0.0797
	hct103	1.0000	0.005	0.99328	0.00125	0.0557
	hct104	1.0000	0.005	0.99468	0.00125	0.0431
	hct105	1.0000	0.005	0.99734	0.00119	0.036
	hct106	1.0000	0.005	0.99239	0.00121	0.0361
	hct107	1.0000	0.005	0.99976	0.00105	0.0308
	hct108	1.0000	0.005	0.9991	0.00122	0.0315
	hct109	1.0000	0.005	0.99777	0.00109	0.0314
	hct110	1.0000	0.005	1.00198	0.00104	0.0287
	hct111	1.0000	0.005	0.99913	0.00109	0.0291
	hct112	1.0000	0.005	1.00052	0.00105	0.0262
	hct113	1.0000	0.005	1.00237	0.001	0.025
	hct114	1.0000	0.005	1.00112	0.00112	0.0281
	hct115	1.0000	0.005	1.00059	0.00113	0.0289
	hct116	1.0001	0.0044	1.00378	0.00114	0.0289
	hct117	1.0010	0.0074	1.00377	0.0011	0.0293
	hct118	1.0000	0.0074	1.0018	0.00117	0.0287
	hct119	1.0000	0.0074	1.00151	0.00105	0.0295
	hct120	1.0001	0.0047	1.0024	0.001	0.0234
	hct121	0.9997	0.0076	1.00416	0.0011	0.0278
Experiment HEU-COMP-THERM-011 (3 cases)	hct11_1	0.9988	0.0042	0.9868	0.00094	0.05331
	hct11_2	0.9988	0.0043	0.98753	0.00093	0.05027
	hct11_3	0.9988	0.0044	0.98806	0.00095	0.04698
	hct12_1	0.9987	0.0032	0.98578	0.001	0.05512

Table II-1. k_{eff} Values for Benchmarks Applicable to Intact Moderated Configurations for Shippingport PWR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment HEU-COMP-THERM-012 (2 cases)	hct12_1	0.9987	0.0032	0.98578	0.001	0.05512
	hct12_2	0.9987	0.0034	0.98948	0.00088	0.05089
Experiment HEU-COMP-THERM-013 (2 cases)	hct13_1	0.9988	0.0042	0.98828	0.00084	0.04811
	hct13_2	0.9988	0.0043	0.99016	0.00091	0.0432
Experiment HEU-COMP-THERM-014 (2 cases)	hct14_1	0.9986	0.0048	0.99761	0.00088	0.02589
	hct14_2	0.9986	0.0049	0.99704	0.00081	0.02266

Source: BSC 2002a, Table 6-1

Table II-2. k_{eff} Values for Benchmarks Applicable to Intact Non-moderated Configurations for Shippingport PWR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment HEU-COMP-INTER-002 (also HEU-COMP-MIXED-004) (5 cases)	hci2-1	1.0000	0.0004	0.99236	0.00081	0.243
	hci2-2	1.0000	0.0004	0.99339	0.00107	0.2439
	hci2-3	1.0000	0.0004	0.99603	0.00101	0.2377
	hci2-4	1.0000	0.0004	0.99676	0.00101	0.2394
	hci2-5	1.0000	0.0004	0.99736	0.001	0.2391
Experiment HEU-MET-FAST-007 (43 cases)	hmf7_01	0.9971	0.0001	0.9941	0.0013	1.5855
	hmf7_02	0.9986	0.0001	0.9943	0.0013	1.4036
	hmf7_03	1.0012	0.0001	0.9929	0.0015	1.3617
	hmf7_04	0.997	0.0001	0.9916	0.0015	1.3232
	hmf7_05	1.0000	0.0001	0.9909	0.0016	1.253
	hmf7_06	1.0028	0.0001	0.9995	0.0014	1.223
	hmf7_07	0.9996	0.0001	0.9945	0.0014	1.2195
	hmf7_08	0.9992	0.0001	0.9898	0.0014	1.2156
	hmf7_09	1.0017	0.0008	1.0003	0.0016	1.2192
	hmf7_10	1.0000	0.0001	0.9908	0.0019	0.9503
	hmf7_11	0.9982	0.0001	0.9887	0.0021	0.7392
	hmf7_12	0.9951	0.0001	0.9865	0.0015	0.7036
	hmf7_13	1.0009	0.0001	0.9956	0.0018	0.743
	hmf7_14	0.9983	0.0001	0.9891	0.0018	0.7021
	hmf7_15	0.9978	0.0001	0.9924	0.0019	0.7483
	hmf7_16	0.9988	0.0001	0.9911	0.0019	0.7497
	hmf7_17	0.9972	0.0001	0.9886	0.0021	0.521
	hmf7_18	0.9991	0.0001	0.9936	0.002	0.5176
	hmf7_19	0.9983	0.0001	0.9971	0.0014	1.5781
	hmf7_20	0.9981	0.0001	0.989	0.0015	1.264
	hmf7_21	0.9987	0.0001	0.9938	0.0014	1.2465
	hmf7_22	0.9994	0.0001	0.9935	0.0016	1.2323
	hmf7_23	0.9993	0.0001	0.9937	0.0014	1.1298
	hmf7_24	1.0001	0.0001	0.995	0.0017	1.1177

Table II-2. k_{eff} Values for Benchmarks Applicable to Intact Non-moderated Configurations for Shippingport PWR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	hmf7_25	0.999	0.0001	0.9921	0.0018	1.0153
	hmf7_26	0.9997	0.0001	0.9894	0.0016	1.0067
	hmf7_27	0.9965	0.0002	0.9916	0.0014	1.3907
	hmf7_28	0.9987	0.0002	0.9913	0.0016	1.2784
	hmf7_29	0.9978	0.0002	0.9934	0.0015	1.1714
	hmf7_30	0.9981	0.0002	0.9936	0.0018	0.8973
	hmf7_31	1.0013	0.0002	0.9967	0.002	0.6162
	hmf7_32	0.9959	0.0001	0.9968	0.0013	1.4869
	hmf7_33	0.9995	0.0001	1.0061	0.0015	1.4324
	hmf7_34	0.9977	0.0001	1.0058	0.0014	1.3814
	hmf7_35	1.0011	0.0001	0.9894	0.0019	1.013
	hmf7_36	0.9999	0.0001	0.9976	0.0017	0.8594
	hmf7_37	0.9988	0.0001	0.9959	0.002	0.7462
	hmf7_38	1.0000	0.0001	0.9996	0.0017	0.7181
	hmf7_39	1.0018	0.0001	1.0009	0.0016	0.7182
	hmf7_40	1.0013	0.0001	0.9976	0.0019	0.7339
	hmf7_41	0.9994	0.0001	0.9968	0.0019	0.5383
	hmf7_42	1.0016	0.0001	0.9979	0.0017	0.5269
	hmf7_43	0.9998	0.0001	0.999	0.0018	0.3145
Experiment HEU-MET-FAST-030 (1 case)	hmf030	1.0000	0.0009	0.9999	0.0005	1.129
Experiment HEU-MET-FAST-033 (2 cases)	heumf33c1	0.9991	0.0014	0.994	0.0004	0.85
	heumf33c2	0.9991	0.0014	0.9924	0.0004	0.717
Experiment HEU-MET-FAST-034 (3 cases)	heumf34c1	0.999	0.0012	0.9913	0.0004	0.958
	heumf34c2	0.999	0.0012	0.991	0.0004	0.958
	heumf34c3	0.999	0.0012	0.9929	0.0004	0.953
Experiment HEU-MET-FAST-036 (2 cases)	heumf36c1	0.9993	0.0015	0.9932	0.0004	0.866
	heumf36c2	0.9993	0.0013	0.9938	0.0004	1.097
Experiment HEU-MET-FAST-037 (2 cases)	heumf37c1	0.9997	0.0011	0.9966	0.0004	0.896
	heumf37c2	0.9997	0.0011	0.9931	0.0004	1.02
Experiment HEU-MET-FAST-038 (1 case)	heumf38c1	0.9999	0.0015	1.0012	0.0004	1.139
HEU-MET-INTER-006 (2 cases)	hmi06-01	0.9976	0.0008	0.9967	0.0003	0.342
	hmi06-02	0.9997	0.0008	0.9984	0.0003	0.386
HEU-MET-MIXED-001 (1 case)	heumm1c1	0.9995	0.0013	1.0044	0.0004	0.762
HEU-MET-MIXED-004 (1 case)	heumm4c1	0.9999	0.0009	1.0048	0.0004	0.914
HEU-COMP-INTER-001 (1 case)	heuci1c5	1.0000	0	0.9951	0.0008	0.22
HEU-MET-MIXED-005 (5 cases)	hmm5_1	1.0007	0.0027	1.01308	0.00057	0.307
	hmm5_2	1.0003	0.0028	1.0217	0.00055	0.247
	hmm5_3	1.0012	0.0029	1.01904	0.00052	0.212

Table II-2. k_{eff} Values for Benchmarks Applicable to Intact Non-moderated Configurations for Shippingport PWR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	hmm5_4	1.0016	0.003	1.0145	0.0006	0.3175
	hmm5_5	1.0005	0.004	1.00682	0.00052	0.377

Source: BSC2002a, Table 6-2

Table II-3. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for Shippingport PWR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment HEU-SOL-THERM-001 (10 cases)	hest1-1	1.0000	0.0025	1.00241	0.00131	0.01582
	hest1-2	1.0000	0.0025	0.99816	0.00209	0.03873
	hest1-3	1.0000	0.0025	1.00453	0.00199	0.01546
	hest1-4	1.0000	0.0025	1.0013	0.00203	0.0405
	hest1-5	1.0000	0.0025	1.00361	0.00166	0.00651
	hest1-6	1.0000	0.0025	1.01038	0.00187	0.00678
	hest1-7	1.0000	0.0025	1.0023	0.00201	0.01501
	hest1-8	1.0000	0.0025	1.00505	0.00213	0.0161
	hest1-9	1.0000	0.0025	0.99973	0.00212	0.04099
	hest110	1.0000	0.0025	0.99468	0.00178	0.00757
Experiment HEU-SOL-THERM-002 (14 cases)	hest2-1	1.0000	0.002	1.00548	0.00148	0.01558
	hest2-2	1.0000	0.002	1.00773	0.00235	0.01516
	hest2-3	1.0000	0.002	1.00219	0.0022	0.0374
	hest2-4	1.0000	0.002	1.00809	0.00242	0.03541
	hest2-5	1.0000	0.002	1.01049	0.0023	0.01622
	hest2-6	1.0000	0.002	1.00968	0.00215	0.01496
	hest2-7	1.0000	0.002	1.00691	0.00224	0.03747
	hest2-8	1.0000	0.002	1.01131	0.00206	0.03511
	hest2-9	1.0000	0.002	1.00348	0.00209	0.00654
	hest2-10	1.0000	0.002	1.00937	0.00202	0.00663
	hest2-11	1.0000	0.002	1.00875	0.00211	0.01595
	hest2-12	1.0000	0.002	1.0127	0.00209	0.01487
	hest2-13	1.0000	0.002	0.99869	0.00232	0.03676
	hest2-14	1.0000	0.002	1.01062	0.00238	0.03377
Experiment HEU-SOL-THERM-003 (19 cases)	heust31	1.0000	0.005	1.00638	0.00189	0.00676
	heust32	1.0000	0.005	1.00635	0.002	0.00688
	heust33	1.0000	0.005	1.00317	0.00235	0.0158
	heust34	1.0000	0.005	1.00447	0.00249	0.01541
	heust35	1.0000	0.005	1.00436	0.00221	0.03818
	heust36	1.0000	0.005	1.00427	0.00241	0.03573
	heust37	1.0000	0.005	1.00585	0.00173	0.00685
	heust38	1.0000	0.005	1.01086	0.00202	0.01639

Table II-3. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for Shippingport PWR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	heust39	1.0000	0.005	1.01063	0.00204	0.01512
	hest310	1.0000	0.005	1.00102	0.00243	0.03817
	hest311	1.0000	0.005	1.00606	0.00232	0.03566
	hest312	1.0000	0.005	1.0074	0.00204	0.00651
	hest313	1.0000	0.005	1.00045	0.00185	0.00654
	hest314	1.0000	0.005	1.00822	0.00205	0.00704
	hest315	1.0000	0.005	0.99675	0.0015	0.00704
	hest316	1.0000	0.005	1.00356	0.00241	0.01593
	hest317	1.0000	0.005	1.00604	0.00213	0.01498
	hest318	1.0000	0.005	1.00007	0.00225	0.03842
	hest319	1.0000	0.005	1.01306	0.00225	0.03414
Experiment HEU-SOL-THERM-005 (17 cases)	heust5c1	1.0000	0.0124	1.0007	0.0011	0.035
	heust5c10	1.0000	0.0124	0.9947	0.0013	0.04
	heust5c11	1.0000	0.0083	0.9885	0.0012	0.032
	heust5c12	1.0000	0.0084	1.0201	0.0013	0.034
	heust5c13	1.0000	0.0119	1.0028	0.0012	0.021
	heust5c14	1.0000	0.0058	0.991	0.0012	0.019
	heust5c15	1.0000	0.0059	1.0115	0.0014	0.02
	heust5c16	1.0000	0.0121	1.0068	0.0011	0.011
	heust5c17	1.0000	0.0057	0.9926	0.0013	0.011
	heust5c2	1.0000	0.0124	0.988	0.0012	0.041
	heust5c3	1.0000	0.0124	1.0128	0.0012	0.036
	heust5c4	1.0000	0.0126	1.0128	0.0012	0.036
	heust5c5	1.0000	0.0124	0.9937	0.0012	0.039
	heust5c6	1.0000	0.0124	1.0082	0.0012	0.036
	heust5c7	1.0000	0.0124	1.0048	0.0012	0.033
	heust5c8	1.0000	0.0124	0.9914	0.0013	0.04
	heust5c9	1.0000	0.0125	1.007	0.0011	0.035
Experiment HEU-SOL-THERM-006 (29 cases)	heust6c1	0.9973	0.005	0.987	0.0015	0.033
	heust6c10	1.0000	0.0065	1.002	0.0013	0.037
	heust6c11	1.0000	0.0088	1.0023	0.0011	0.042
	heust6c12	0.9973	0.005	0.9857	0.0014	0.032
	heust6c13	0.998	0.0054	0.9904	0.0014	0.035
	heust6c14	1.0000	0.0078	1.0027	0.0013	0.039
	heust6c15	1.0000	0.0091	1.0093	0.0011	0.041
	heust6c16	1.0000	0.0087	1.0032	0.0012	0.042
	heust6c17	1.0000	0.0088	1.0034	0.0012	0.042
	heust6c18	1.0000	0.0078	1.0047	0.0012	0.039
	heust6c19	1.0000	0.0091	1.0115	0.0011	0.04
	heust6c2	0.9986	0.0054	0.9907	0.0014	0.036
	heust6c20	1.0000	0.0087	1.0027	0.0012	0.041
	heust6c21	1.0000	0.0088	1.0009	0.0011	0.042
	heust6c22	1.0000	0.0065	1.0027	0.0014	0.038

Table II-3. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for Shippingport PWR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	heust6c23	1.0000	0.0078	1.0032	0.0013	0.039
	heust6c24	1.0000	0.0091	1.0089	0.0012	0.04
	heust6c25	1.0000	0.0087	1.001	0.0011	0.042
	heust6c26	1.0000	0.0088	1.0019	0.0011	0.042
	heust6c27	0.9973	0.005	0.9853	0.0014	0.032
	heust6c28	0.9986	0.0054	0.9895	0.0014	0.036
	heust6c29	1.0000	0.0088	1.0038	0.0011	0.042
	heust6c3	1.0000	0.0065	1.002	0.0013	0.037
	heust6c4	1.0000	0.0078	1.0033	0.0012	0.04
	heust6c5	1.0000	0.0091	1.0115	0.0011	0.041
	heust6c6	1.0000	0.0087	1.002	0.0012	0.042
	heust6c7	1.0000	0.0088	1.0011	0.0011	0.043
	heust6c8	0.9973	0.005	0.9832	0.0014	0.032
	heust6c9	0.9986	0.0054	0.9904	0.0013	0.035
Experiment HEU-SOL-THERM-009 (4 cases)	heust9c1	1.0000	0.0057	1.0051	0.0006	0.058
	heust9c2	1.0000	0.0057	1.0045	0.0006	0.045
	heust9c3	1.0000	0.0057	1.0047	0.0007	0.029
	heust9c4	1.0000	0.0057	0.9994	0.0007	0.018
Experiment HEU-SOL-THERM-010 (4 cases)	heust10c1	1.0000	0.0018	1.005	0.0007	0.009
	heust10c2	1.0000	0.0018	1.0049	0.0006	0.009
	heust10c3	1.0000	0.0018	1.0026	0.0006	0.01
	heust10c4	1.0000	0.0018	0.9999	0.0007	0.01
Experiment HEU-SOL-THERM-012 (1 case)	heust12	0.9999	0.0058	1.0027	0.0005	0.0027
Experiment HEU-SOL-THERM-011 (2 cases)	heust11c1	1.0000	0.0018	1.0086	0.0005	0.005
	heust11c2	1.0000	0.002	1.0044	0.0005	0.005
Experiment HEU-SOL-THERM-027 (9 cases)	hst27_1	1.0000	0.0046	1.00009	0.00099	0.015
	hst27_2	1.0000	0.0043	1.00204	0.00106	0.015
	hst27_3	1.0000	0.0037	1.00171	0.00101	0.015
	hst27_4	1.0000	0.0037	1.00394	0.00097	0.015
	hst27_5	1.0000	0.0044	1.00241	0.001	0.015
	hst27_6	1.0000	0.0043	0.99517	0.001	0.014
	hst27_7	1.0000	0.0038	1.00003	0.00102	0.015
	hst27_8	1.0000	0.0035	1.0026	0.00103	0.014
	hst27_9	1.0000	0.0039	1.00098	0.00103	0.015
Experiment HEU-SOL-THERM-028 (18 cases)	hst28_1	1.0000	0.0023	1.00234	0.00086	0.007
	hst28_2	1.0000	0.0034	1.00156	0.00082	0.008
	hst28_3	1.0000	0.0026	1.00102	0.00085	0.007
	hst28_4	1.0000	0.0028	1.00236	0.00087	0.008
	hst28_5	1.0000	0.0031	0.99733	0.00092	0.008
	hst28_6	1.0000	0.0023	1.00141	0.00086	0.008
	hst28_7	1.0000	0.0038	1.00259	0.0009	0.007
	hst28_8	1.0000	0.0027	1.00111	0.00086	0.008

Table II-3. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for Shippingport PWR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	hst28_9	1.0000	0.0049	1.00008	0.00095	0.026
	hst28_10	1.0000	0.0053	0.99653	0.00091	0.026
	hst28_11	1.0000	0.0052	1.00188	0.00102	0.026
	hst28_12	1.0000	0.0046	0.99633	0.00096	0.027
	hst28_13	1.0000	0.0058	0.99826	0.00097	0.026
	hst28_14	1.0000	0.0046	0.99993	0.00092	0.027
	hst28_15	1.0000	0.0064	1.00725	0.00095	0.027
	hst28_16	1.0000	0.0052	1.00292	0.00096	0.027
	hst28_17	1.0000	0.0066	0.99727	0.00095	0.027
	hst28_18	1.0000	0.006	0.99794	0.00096	0.027
Experiment HEU-SOL-THERM-029 (7 cases)	hst29_1	1.0000	0.0066	1.00095	0.001	0.028
	hst29_2	1.0000	0.0058	1.00562	0.00097	0.027
	hst29_3	1.0000	0.0068	0.99616	0.00094	0.028
	hst29_4	1.0000	0.0074	0.99727	0.00097	0.028
	hst29_5	1.0000	0.0067	1.00111	0.00098	0.029
	hst29_6	1.0000	0.0065	1.00159	0.00097	0.029
	hst29_7	1.0000	0.0063	1.00199	0.001	0.028
Experiment HEU-SOL-THERM-030 (7 cases)	hst30_1	1.0000	0.0039	1.00043	0.0009	0.008
	hst30_2	1.0000	0.0032	1.00205	0.00087	0.008
	hst30_3	1.0000	0.0031	0.99961	0.00083	0.008
	hst30_4	1.0000	0.0064	1.00322	0.00099	0.028
	hst30_5	1.0000	0.0058	0.99887	0.00095	0.027
	hst30_6	1.0000	0.0059	1.00262	0.001	0.028
	hst30_7	1.0000	0.0064	1.00028	0.00097	0.028
Experiment HEU-SOL-THERM-031 (4 cases)	hst31_1	1.0000	0.0046	1.0165	0.00093	0.028
	hst31_2	1.0000	0.0058	1.04116	0.00091	0.029
	hst31_3	1.0000	0.0058	1.00109	0.00092	0.029
	hst31_4	1.0000	0.0068	1.00745	0.00098	0.031
Experiment HEU-SOL-THERM-032 (1 case)	heust032	1.0015	0.0026	1.0001	0.0004	0.0021
Experiment HEU-SOL-THERM-033 (26 cases)	hst33d_02a	1.0000	0.0111	1.00007	0.00128	0.036
	hst33d_02b	1.0000	0.0108	0.99792	0.00113	0.036
	hst33d_02c	1.0000	0.0065	0.99796	0.00119	0.036
	hst33d_03a	1.0000	0.0114	1.00634	0.00108	0.033
	hst33d_03b	1.0000	0.0111	1.00608	0.00115	0.034
	hst33d_03c	1.0000	0.007	1.01079	0.00118	0.032
	hst33d_04a	1.0000	0.0114	1.0057	0.00109	0.035
	hst33d_04b	1.0000	0.0111	1.0116	0.00117	0.035
	hst33d_05a	1.0000	0.0111	1.01126	0.00114	0.035
	hst33d_05b	1.0000	0.0108	1.00608	0.00128	0.035
	hst33d_06a	1.0000	0.0111	1.00936	0.00112	0.035
	hst33d_06b	1.0000	0.0108	1.00915	0.00114	0.034
	hst33d_07a	1.0000	0.0111	1.00453	0.00107	0.035

Table II-3. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for Shippingport PWR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	hst33d_07b	1.0000	0.0108	1.00406	0.00109	0.035
	hst33d_08a	1.0000	0.0111	1.00558	0.00113	0.034
	hst33d_08b	1.0000	0.0108	1.00213	0.00111	0.035
	hst33d_09a	1.0000	0.0111	1.00228	0.00115	0.036
	hst33d_09b	1.0000	0.0108	0.99359	0.00113	0.035
	hst33d_09c	1.0000	0.0104	0.99619	0.00116	0.036
	hst33d_10a	1.0000	0.0114	1.00267	0.00113	0.034
	hst33d_10c	1.0000	0.007	1.00333	0.00103	0.032
	hst33d_10d	1.0000	0.0104	0.99286	0.00111	0.033
	hst33d_11a	1.0000	0.0111	1.00669	0.0011	0.035
	hst33d_11b	1.0000	0.0108	1.00176	0.00097	0.034
	hst33d_12a	1.0000	0.0111	1.00386	0.00112	0.036
	hst33d_12b	1.0000	0.0108	1.00165	0.00107	0.035
Experiment HEU-SOL-THERM-035 (9 cases)	hst35_1	1.0000	0.0031	1.0049	0.00073	0.004
	hst35_2	1.0000	0.0032	1.00859	0.00068	0.004
	hst35_3	1.0000	0.003	1.00832	0.00072	0.004
	hst35_4	1.0000	0.003	1.00757	0.0007	0.004
	hst35_5	1.0000	0.0033	1.00565	0.00087	0.008
	hst35_6	1.0000	0.0029	1.00828	0.00089	0.008
	hst35_7	1.0000	0.0035	1.00811	0.00095	0.015
	hst35_8	1.0000	0.0038	1.0048	0.00095	0.016
	hst35_9	1.0000	0.0041	1.00486	0.00095	0.016
Experiment HEU-SOL-THERM-036 (4 cases)	hst36_1	0.9974	0.0045	0.9989	0.0009	0.01
	hst36_2	0.9979	0.0039	1.0044	0.001	0.011
	hst36_3	0.9993	0.0044	0.9995	0.0009	0.012
	hst36_4	1.0000	0.0062	1.0008	0.0009	0.012
Experiment HEU-SOL-THERM-037 (9 cases)	hst37_1	0.9980	0.0034	1.0129	0.0011	0.005
	hst37_2	0.9990	0.0035	1.0048	0.0011	0.005
	hst37_3	0.9970	0.0042	1.0096	0.0012	0.007
	hst37_4	0.9980	0.0035	1.0141	0.0012	0.007
	hst37_5	0.9980	0.0042	1.0089	0.0011	0.007
	hst37_6	0.9960	0.0051	1.0172	0.0013	0.009
	hst37_7	0.9980	0.0034	1.0162	0.0012	0.009
	hst37_8	0.9980	0.004	1.0125	0.0013	0.009
	hst37_9	0.9980	0.0047	1.008	0.0012	0.009
Experiment HEU-SOL-THERM-043 (3 cases)	heust43c1	0.9986	0.0017	0.9995	0.0007	0.014
	heust43c2	0.9995	0.0041	1.0082	0.0004	0.003
	heust43c3	0.9990	0.0044	1.0033	0.0004	0.003

Source: BSC2002a, Table 6-3

Table II-4. k_{eff} Values for Benchmarks Applicable to Degraded Non-moderated Configurations for Shippingport PWR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment HEU-MET-THERM-003 (7 cases)	heumt3c1	1.0000	0.001	1.0039	0.0008	1.094
	heumt3c2	0.9910	0.003	0.9832	0.0008	1.091
	heumt3c3	0.9826	0.006	0.9766	0.0008	0.548
	heumt3c4	0.9876	0.004	0.9842	0.0009	0.444
	heumt3c5	0.9930	0.003	1.0014	0.0009	0.222
	heumt3c6	0.9889	0.003	0.9719	0.0009	0.291
	heumt3c7	0.9919	0.003	0.9887	0.0008	0.231
Experiment HEU-MET-MIXED-002 (1 case)	heumm2c1	1.0000	0.0037	1.0032	0.0007	0.788
Experiment HEU-MET-MIXED-003 (1 case)	heumm3c1	1.0000	0.0038	1.0039	0.0008	0.784
Experiment HEU-MET-FAST-002 (6 cases)	heumf2-1	1.0000	0.003	1.0024	0.0011	1.599
	heumf2-2	1.0000	0.003	1.0034	0.0011	1.597
	heumf2-3	1.0000	0.003	1.002	0.001	1.592
	heumf2-4	1.0000	0.003	1.0041	0.001	1.583
	heumf2-5	1.0000	0.003	1.0039	0.001	1.579
	heumf2-6	1.0000	0.003	1.0028	0.0011	1.583
Experiment HEU-MET-FAST-004 (1 case)	heumf4c2	0.9985	0.0008	1.0017	0.0007	1.166
Experiment HEU-MET-FAST-008 (1 case)	HMF8	0.9989	0.0016	0.9951	0.00058	1.5501
Experiment HEU-MET-FAST-011 (1 case)	HMF11	0.9989	0.0015	0.99348	0.00079	1.1607
Experiment HEU-MET-FAST-012 (1 case)	HMF12	0.9992	0.0018	0.99399	0.00043	1.5237
Experiment HEU-MET-FAST-013 (1 case)	HMF13	0.999	0.0015	0.99997	0.00061	1.4838
Experiment HEU-MET-FAST-014 (1 case)	HMF14	0.9989	0.0017	0.99831	0.00062	1.5465
Experiment HEU-MET-FAST-015 (1 case)	HMF15	0.9996	0.0017	0.99263	0.00056	1.5813
Experiment HEU-MET-FAST-018 (1 case)	HMF18	1.0000	0.0014	0.99805	0.00056	1.5515
Experiment HEU-MET-FAST-019 (1 case)	HMF19	1.0000	0.0028	1.00277	0.0006	1.4793
Experiment HEU-MET-FAST-020 (1 case)	HMF20	1.0000	0.0028	0.99574	0.00061	1.4341
Experiment HEU-MET-FAST-021 (1 case)	HMF21	1.0000	0.0024	1.00192	0.0006	1.4431
Experiment HEU-MET-FAST-022 (1 case)	HMF22	1.0000	0.0019	0.99272	0.0006	1.5049
Experiment HEU-MET-FAST-024 (1 case)	HMF24	0.9990	0.0015	0.99521	0.00109	1.2553

Table II-4. k_{eff} Values for Benchmarks Applicable to Degraded Non-moderated Configurations for Shippingport PWR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment HEU-MET-FAST-027 (1 case)	heumf27c1	1.0000	0.0025	1.0098	0.0006	1.512
Experiment HEU-MET-FAST-029 (1 case)	heumf29c1	1.0000	0.002	1.0038	0.0006	1.547
Experiment HEU-MET-FAST-031 (1 case)	heumf31c1	1.0000	0.0059	0.9964	0.0007	0.966
Experiment HEU-MET-FAST-032 (4 cases)	heumf32c1	1.0000	0.0016	1.0054	0.0007	1.592
	heumf32c2	1.0000	0.0027	1.0057	0.0006	1.59
	heumf32c3	1.0000	0.0017	0.9992	0.0006	1.575
	heumf32c4	1.0000	0.0017	0.9994	0.0006	1.565
Experiment HEU-MET-FAST-041 (6 cases)	heumf41c1	1.0013	0.003	0.9991	0.0007	1.331
	heumf41c2	1.0022	0.0043	0.9973	0.0007	1.128
	heumf41c3	1.0006	0.0029	0.9984	0.0006	1.466
	heumf41c4	1.0006	0.0025	1.0009	0.0007	1.402
	heumf41c5	1.0006	0.0031	0.9966	0.0008	1.354
	heumf41c6	1.0006	0.0045	0.9993	0.0007	1.315
Experiment HEU-MET-FAST-055 (1 case)	hmf055	0.9977	0.0003	0.9938	0.0003	1.077
HEU-MET-MIXED-005 (5 cases)	hmm5_1	1.0007	0.0027	1.01308	0.00057	0.307
	hmm5_2	1.0003	0.0028	1.0217	0.00055	0.247
	hmm5_3	1.0012	0.0029	1.01904	0.00052	0.212
	hmm5_4	1.0016	0.003	1.0145	0.0006	0.3175
	hmm5_5	1.0005	0.004	1.00682	0.00052	0.377

Source: BSC2002a, Table 6-4

k_{eff} Values for Benchmark Experiments Applicable to Configurations of the Codisposal Waste Package Containing UZrH (TRIGA) DOE SNF

Table II-5. k_{eff} Values for Benchmarks Applicable to Intact Moderated Configurations for TRIGA DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment IEU-COMP-THERM-003 (2 cases)	ieuct3/1	1.0006	0.0056	0.99746	0.00028	0.024
	ieuct3/2	1.0046	0.0056	1.00167	0.00028	0.024
Experiment HEU-COMP-THERM-003 (15 cases)	hct3-1	1.0000	0.0044	0.99381	0.00136	0.0467
	hct3-2	1.0000	0.0044	0.99746	0.00144	0.0404
	hct3-3	1.0000	0.0044	0.99637	0.00144	0.0337
	hct3-4	1.0000	0.0044	0.99796	0.00148	0.0259
	hct3-5	1.0000	0.0044	1.00253	0.00137	0.0202
	hct3-6	1.0000	0.0044	1.00616	0.00152	0.0405

Table II-5. k_{eff} Values for Benchmarks Applicable to Intact Moderated Configurations for TRIGA DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	hct3-7	1.0000	0.0044	1.01132	0.00143	0.0339
	hct3-8	1.0000	0.0044	1.00988	0.00155	0.0329
	hct3-9	1.0000	0.0044	1.01309	0.00154	0.0263
	hct310	1.0000	0.0044	1.00962	0.0014	0.0209
	hct311	1.0000	0.0044	1.0133	0.0014	0.0177
	hct312	1.0000	0.0044	0.98956	0.00133	0.0265
	hct313	1.0000	0.0044	0.99677	0.00119	0.0139
	hct314	1.0000	0.0044	1.005	0.00157	0.03
	hct315	1.0000	0.0044	1.00775	0.00142	0.0183
Experiment HEU-COMP-THERM-004 (4 cases)	hct4-1	1.0000	0.0038	0.98756	0.00122	0.0744
	hct4-2	1.0000	0.0039	0.9889	0.0012	0.0736
	hct4-3	1.0000	0.0037	0.99157	0.00119	0.0756
	hct4-4	1.0000	0.0038	0.99116	0.00114	0.0742
Experiment HEU-COMP-THERM-005 (1 case)	hct5-1	1.0000	0.0094	0.98455	0.00128	0.0764
Experiment HEU-COMP-THERM-006 (3 cases)	hct6-t1	1.0000	0.0058	0.98952	0.00137	0.072
	hct6-t2	1.0000	0.002	1.0104	0.0013	0.0232
	hct6-t3	1.0000	0.0048	0.99557	0.00095	0.0104
Experiment HEU-COMP-THERM-007 (3 cases)	hct7-4	1.0000	0.0035	0.99932	0.00164	0.0339
	hct7-5	1.0000	0.0041	0.99492	0.00156	0.0458
	hct7-6	1.0000	0.0043	0.99487	0.00154	0.0475
Experiment HEU-COMP-THERM-008 (2 cases)	hct8-1	1.0000	0.0055	0.99042	0.00106	0.0882
	hct8-2	1.0000	0.0056	0.98954	0.00112	0.0922
Experiment HEU-COMP-THERM-010 (21cases)	hct101	1.0000	0.005	0.98716	0.00118	0.0797
	hct102	1.0000	0.005	0.98361	0.00115	0.0797
	hct103	1.0000	0.005	0.99328	0.00125	0.0557
	hct104	1.0000	0.005	0.99468	0.00125	0.0431
	hct105	1.0000	0.005	0.99734	0.00119	0.036
	hct106	1.0000	0.005	0.99239	0.00121	0.0361
	hct107	1.0000	0.005	0.99976	0.00105	0.0308
	hct108	1.0000	0.005	0.9991	0.00122	0.0315
	hct109	1.0000	0.005	0.99777	0.00109	0.0314
	hct110	1.0000	0.005	1.00198	0.00104	0.0287
	hct111	1.0000	0.005	0.99913	0.00109	0.0291
	hct112	1.0000	0.005	1.00052	0.00105	0.0262
	hct113	1.0000	0.005	1.00237	0.001	0.025
	hct114	1.0000	0.005	1.00112	0.00112	0.0281
	hct115	1.0000	0.005	1.00059	0.00113	0.0289
	hct116	1.0001	0.0044	1.00378	0.00114	0.0289
	hct117	1.0010	0.0074	1.00377	0.0011	0.0293
	hct118	1.0000	0.0074	1.0018	0.00117	0.0287
	hct119	1.0000	0.0074	1.00151	0.00105	0.0295

Table II-5. k_{eff} Values for Benchmarks Applicable to Intact Moderated Configurations for TRIGA DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	hct120	1.0001	0.0047	1.0024	0.001	0.0234
	hct121	1.0007	0.0076	1.00416	0.0011	0.0278
Experiment HEU-COMP-THERM-011 (3 cases)	hct11_1	0.9988	0.0042	0.9868	0.00094	0.05331
	hct11_2	0.9988	0.0043	0.98753	0.00093	0.05027
	hct11_3	0.9988	0.0044	0.98806	0.00095	0.04698
Experiment HEU-COMP-THERM-012 (2 cases)	hct12_1	0.9987	0.0032	0.98578	0.001	0.05512
	hct12_2	0.9987	0.0034	0.98948	0.00088	0.05089
Experiment HEU-COMP-THERM-013 (2 cases)	hct13_1	0.9988	0.0042	0.98828	0.00084	0.04811
	hct13_2	0.9988	0.0043	0.99016	0.00091	0.0432
Experiment HEU-COMP-THERM-014 (2 cases)	hct14_1	0.9986	0.0048	0.99761	0.00088	0.02589
	hct14_2	0.9986	0.0049	0.99704	0.00081	0.02266
Experiment HEU-MET-THERM-006 (23 cases)	spert1	1.0000	0.004	0.99792	0.00184	0.0147
	spert2	1.0000	0.004	0.99952	0.0019	0.0126
	spert3	1.0000	0.004	1.00676	0.00114	0.0117
	spert4	1.0000	0.004	0.99542	0.00173	0.011
	spert5	1.0000	0.004	1.00104	0.00162	0.0105
	spert6	1.0000	0.004	1.00133	0.00168	0.0102
	spert7	1.0000	0.004	0.99923	0.00163	0.0097
	spert8	1.0000	0.004	0.99843	0.00154	0.0098
	spert9	1.0000	0.004	1.00003	0.00143	0.0099
	spert10	1.0000	0.004	1.00608	0.00177	0.0147
	spert11	1.0000	0.004	1.00565	0.00163	0.0115
	spert12	1.0000	0.004	1.00676	0.00156	0.0101
	spert13	1.0000	0.004	1.03289	0.00181	0.0143
	spert14	1.0000	0.004	0.99451	0.00158	0.0106
	spert15	1.0000	0.004	0.99355	0.00107	0.0106
	spert16	1.0000	0.004	1.00791	0.00175	0.012
	spert17	1.0000	0.004	1.00569	0.00188	0.0131
	spert18	1.0000	0.004	1.00028	0.00198	0.014
	spert19	1.0000	0.004	0.99482	0.00148	0.0097
	spert20	1.0000	0.004	0.99652	0.00158	0.0114
	spert21	1.0000	0.004	1.00113	0.00186	0.0126
	spert22	1.0000	0.004	1.00272	0.00194	0.0133
	spert23	1.0000	0.004	1.00695	0.0011	0.0132
Experiment HEU-COMP-THERM-002 (25 cases)	hct2_1	1.0011	0.0069	1.0095	0.0017	0.02439
	hct2_2	1.0011	0.0069	1.0157	0.0018	0.01948
	hct2_3	1.0011	0.0069	1.0161	0.0017	0.01643
	hct2_4	1.0011	0.0069	1.0186	0.0019	0.01449
	hct2_5	1.0011	0.0069	1.0181	0.0016	0.01295
	hct2_6	1.0011	0.0069	1.0182	0.0016	0.01208
	hct2_7	1.0011	0.0069	1.0171	0.0014	0.01181
	hct2_8	1.0011	0.0069	1.0178	0.0016	0.01054
	hct2_9	1.0011	0.0069	1.0173	0.0013	0.00994

Table II-5. k_{eff} Values for Benchmarks Applicable to Intact Moderated Configurations for TRIGA DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	hct2_10	1.0011	0.0069	1.016	0.0013	0.00986
	hct2_11	1.0011	0.0053	1.0155	0.0018	0.02013
	hct2_12	1.0011	0.0053	1.0171	0.0016	0.01411
	hct2_13	1.0011	0.0053	1.0219	0.0017	0.01249
	hct2_14	1.0011	0.0055	1.0179	0.0017	0.01201
	hct2_15	1.0011	0.0055	1.0181	0.0014	0.01122
	hct2_16	1.0011	0.0055	1.0161	0.0016	0.01024
	hct2_17	1.0011	0.0055	1.0196	0.0013	0.00978
	hct2_18	1.0020	0.0043	1.019	0.0018	0.02096
	hct2_19	1.0020	0.0043	1.0155	0.0016	0.01522
	hct2_20	1.0020	0.0043	1.0135	0.0017	0.01223
	hct2_21	1.0020	0.0043	1.0178	0.0014	0.01125
	hct2_22	1.0020	0.0043	1.0183	0.0015	0.00936
	hct2_23	1.0008	0.0085	1.0196	0.0018	0.01542
	hct2_24	1.0008	0.0085	1.0185	0.0016	0.01212
	hct2_25	1.0008	0.0085	1.0136	0.0017	0.0112

Source: BSC2002a, Table 6-5

Table II-6. k_{eff} Values for Benchmarks Applicable to Intact Non-moderated Configurations for TRIGA DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment HEU-MET-FAST-023 (22 cases)	hmf023_02	1.0000	0.0052	0.9932	0.0011	1.452
	hmf023_03	1.0000	0.0052	1.0052	0.0012	1.185
	hmf023_04	1.0000	0.0052	1.0251	0.0013	1.032
	hmf023_05	1.0000	0.0052	1.0294	0.0013	1.005
	hmf023_06	1.0000	0.0052	0.9935	0.001	1.581
	hmf023_07	1.0000	0.0052	0.9927	0.0011	1.461
	hmf023_08	1.0000	0.0052	1.0004	0.0012	1.172
	hmf023_09	1.0000	0.0052	1.0215	0.0011	1.015
	hmf023_10	1.0000	0.0052	1.027	0.0013	0.993
	hmf023_12	1.0000	0.0052	0.9933	0.0011	1.46
	hmf023_13	1.0000	0.0052	1.0119	0.0011	1.193
	hmf023_14	1.0000	0.0052	1.0258	0.0013	1.044
	hmf023_15	1.0000	0.0052	1.0296	0.0013	1.017
	hmf023_16	1.0000	0.0052	0.9975	0.001	1.581
	hmf023_17	1.0000	0.0052	0.9961	0.0011	1.469
	hmf023_18	1.0000	0.0052	0.9999	0.0012	1.181
	hmf023_19	1.0000	0.0052	1.0185	0.0012	1.034
	hmf023_20	1.0000	0.0052	1.0246	0.0012	1.009

Table II-6. k_{eff} Values for Benchmarks Applicable to Intact Non-moderated Configurations for TRIGA DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	hmf023_21	1.0000	0.0057	0.9934	0.001	1.585
	hmf023_22	1.0000	0.0052	1.0252	0.0011	0.983
	hmf023_28	1.0000	0.0052	0.9948	0.0009	1.58
	hmf023_29	1.0000	0.0052	0.9947	0.001	1.582
Experiment HEU-MET-FAST-026 (32 cases)	hmf26b1	0.9982	0.0042	1.0001	0.0014	1.5756
	hmf26b2	0.9982	0.0042	0.9982	0.0014	1.4694
	hmf26b3	1.0000	0.0038	0.998	0.0018	1.2064
	hmf26b4	1.0000	0.0038	0.997	0.0017	1.1093
	hmf26b5	1.0000	0.0038	0.9977	0.0018	1.0961
	hmf26b6	0.9982	0.0042	0.9963	0.0014	1.5835
	hmf26b7	0.9982	0.0042	0.997	0.0016	1.4657
	hmf26b8	1.0000	0.0038	0.9975	0.0015	1.2118
	hmf26b9	1.0000	0.0038	0.9975	0.0017	1.1028
	hmf26b10	1.0000	0.0038	0.9975	0.0016	1.0979
	hmf26c1	0.9982	0.0042	0.9989	0.0014	1.5784
	hmf26c10	1.0000	0.0038	0.9969	0.0016	1.2326
	hmf26c11	1.0000	0.0038	1.0026	0.0017	1.1529
	hmf26c12	1.0000	0.0038	1.0039	0.0016	1.1412
	hmf26c2	0.9982	0.0042	0.9982	0.0014	1.5803
	hmf26c3	0.9982	0.0042	0.9987	0.0016	1.4701
	hmf26c4	1.0000	0.0038	1.0023	0.0017	1.3449
	hmf26c5	1.0000	0.0038	0.9985	0.0017	1.233
	hmf26c6	1.0000	0.0038	0.9993	0.0018	1.1473
	hmf26c7	1.0000	0.0038	0.9955	0.0017	1.1437
	hmf26c8	0.9982	0.0042	0.9949	0.0015	1.5745
	hmf26c9	0.9982	0.0042	0.9944	0.0015	1.4747
	hmf26d1	0.9982	0.0042	0.9964	0.0014	1.5776
	hmf26d10	1.0000	0.0038	0.9961	0.0019	1.1907
	hmf26d2	0.9982	0.0042	0.9998	0.0014	1.4797
	hmf26d3	1.0000	0.0038	0.998	0.0016	1.262
	hmf26d4	1.0000	0.0038	0.9989	0.0016	1.1935
	hmf26d5	1.0000	0.0038	0.9956	0.0017	1.1859
	hmf26d6	0.9982	0.0042	0.9989	0.0014	1.5785
	hmf26d7	0.9982	0.0042	0.9959	0.0015	1.4784
	hmf26d8	1.0000	0.0038	0.9982	0.0017	1.273
	hmf26d9	1.0000	0.0038	1.0015	0.0018	1.2025
Experiment HEU-COMP-INTER-003 (7 cases)	hci3-1	1.0000	0.0057	1.0097	0.0016	0.824
	hci3-2	1.0000	0.0061	1.0061	0.0017	0.675
	hci3-3	1.0000	0.0056	1.0048	0.0018	0.679
	hci3-4	1.0000	0.0055	1.0035	0.0017	0.702
	hci3-5	1.0000	0.0047	0.993	0.0018	0.564
	hci3-6	1.0000	0.0047	0.9963	0.0017	0.706
	hci3-7	1.0000	0.005	0.9976	0.0019	0.705

Table II-6. k_{eff} Values for Benchmarks Applicable to Intact Non-moderated Configurations for TRIGA DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment HEU-COMP-INTER-001 (HEU-COMP-MIXED-003) (1 case)	heuci1c5	1.0000	0	0.9951	0.0008	0.22
Experiment HEU-COMP-MIXED-001 (HEU-COMP-THERM-001) (26 cases)	hcm-1	1.0000	0.0059	1.0027	0.001	0.1045
	hcm-2	1.0012	0.0059	1.0059	0.0011	0.1053
	hcm-5	0.9985	0.0056	0.9963	0.001	0.7833
	hcm-6	0.9953	0.0056	0.9899	0.001	0.7962
	hcm-7	0.9997	0.0038	0.9949	0.001	0.8015
	hcm-8	0.9984	0.0052	0.9915	0.0011	0.6872
	hcm-9	0.9983	0.0052	0.9931	0.0011	0.6536
	hcm-10	0.9979	0.0052	0.9941	0.001	0.6494
	hcm-11	0.9983	0.0052	0.9934	0.0011	0.6385
	hcm-12	0.9972	0.0052	0.996	0.0011	0.6358
	hcm-13	1.0032	0.0053	0.9977	0.0011	0.6309
	hcm-15	1.0083	0.005	1.0063	0.0011	0.4671
	hcm-16	1.0001	0.0046	0.9949	0.0011	0.4692
	hcm-17	0.9997	0.0046	0.9926	0.001	0.4647
	hcm-18	1.0075	0.0046	1	0.001	0.4625
	hcm-19	1.0039	0.0047	1	0.0011	0.5191
	hcm-20	1.0060	0.0065	1.0051	0.0015	0.5357
	hcm-21	1.0026	0.0064	1.0046	0.0016	0.5378
	hcm-22	1.0013	0.0064	0.9995	0.0016	0.5371
	hcm-23	0.9995	0.0053	1.0056	0.0015	0.535
	hcm-24	1.0020	0.0053	1.0003	0.0016	0.5352
	hcm-25	0.9983	0.0053	0.997	0.0014	0.5333
	hcm-26	0.9998	0.0053	1.0001	0.0015	0.5283
	hcm-27	0.9991	0.0053	0.9978	0.0016	0.5302
	hcm-28	1.0037	0.0053	1.0033	0.0015	0.541
	hcm-29	0.9992	0.0052	0.9998	0.0014	0.5401
Experiment HEU-COMP-MIXED-002 (23 cases)	hcm02_1	1.0000	0.0085	0.9866	0.0017	0.868
	hcm02_10	1.0000	0.0081	0.9856	0.0019	0.57
	hcm02_11	1.0000	0.0088	0.9829	0.0019	0.568
	hcm02_12	1.0000	0.0078	0.99	0.0019	0.556
	hcm02_13	1.0000	0.0083	0.9874	0.0017	0.559
	hcm02_14	1.0000	0.0112	0.988	0.0017	0.735
	hcm02_15	1.0000	0.0111	0.985	0.0017	0.73
	hcm02_16	1.0000	0.0108	0.9861	0.0017	0.735
	hcm02_17	1.0000	0.0112	0.9861	0.0016	0.732
	hcm02_18	1.0000	0.0111	0.9902	0.0017	0.727
	hcm02_19	1.0000	0.0107	0.991	0.0017	0.712
	hcm02_2	1.0000	0.0088	0.9907	0.0017	0.865
	hcm02_20	1.0000	0.0108	0.9824	0.0018	0.735
	hcm02_21	1.0000	0.0092	0.9843	0.0016	0.902

Table II-6. k_{eff} Values for Benchmarks Applicable to Intact Non-moderated Configurations for TRIGA DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	hcm02_22	1.0000	0.009	0.9879	0.0019	0.899
	hcm02_23	1.0000	0.0093	0.9866	0.0016	0.896
	hcm02_3	1.0000	0.0093	0.9914	0.0016	0.724
	hcm02_4	1.0000	0.0087	0.9923	0.0017	0.716
	hcm02_5	1.0000	0.0089	0.9933	0.0017	0.722
	hcm02_6	1.0000	0.0093	0.9852	0.0018	0.574
	hcm02_7	1.0000	0.0086	0.9813	0.0019	0.578
	hcm02_8	1.0000	0.0068	0.9943	0.0018	0.537
	hcm02_9	1.0000	0.0076	0.9913	0.0018	0.541

Source: BSC2002a, Table 6-6

Table II-7. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for TRIGA DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment HEU-SOL-THERM-001 (10 cases)	hest1-1	1.0000	0.0025	1.00241	0.00131	0.01582
	hest1-2	1.0000	0.0025	0.99816	0.00209	0.03873
	hest1-3	1.0000	0.0025	1.00453	0.00199	0.01546
	hest1-4	1.0000	0.0025	1.0013	0.00203	0.0405
	hest1-5	1.0000	0.0025	1.00361	0.00166	0.00651
	hest1-6	1.0000	0.0025	1.01038	0.00187	0.00678
	hest1-7	1.0000	0.0025	1.0023	0.00201	0.01501
	hest1-8	1.0000	0.0025	1.00505	0.00213	0.0161
	hest1-9	1.0000	0.0025	0.99973	0.00212	0.04099
	hest110	1.0000	0.0025	0.99468	0.00178	0.00757
Experiment HEU-SOL-THERM-005 (17 cases)	heust5c1	1.0000	0.0124	1.0007	0.0011	0.035
	heust5c10	1.0000	0.0124	0.9947	0.0013	0.04
	heust5c11	1.0000	0.0083	0.9885	0.0012	0.032
	heust5c12	1.0000	0.0084	1.0201	0.0013	0.034
	heust5c13	1.0000	0.0119	1.0028	0.0012	0.021
	heust5c14	1.0000	0.0058	0.991	0.0012	0.019
	heust5c15	1.0000	0.0059	1.0115	0.0014	0.02
	heust5c16	1.0000	0.0121	1.0068	0.0011	0.011
	heust5c17	1.0000	0.0057	0.9926	0.0013	0.011
	heust5c2	1.0000	0.0124	0.988	0.0012	0.041
	heust5c3	1.0000	0.0124	1.0128	0.0012	0.036
	heust5c4	1.0000	0.0126	1.0128	0.0012	0.036
	heust5c5	1.0000	0.0124	0.9937	0.0012	0.039
	heust5c6	1.0000	0.0124	1.0082	0.0012	0.036
	heust5c7	1.0000	0.0124	1.0048	0.0012	0.033

Table II-7. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for TRIGA DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	heust5c8	1.0000	0.0124	0.9914	0.0013	0.04
	heust5c9	1.0000	0.0125	1.007	0.0011	0.035
Experiment HEU-SOL-THERM-006 (29 cases)	heust6c1	0.9973	0.005	0.987	0.0015	0.033
	heust6c10	1.0000	0.0065	1.002	0.0013	0.037
	heust6c11	1.0000	0.0088	1.0023	0.0011	0.042
	heust6c12	0.9973	0.005	0.9857	0.0014	0.032
	heust6c13	0.998	0.0054	0.9904	0.0014	0.035
	heust6c14	1.0000	0.0078	1.0027	0.0013	0.039
	heust6c15	1.0000	0.0091	1.0093	0.0011	0.041
	heust6c16	1.0000	0.0087	1.0032	0.0012	0.042
	heust6c17	1.0000	0.0088	1.0034	0.0012	0.042
	heust6c18	1.0000	0.0078	1.0047	0.0012	0.039
	heust6c19	1.0000	0.0091	1.0115	0.0011	0.04
	heust6c2	0.9986	0.0054	0.9907	0.0014	0.036
	heust6c20	1.0000	0.0087	1.0027	0.0012	0.041
	heust6c21	1.0000	0.0088	1.0009	0.0011	0.042
	heust6c22	1.0000	0.0065	1.0027	0.0014	0.038
	heust6c23	1.0000	0.0078	1.0032	0.0013	0.039
	heust6c24	1.0000	0.0091	1.0089	0.0012	0.04
	heust6c25	1.0000	0.0087	1.001	0.0011	0.042
	heust6c26	1.0000	0.0088	1.0019	0.0011	0.042
	heust6c27	0.9973	0.005	0.9853	0.0014	0.032
	heust6c28	0.9986	0.0054	0.9895	0.0014	0.036
	heust6c29	1.0000	0.0088	1.0038	0.0011	0.042
	heust6c3	1.0000	0.0065	1.002	0.0013	0.037
	heust6c4	1.0000	0.0078	1.0033	0.0012	0.04
	heust6c5	1.0000	0.0091	1.0115	0.0011	0.041
	heust6c6	1.0000	0.0087	1.002	0.0012	0.042
	heust6c7	1.0000	0.0088	1.0011	0.0011	0.043
	heust6c8	0.9973	0.005	0.9832	0.0014	0.032
	heust6c9	0.9986	0.0054	0.9904	0.0013	0.035
Experiment HEU-SOL-THERM-008 (5 cases evaluated)	heust81	1.0000	0.003	1.00316	0.00134	0.00661
	heust83	1.0000	0.003	0.9973	0.0019	0.00644
	heust86	1.0000	0.003	1.00969	0.0023	0.03669
	heust89	1.0000	0.003	1.00373	0.00116	0.0066
	hest813	1.0000	0.003	1.00331	0.002	0.03616
Experiment HEU-SOL-THERM-009 (4 cases)	heust9c1	1.0000	0.0057	1.0051	0.0006	0.058
	heust9c2	1.0000	0.0057	1.0045	0.0006	0.045
	heust9c3	1.0000	0.0057	1.0047	0.0007	0.029
	heust9c4	1.0000	0.0057	0.9994	0.0007	0.018
Experiment HEU-SOL-THERM-010 (4 cases)	heust10c1	1.0000	0.0018	1.005	0.0007	0.009
	heust10c2	1.0000	0.0018	1.0049	0.0006	0.009
	heust10c3	1.0000	0.0018	1.0026	0.0006	0.01

Table II-7. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for TRIGA DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	heust10c4	1.0000	0.0018	0.9999	0.0007	0.01
Experiment HEU-SOL-THERM-011 (2 cases)	heust11c1	1.0000	0.0018	1.0086	0.0005	0.005
	heust11c2	1.0000	0.002	1.0044	0.0005	0.005
Experiment HEU-SOL-THERM-012 (1 case)	heust12	0.9999	0.0058	1.0027	0.0005	0.0027
Experiment HEU-SOL-THERM-013 (4 cases)	hest131	1.0012	0.0026	1.00135	0.0005	0.00267
	hest132	1.0007	0.0036	1.0002	0.00057	0.00307
	hest133	1.0009	0.0036	0.99689	0.00065	0.00378
	hest134	1.0003	0.0036	0.99777	0.00061	0.00374
Experiment HEU-SOL-THERM-014 (3 cases)	hest141	1.0000	0.0028	0.99854	0.00119	0.00716
	hest142	1.0000	0.0052	1.01307	0.00115	0.0073
	hest143	1.0000	0.0087	1.02137	0.00109	0.00775
Experiment HEU-SOL-THERM-015 (5 cases)	hest151	1.0000	0.0032	1.0058	0.00123	0.01056
	hest152	1.0000	0.0034	0.99295	0.00125	0.00998
	hest153	1.0000	0.0068	1.00874	0.0012	0.01127
	hest154	1.0000	0.0069	1.01579	0.00115	0.0104
	hest155	1.0000	0.0089	1.01277	0.00116	0.01133
Experiment HEU-SOL-THERM-016 (3 cases)	hest161	1.0000	0.0036	0.9922	0.00137	0.01513
	hest162	1.0000	0.0069	1.01098	0.00122	0.01539
	hest163	1.0000	0.0079	1.02046	0.00119	0.01608
Experiment HEU-SOL-THERM-017 (8 cases)	hest171	1.0000	0.0028	0.99352	0.00125	0.01892
	hest172	1.0000	0.004	0.98387	0.0015	0.02097
	hest173	1.0000	0.0036	0.98507	0.00134	0.01969
	hest174	1.0000	0.0047	1.0036	0.00131	0.01947
	hest175	1.0000	0.0058	1.01001	0.00121	0.01973
	hest176	1.0000	0.0055	1.00653	0.00109	0.02183
	hest177	1.0000	0.0057	1.01111	0.00121	0.02087
	hest178	1.0000	0.0067	1.00409	0.00112	0.0221
Experiment HEU-SOL-THERM-018 (12 cases)	hest181	1.0000	0.0034	0.99364	0.00143	0.02846
	hest182	1.0000	0.0046	0.99331	0.00142	0.03121
	hest183	1.0000	0.0042	0.99025	0.00136	0.02976
	hest184	1.0000	0.0044	1.00177	0.00133	0.02919
	hest185	1.0000	0.0046	0.99727	0.00141	0.03274
	hest186	1.0000	0.0045	0.99699	0.00129	0.03086
	hest187	1.0000	0.0058	1.01204	0.00118	0.02988
	hest188	1.0000	0.0056	1.01266	0.00117	0.03286
	hest189	1.0000	0.0056	1.00855	0.00114	0.03109
	hst1810	1.0000	0.0057	1.02526	0.00114	0.03464
	hst1811	1.0000	0.0059	1.02814	0.00115	0.03203
	hst1812	1.0000	0.0065	1.01861	0.00101	0.03353
Experiment HEU-SOL-THERM-019 (3 cases)	hest191	1.0000	0.0041	1.00102	0.00129	0.04249
	hest192	1.0000	0.0041	1.00497	0.00116	0.03928
	hest193	1.0000	0.0067	1.00044	0.00122	0.04166

Table II-7. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for TRIGA DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment HEU-SOL-THERM-021 (32 cases)	hst021_01	0.9975	0.0054	1.005	0.0011	0.0425
	hst021_02	0.9975	0.0054	1.0057	0.0011	0.0403
	hst021_03	0.9975	0.0054	1.0099	0.0011	0.0393
	hst021_04	0.9975	0.0054	1.0124	0.0009	0.037
	hst021_05	0.9975	0.0054	1.0118	0.001	0.0365
	hst021_06	0.9975	0.0054	1.0114	0.001	0.0365
	hst021_07	0.9975	0.0054	1.0088	0.0009	0.0363
	hst021_08	0.9975	0.0054	1.0052	0.001	0.0362
	hst021_09	0.9975	0.0054	1.0086	0.001	0.0404
	hst021_10	0.9975	0.0054	1.0088	0.001	0.0399
	hst021_11	0.9975	0.0054	1.0084	0.0009	0.0381
	hst021_12	0.9975	0.0054	1.014	0.001	0.0369
	hst021_13	0.9975	0.0054	1.0125	0.001	0.0364
	hst021_14	0.9975	0.0054	1.0129	0.0009	0.0363
	hst021_15	0.9975	0.0054	1.0133	0.0009	0.036
	hst021_16	0.9978	0.0054	0.9955	0.001	0.0437
	hst021_17	0.9978	0.0054	1.0141	0.001	0.04
	hst021_18	0.9978	0.0054	1.0023	0.001	0.0403
	hst021_19	0.9978	0.0054	1.0145	0.001	0.0373
	hst021_20	0.9978	0.0054	1.0107	0.0009	0.0373
	hst021_21	0.9978	0.0054	1.0133	0.0009	0.0361
	hst021_22	0.9978	0.0054	1.0026	0.001	0.0368
	hst021_23	0.9978	0.0054	1.0015	0.001	0.0413
	hst021_24	0.9978	0.0054	1.0028	0.001	0.0407
	hst021_25	0.9978	0.0054	1.006	0.001	0.0388
	hst021_26	0.9978	0.0054	0.995	0.001	0.0432
	hst021_27	0.9978	0.0054	0.9995	0.0012	0.0432
	hst021_28	0.9975	0.0054	1.0036	0.001	0.0283
	hst021_29	0.9975	0.0054	1.0081	0.001	0.0242
	hst021_30	0.9978	0.0054	1.0005	0.001	0.039
	hst021_31	0.9978	0.0054	0.9976	0.0009	0.0283
	hst021_32	0.9978	0.0054	1.0062	0.0009	0.0067
Experiment HEU-SOL-THERM-025 (18 cases)	hst25_1	1.0002	0.0025	1.00384	0.00083	0.005
	hst25_2	1.0007	0.0025	1.00515	0.0008	0.005
	hst25_3	1.0002	0.0064	0.99868	0.00079	0.006
	hst25_4	1.0003	0.0027	1.00609	0.0008	0.006
	hst25_5	1.0013	0.003	1.00929	0.00091	0.008
	hst25_6	1.0002	0.0067	1.00997	0.00075	0.006
	hst25_7	1.0009	0.0073	1.01327	0.00078	0.007
	hst25_8	1.0000	0.0067	1.01046	0.00077	0.007
	hst25_9	1.0002	0.0065	1.00682	0.00081	0.009
	hst25_10	1.0003	0.0043	1.01198	0.00079	0.012
	hst25_11	1.0002	0.0045	1.01281	0.0008	0.012

Table II-7. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for TRIGA DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	hst25_12	1.0002	0.0045	1.01092	0.00078	0.015
	hst25_13	1.0009	0.0047	1.01804	0.00074	0.015
	hst25_14	1.0008	0.0053	1.01041	0.00081	0.02
	hst25_15	1.0002	0.0058	1.0044	0.0008	0.019
	hst25_16	1.0000	0.0049	1.0162	0.00079	0.028
	hst25_17	1.0000	0.0055	1.00831	0.00077	0.027
	hst25_18	1.0000	0.0061	1.00518	0.00077	0.026
Experiment HEU-SOL-THERM-027 (9 cases)	hst27_1	1.0000	0.0046	1.00009	0.00099	0.015
	hst27_2	1.0000	0.0043	1.00204	0.00106	0.015
	hst27_3	1.0000	0.0037	1.00171	0.00101	0.015
	hst27_4	1.0000	0.0037	1.00394	0.00097	0.015
	hst27_5	1.0000	0.0044	1.00241	0.001	0.015
	hst27_6	1.0000	0.0043	0.99517	0.001	0.014
	hst27_7	1.0000	0.0038	1.00003	0.00102	0.015
	hst27_8	1.0000	0.0035	1.0026	0.00103	0.014
	hst27_9	1.0000	0.0039	1.00098	0.00103	0.015
Experiment HEU-SOL-THERM-028 (18 cases)	hst28_1	1.0000	0.0023	1.00234	0.00086	0.007
	hst28_2	1.0000	0.0034	1.00156	0.00082	0.008
	hst28_3	1.0000	0.0026	1.00102	0.00085	0.007
	hst28_4	1.0000	0.0028	1.00236	0.00087	0.008
	hst28_5	1.0000	0.0031	0.99733	0.00092	0.008
	hst28_6	1.0000	0.0023	1.00141	0.00086	0.008
	hst28_7	1.0000	0.0038	1.00259	0.0009	0.007
	hst28_8	1.0000	0.0027	1.00111	0.00086	0.008
	hst28_9	1.0000	0.0049	1.00008	0.00095	0.026
	hst28_10	1.0000	0.0053	0.99653	0.00091	0.026
	hst28_11	1.0000	0.0052	1.00188	0.00102	0.026
	hst28_12	1.0000	0.0046	0.99633	0.00096	0.027
	hst28_13	1.0000	0.0058	0.99826	0.00097	0.026
	hst28_14	1.0000	0.0046	0.99993	0.00092	0.027
	hst28_15	1.0000	0.0064	1.00725	0.00095	0.027
	hst28_16	1.0000	0.0052	1.00292	0.00096	0.027
	hst28_17	1.0000	0.0066	0.99727	0.00095	0.027
	hst28_18	1.0000	0.006	0.99794	0.00096	0.027
Experiment HEU-SOL-THERM-029 (7 cases)	hst29_1	1.0000	0.0066	1.00095	0.001	0.028
	hst29_2	1.0000	0.0058	1.00562	0.00097	0.027
	hst29_3	1.0000	0.0068	0.99616	0.00094	0.028
	hst29_4	1.0000	0.0074	0.99727	0.00097	0.028
	hst29_5	1.0000	0.0067	1.00111	0.00098	0.029
	hst29_6	1.0000	0.0065	1.00159	0.00097	0.029
	hst29_7	1.0000	0.0063	1.00199	0.001	0.028
Experiment HEU-SOL-THERM-030 (7 cases)	hst30_1	1.0000	0.0039	1.00043	0.0009	0.008
	hst30_2	1.0000	0.0032	1.00205	0.00087	0.008

Table II-7. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for TRIGA DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	hst30_3	1.0000	0.0031	0.99961	0.00083	0.008
	hst30_4	1.0000	0.0064	1.00322	0.00099	0.028
	hst30_5	1.0000	0.0058	0.99887	0.00095	0.027
	hst30_6	1.0000	0.0059	1.00262	0.001	0.028
	hst30_7	1.0000	0.0064	1.00028	0.00097	0.028
Experiment HEU-SOL-THERM-031 (4 cases)	hst31_1	1.0000	0.0046	1.0165	0.00093	0.028
	hst31_2	1.0000	0.0058	1.04116	0.00091	0.029
	hst31_3	1.0000	0.0058	1.00109	0.00092	0.029
	hst31_4	1.0000	0.0068	1.00745	0.00098	0.031
Experiment HEU-SOL-THERM-032 (1 case)	Heust032	1.0015	0.0026	1.0001	0.0004	0.0021
Experiment HEU-SOL-THERM-033 (26 cases)	hst33d_02a	1.0000	0.0111	1.00007	0.00128	0.036
	hst33d_02b	1.0000	0.0108	0.99792	0.00113	0.036
	hst33d_02c	1.0000	0.0065	0.99796	0.00119	0.036
	hst33d_03a	1.0000	0.0114	1.00634	0.00108	0.033
	hst33d_03b	1.0000	0.0111	1.00608	0.00115	0.034
	hst33d_03c	1.0000	0.007	1.01079	0.00118	0.032
	hst33d_04a	1.0000	0.0114	1.0057	0.00109	0.035
	hst33d_04b	1.0000	0.0111	1.0116	0.00117	0.035
	hst33d_05a	1.0000	0.0111	1.01126	0.00114	0.035
	hst33d_05b	1.0000	0.0108	1.00608	0.00128	0.035
	hst33d_06a	1.0000	0.0111	1.00936	0.00112	0.035
	hst33d_06b	1.0000	0.0108	1.00915	0.00114	0.034
	hst33d_07a	1.0000	0.0111	1.00453	0.00107	0.035
	hst33d_07b	1.0000	0.0108	1.00406	0.00109	0.035
	hst33d_08a	1.0000	0.0111	1.00558	0.00113	0.034
	hst33d_08b	1.0000	0.0108	1.00213	0.00111	0.035
	hst33d_09a	1.0000	0.0111	1.00228	0.00115	0.036
	hst33d_09b	1.0000	0.0108	0.99359	0.00113	0.035
	hst33d_09c	1.0000	0.0104	0.99619	0.00116	0.036
	hst33d_10a	1.0000	0.0114	1.00267	0.00113	0.034
	hst33d_10c	1.0000	0.007	1.00333	0.00103	0.032
	hst33d_10d	1.0000	0.0104	0.99286	0.00111	0.033
	hst33d_11a	1.0000	0.0111	1.00669	0.0011	0.035
	hst33d_11b	1.0000	0.0108	1.00176	0.00097	0.034
	hst33d_12a	1.0000	0.0111	1.00386	0.00112	0.036
	hst33d_12b	1.0000	0.0108	1.00165	0.00107	0.035
Experiment HEU-SOL-THERM-035 (9 cases)	hst35_1	1.0000	0.0031	1.0049	0.00073	0.004
	hst35_2	1.0000	0.0032	1.00859	0.00068	0.004
	hst35_3	1.0000	0.003	1.00832	0.00072	0.004
	hst35_4	1.0000	0.003	1.00757	0.0007	0.004
	hst35_5	1.0000	0.0033	1.00565	0.00087	0.008
	hst35_6	1.0000	0.0029	1.00828	0.00089	0.008

Table II-7. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for TRIGA DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment HEU-SOL-THERM-036 (4 cases)	hst35_7	1.0000	0.0035	1.00811	0.00095	0.015
	hst35_8	1.0000	0.0038	1.0048	0.00095	0.016
	hst35_9	1.0000	0.0041	1.00486	0.00095	0.016
	hst36_1	0.9974	0.0045	0.9989	0.0009	0.01
	hst36_2	0.9979	0.0039	1.0044	0.001	0.011
	hst36_3	0.9993	0.0044	0.9995	0.0009	0.012
	hst36_4	1.0000	0.0062	1.0008	0.0009	0.012
Experiment HEU-SOL-THERM-037 (9 cases)	hst37_1	0.9980	0.0034	1.0129	0.0011	0.005
	hst37_2	0.9990	0.0035	1.0048	0.0011	0.005
	hst37_3	0.9970	0.0042	1.0096	0.0012	0.007
	hst37_4	0.9980	0.0035	1.0141	0.0012	0.007
	hst37_5	0.9980	0.0042	1.0089	0.0011	0.007
	hst37_6	0.9960	0.0051	1.0172	0.0013	0.009
	hst37_7	0.9980	0.0034	1.0162	0.0012	0.009
	hst37_8	0.9980	0.004	1.0125	0.0013	0.009
	hst37_9	0.9980	0.0047	1.008	0.0012	0.009
Experiment HEU-SOL-THERM-043 (3 cases)	heust43c1	0.9986	0.0017	0.9995	0.0007	0.014
	heust43c2	0.9995	0.0041	1.0082	0.0004	0.003
	heust43c3	0.9990	0.0044	1.0033	0.0004	0.003
Experiment HEU-SOL-THERM-044 (16 cases)	hst4410	0.9944	0.0077	0.9909	0.0018	0.039
	hst4411	0.9944	0.0078	0.9847	0.002	0.041
	hst4412	0.9944	0.0078	0.9872	0.0017	0.04
	hst4413	0.9964	0.0067	1	0.0018	0.042
	hst4416	0.9974	0.0062	1.0178	0.0018	0.043
	hst4417	0.9964	0.0057	0.9987	0.0017	0.044
	hst4419	0.9974	0.0063	1.0079	0.0018	0.045
	hst4444	0.9984	0.0057	1.0004	0.0017	0.045
	hst4449	0.9964	0.0047	1.0116	0.0017	0.034
	hst4450	0.9946	0.0047	0.9881	0.0018	0.038
	hst4451	0.9984	0.0057	1.0047	0.0017	0.046
	hst4453	0.9984	0.0064	1.0189	0.0018	0.047
	hst4454	0.9984	0.0065	1.0142	0.0015	0.046
	hst4455	0.9984	0.0065	1.0196	0.0017	0.046
	hst447	0.9944	0.0097	0.9948	0.0018	0.037
	hst448	0.9946	0.0083	0.9955	0.0021	0.042

Source: BSC2002a, Table 6-7

Table II-8. k_{eff} Values for Benchmarks Applicable to Degraded Non-Moderated Configurations for TRIGA DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment HEU-MET-FAST-002 (6 cases)	heumf2-1	1.0000	0.003	1.0024	0.0011	1.599
	heumf2-2	1.0000	0.003	1.0034	0.0011	1.597
	heumf2-3	1.0000	0.003	1.002	0.001	1.592
	heumf2-4	1.0000	0.003	1.0041	0.001	1.583
	heumf2-5	1.0000	0.003	1.0039	0.001	1.579
	heumf2-6	1.0000	0.003	1.0028	0.0011	1.583
Experiment HEU-MET-FAST-004 (1 case)	heumf4c2	0.9985	0.0008	1.0017	0.0007	1.166
Experiment HEU-MET-FAST-008 (1 case)	HMF8	0.9989	0.0016	0.9951	0.00058	1.5501
Experiment HEU-MET-FAST-011 (1 case)	HMF11	0.9989	0.0015	0.99348	0.00079	1.1607
Experiment HEU-MET-FAST-012 (1 case)	HMF12	0.9992	0.0018	0.99399	0.00043	1.5237
Experiment HEU-MET-FAST-013 (1 case)	HMF13	0.999	0.0015	0.99997	0.00061	1.4838
Experiment HEU-MET-FAST-014 (1 case)	HMF14	0.9989	0.0017	0.99831	0.00062	1.5465
Experiment HEU-MET-FAST-015 (1 case)	HMF15	0.9996	0.0017	0.99263	0.00056	1.5813
Experiment HEU-MET-FAST-018 (1 case)	HMF18	1.0000	0.0014	0.99805	0.00056	1.5515
Experiment HEU-MET-FAST-019 (1 case)	HMF19	1.0000	0.0028	1.00277	0.0006	1.4793
Experiment HEU-MET-FAST-020 (1 case)	HMF20	1.0000	0.0028	0.99574	0.00061	1.4341
Experiment HEU-MET-FAST-021 (1 case)	HMF21	1.0000	0.0024	1.00192	0.0006	1.4431
Experiment HEU-MET-FAST-022 (1 case)	HMF22	1.0000	0.0019	0.99272	0.0006	1.5049
Experiment HEU-MET-FAST-024 (1 case)	HMF24	0.9990	0.0015	0.99521	0.00109	1.2553
Experiment HEU-MET-FAST-027 (1 case)	heumf27c1	1.0000	0.0025	1.0098	0.0006	1.512
Experiment HEU-MET-FAST-029 (1 case)	heumf29c1	1.0000	0.002	1.0038	0.0006	1.547
Experiment HEU-MET-FAST-031 (1 case)	heumf31c1	1.0000	0.0059	0.9964	0.0007	0.966
Experiment HEU-MET-FAST-032 (4 cases)	heumf32c1	1.0000	0.0016	1.0054	0.0007	1.592
	heumf32c2	1.0000	0.0027	1.0057	0.0006	1.59
	heumf32c3	1.0000	0.0017	0.9992	0.0006	1.575
	heumf32c4	1.0000	0.0017	0.9994	0.0006	1.565

Table II-8. k_{eff} Values for Benchmarks Applicable to Degraded Non-Moderated Configurations for TRIGA DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment HEU-MET-FAST-041 (6 cases)	heumf41c1	1.0013	0.003	0.9991	0.0007	1.331
	heumf41c2	1.0022	0.0043	0.9973	0.0007	1.128
	heumf41c3	1.0006	0.0029	0.9984	0.0006	1.466
	heumf41c4	1.0006	0.0025	1.0009	0.0007	1.402
	heumf41c5	1.0006	0.0031	0.9966	0.0008	1.354
	heumf41c6	1.0006	0.0045	0.9993	0.0007	1.315
Experiment HEU-MET-FAST-055 (1 case)	hmf055	0.9977	0.0003	0.9938	0.0003	1.077
HEU-MET-MIXED-005 (5 cases)	hmm5_1	1.0007	0.0027	1.01308	0.00057	0.307
	hmm5_2	1.0003	0.0028	1.0217	0.00055	0.247
	hmm5_3	1.0012	0.0029	1.01904	0.00052	0.212
	hmm5_4	1.0016	0.003	1.0145	0.0006	0.3175
	hmm5_5	1.0005	0.004	1.00682	0.00052	0.377
Experiment HEU-MET-THERM-003 (7 cases)	heumt3c1	1.0000	0.001	1.0039	0.0008	1.094
	heumt3c2	0.9910	0.003	0.9832	0.0008	1.091
	heumt3c3	0.9826	0.006	0.9766	0.0008	0.548
	heumt3c4	0.9876	0.004	0.9842	0.0009	0.444
	heumt3c5	0.9930	0.003	1.0014	0.0009	0.222
	heumt3c6	0.9889	0.003	0.9719	0.0009	0.291
	heumt3c7	0.9919	0.003	0.9887	0.0008	0.231
Experiment HEU-MET-MIXED-002 (1 case)	heumm2c1	1.0000	0.0037	1.0032	0.0007	0.788
Experiment HEU-MET-MIXED-003 (1 case)	heumm3c1	1.0000	0.0038	1.0039	0.0008	0.784

Source: BSC2002a, Table 6-8

k_{eff} Values for Benchmark Experiments Applicable to Configurations of the Codisposal Waste Package Containing Melt and Dilute Waste Form

Table II-9. k_{eff} Values for Benchmarks Applicable to Intact Moderated Configurations for Melt and Dilute Waste Form

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment IEU-COMP-THERM-002 (6 cases)	ieuct2_1	1.0014	0.0039	0.9994	0.0008	0.044
	ieuct2_2	1.0019	0.004	1.0012	0.0008	0.047
	ieuct2_3	1.0017	0.0044	1.0026	0.0007	0.047
	ieuct2_4	1.0019	0.0044	1.0017	0.0007	0.049
	ieuct2_5	1.0014	0.0043	0.9950	0.0007	0.047
	ieuct2_6	1.0016	0.0044	0.9941	0.0007	0.049
Experiment IEU-COMP-	ieuct3/1	1.0006	0.0056	0.9975	0.0003	0.024

Table II-9. k_{eff} Values for Benchmarks Applicable to Intact Moderated Configurations for Melt and Dilute Waste Form

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
THERM-003 (2 cases)	ieuct3/2	1.0046	0.0056	1.0017	0.0003	0.024
Experiment IEU-COMP-THERM-001 (29 cases)	iect101	1.0000	0.004	0.9974	0.0009	0.21679
	iect102	1.0000	0.004	0.9960	0.0009	0.15817
	iect103	1.0000	0.004	0.9931	0.0010	0.10412
	iect104	1.0000	0.004	0.9974	0.0011	0.07405
	iect105	1.0000	0.004	1.0085	0.0009	0.04552
	iect106	1.0000	0.004	1.0003	0.0010	0.10793
	iect107	1.0000	0.004	0.9980	0.0010	0.11064
	iect108	1.0000	0.004	0.9960	0.0010	0.11867
	iect109	1.0000	0.004	1.0004	0.0008	0.1679
	iect110	1.0000	0.004	0.9967	0.0010	0.15756
	iect111	1.0000	0.004	0.9958	0.0010	0.15732
	iect112	1.0000	0.004	0.9964	0.0010	0.15568
	iect113	1.0000	0.004	0.9967	0.0010	0.0743
	iect114	1.0000	0.004	0.9979	0.0009	0.07375
	iect115	1.0000	0.004	0.9981	0.0010	0.074
	iect116	1.0000	0.004	1.0021	0.0009	0.05547
	iect117	1.0000	0.004	0.9965	0.0010	0.20814
	iect118	1.0000	0.004	0.9976	0.0011	0.13428
	iect119	1.0000	0.004	1.0045	0.0010	0.06114
	iect120	1.0000	0.004	1.0005	0.0009	0.15539
	iect121	1.0000	0.004	0.9988	0.0009	0.21334
	iect122	1.0000	0.004	0.9990	0.0011	0.19772
	iect123	1.0000	0.004	0.9952	0.0011	0.12826
	iect124a	1.0000	0.004	1.0004	0.0011	0.13305
	iect125	1.0000	0.004	0.9987	0.0009	0.05992
	iect126	1.0000	0.004	1.0044	0.0010	0.05663
	iect127	1.0000	0.004	1.0032	0.0009	0.05633
	iect128	1.0000	0.004	1.0051	0.0009	0.15824
	iect129	1.0000	0.004	1.0012	0.0010	0.15184

Source: BSC2002a, Table 6-9

Table II-10. k_{eff} Values for Benchmarks Applicable to Intact Non-moderated Configurations for Melt and Dilute Waste Form

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment IEU-MET-FAST-001 (4 cases)	imf1-1	0.9988	0.0012	1.0022	0.00029	1.4394
	imf1-2	0.9988	0.0012	1.0023	0.00028	1.4398
	imf1-3	0.9990	0.001	1.0040	0.00029	1.386
	imf1-4	0.9990	0.001	1.0048	0.00028	1.3859

Table II-10. k_{eff} Values for Benchmarks Applicable to Intact Non-moderated Configurations for Melt and Dilute Waste Form

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment IEU-MET-FAST-002 (1 case)	imf2-1	1.0000	0.003	1.0059	0.0006	1.2784
Experiment IEU-MET-FAST-003 (1 case)	imf3-1	1.0000	0.0017	0.9993	0.00076	1.3502
Experiment IEU-MET-FAST-004 (1 case)	imf4-1	1.0000	0.003	1.0105	0.00084	1.3071
Experiment IEU-MET-FAST-005 (1 case)	imf5-1	1.0000	0.0021	1.0088	0.00079	1.2852
Experiment IEU-MET-FAST-006 (1 case)	imf6-1	1.0000	0.0023	0.9960	0.00081	1.2892
Experiment IEU-MET-FAST-007 (1 case)	ieumf7	1.0045	0.0007	1.0125	0.0002	1.253
Experiment IEU-MET-FAST-008 (1 case)	imf8-1	1.0000	0.0018	1.0087	0.00084	1.365
Experiment IEU-MET-FAST-009 (1 case)	ieumf09-01	1.0000	0.0053	1.0081	0.0008	1.014
Experiment IEU-MET-FAST-010 (1 case)	ieumf10	0.9954	0.0024	0.9982	0.0002	1.149

Source: BSC2002a, Table 6-10

Table II-11. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for Melt and Dilute Waste Form

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment IEU-SOL-THERM-001 (4 cases)	ist1-1	1.0000	0.0052	0.9807	0.00108	0.0149
	ist1-2	1.0000	0.0052	0.9760	0.00121	0.0207
	ist1-3	1.0000	0.0052	0.9722	0.00119	0.0205
	ist1-4	1.0000	0.0052	0.9711	0.00124	0.0275
Experiment LEU-SOL-THERM-003 (9 cases)	lst3-1	0.9997	0.0039	0.9993	0.0004	0.0186
	lst3-2	0.9993	0.0042	0.9971	0.00038	0.0166
	lst3-3	0.9995	0.0042	1.0015	0.00037	0.0164
	lst3-4	0.9995	0.0042	0.9954	0.00038	0.0162
	lst3-5	0.9997	0.0048	0.9990	0.00031	0.0133
	lst3-6	0.9999	0.0049	0.9992	0.0003	0.0129
	lst3-7	0.9994	0.0049	0.9972	0.0003	0.0127
	lst3-8	0.9993	0.0052	1.0008	0.00025	0.0114
	lst3-9	0.9996	0.0052	0.9973	0.00025	0.0114
Experiment LEU-SOL-THERM-004 (7 cases)	lst4_1	0.9994	0.0008	1.0029	0.0007	0.0188
	lst4_29	0.9999	0.0009	1.0034	0.0006	0.0179
	lst4_33	0.9999	0.0009	1.0013	0.0007	0.017
	lst4_34	0.9999	0.001	1.0037	0.0006	0.0157

Table II-11. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for Melt and Dilute Waste Form

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	lst4_46	0.9999	0.001	1.0032	0.0006	0.0154
	lst4_51	0.9994	0.0011	1.0023	0.0005	0.0148
	lst4_54	0.9996	0.0011	1.0026	0.0005	0.0142
Experiment LEU-SOL-THERM-006 (5 cases)	leust6_1	1.0000	0.0037	0.9996	0.0007	0.0245
	leust6_2	1.0000	0.0038	1.0075	0.0007	0.0251
	leust6_3	1.0000	0.0041	1.0014	0.0007	0.0253
	leust6_4	1.0000	0.0041	1.0020	0.0007	0.0254
	leust6_5	1.0000	0.0047	1.0039	0.0007	0.0257
Experiment LEU-SOL-THERM-007 (5 cases)	leust7_1	0.9961	0.0009	0.9966	0.0002	0.02
	leust7_2	0.9973	0.0009	0.9995	0.0002	0.0187
	leust7_3	0.9985	0.001	0.9979	0.0002	0.0173
	leust7_4	0.9988	0.0011	1.0005	0.0002	0.0166
	leust7_5	0.9983	0.0011	0.9989	0.0002	0.0159
Experiment LEU-SOL-THERM-008 (4 cases)	lst8_72	0.9999	0.0014	1.0038	0.0002	0.0152
	lst8_74	1.0002	0.0015	1.0023	0.0002	0.0154
	lst8_76	0.9999	0.0014	1.0028	0.0002	0.0153
	lst8_78	0.9999	0.0014	1.0040	0.0002	0.0153
Experiment LEU-SOL-THERM-009 (3 cases)	lst9_92	0.9998	0.0014	1.0018	0.0005	0.0155
	lst9_93	0.9999	0.0014	1.0021	0.0002	0.0157
	lst9_94	0.9999	0.0014	1.0022	0.0002	0.0158
Experiment LEU-SOL-THERM-010 (4 cases)	lst10_83	0.9999	0.0153	1.0023	0.0003	0.0153
	lst10_85	0.9999	0.0154	1.0019	0.0003	0.0154
	lst10_86	1.0000	0.0153	1.0032	0.0003	0.0153
	lst10_88	1.0001	0.0154	1.0026	0.0003	0.0154
Experiment LEU-SOL-THERM-016 (7 cases)	lst16_05	0.9996	0.0013	1.0093	0.0007	0.0267
	lst16_13	0.9999	0.0013	1.0080	0.0006	0.0248
	lst16_25	0.9994	0.0014	1.0075	0.0006	0.0216
	lst16_29	0.9996	0.0014	1.0068	0.0006	0.0209
	lst16_31	0.9995	0.0014	1.0059	0.0005	0.0195
	lst16_40	0.9992	0.0015	1.0043	0.0005	0.0186
	lst16_96	0.9994	0.0015	1.0047	0.0005	0.018
Experiment LEU-SOL-THERM-017 (6 cases)	lst17_04	0.9981	0.0013	1.0051	0.0007	0.0275
	lst17_22	0.9986	0.0013	1.0049	0.0006	0.0258
	lst17_23	0.9989	0.0014	1.0052	0.0006	0.0224
	lst17_26	0.9992	0.0014	1.0043	0.0006	0.0212
	lst17_30	0.9987	0.0015	1.0043	0.0005	0.02
	lst17_47	0.9996	0.0015	1.0042	0.0006	0.0192
Experiment LEU-SOL-THERM-018 (6 cases)	RUN133	0.9992	0.001	1.0033	0.0002	0.0183
	RUN142	0.9996	0.001	1.0042	0.0003	0.0187
	RUN143	0.9996	0.001	1.0045	0.0003	0.0188
	RUN144	0.9997	0.001	1.0033	0.0003	0.0187
	RUN145	0.9992	0.001	1.0038	0.0003	0.0187
	RUN146	0.9996	0.001	1.0037	0.0003	0.0186

Table II-11. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for Melt and Dilute Waste Form

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment LEU-SOL-THERM-019 (6 cases)	RUN149	0.9997	0.0009	1.0043	0.0003	0.019
	RUN150	0.9995	0.0009	1.0043	0.0003	0.019
	RUN151	0.9999	0.0009	1.0049	0.0002	0.0191
	RUN152	0.9996	0.0009	1.0054	0.0003	0.0191
	RUN153	0.9998	0.0009	1.0050	0.0003	0.0191
	RUN183	0.9994	0.0009	1.0036	0.0003	0.0189
Experiment LEU-SOL-THERM-020 (4 cases)	LST20C1	0.9995	0.001	1.0014	0.0003	0.015
	LST20C2	0.9996	0.001	1.0000	0.0003	0.0143
	LST20C3	0.9997	0.0012	0.9993	0.0003	0.0131
	LST20C4	0.9998	0.0012	1.0004	0.0003	0.0125
Experiment LEU-SOL-THERM-021 (4 cases)	LST21C1	0.9983	0.0009	0.9991	0.0003	0.0154
	LST21C2	0.9985	0.001	0.9996	0.0003	0.0144
	LST21C3	0.9989	0.0011	0.9976	0.0003	0.0135
	LST21C4	0.9993	0.0012	0.9999	0.0003	0.0127
Experiment IEU-COMP-THERM-001 (29 cases)	iect101	1.0000	0.004	0.9974	0.00092	0.216791
	iect102	1.0000	0.004	0.9960	0.00092	0.15817
	iect103	1.0000	0.004	0.9931	0.00104	0.10412
	iect104	1.0000	0.004	0.9974	0.00105	0.07405
	iect105	1.0000	0.004	1.0085	0.00091	0.04552
	iect106	1.0000	0.004	1.0003	0.00103	0.10793
	iect107	1.0000	0.004	0.9980	0.00101	0.11064
	iect108	1.0000	0.004	0.9960	0.00101	0.11867
	iect109	1.0000	0.004	1.0004	0.00084	0.1679
	iect110	1.0000	0.004	0.9967	0.00099	0.15756
	iect111	1.0000	0.004	0.9958	0.00096	0.15732
	iect112	1.0000	0.004	0.9964	0.00101	0.15568
	iect113	1.0000	0.004	0.9967	0.00103	0.0743
	iect114	1.0000	0.004	0.9979	0.00094	0.07375
	iect115	1.0000	0.004	0.9981	0.00099	0.074
	iect116	1.0000	0.004	1.0021	0.00093	0.05547
	iect117	1.0000	0.004	0.9965	0.00102	0.20814
	iect118	1.0000	0.004	0.9976	0.00113	0.13428
	iect119	1.0000	0.004	1.0045	0.00101	0.06114
	iect120	1.0000	0.004	1.0005	0.00094	0.15539
	iect121	1.0000	0.004	0.9988	0.00087	0.21334
	iect122	1.0000	0.004	0.9990	0.00109	0.19772
	iect123	1.0000	0.004	0.9952	0.00107	0.12826
	iect124a	1.0000	0.004	1.0004	0.00105	0.13305
	iect125	1.0000	0.004	0.9987	0.0009	0.05992
	iect126	1.0000	0.004	1.0044	0.00095	0.05663
	iect127	1.0000	0.004	1.0032	0.00086	0.05633
	iect128	1.0000	0.004	1.0051	0.00091	0.15824
	iect129	1.0000	0.004	1.0012	0.00099	0.15184

Source: BSC2002a, Table 6-11

Table II-12. k_{eff} Values for Benchmarks Applicable to Degraded Non-moderated Configurations for Melt and Dilute Waste Form

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment IEU-MET-FAST-001 (4 cases)	imf1-1	0.9988	0.0012	1.0022	0.00029	1.4394
	imf1-2	0.9988	0.0012	1.0023	0.00028	1.4398
	imf1-3	0.9990	0.001	1.0040	0.00029	1.386
	imf1-4	0.9990	0.001	1.0048	0.00028	1.3859
Experiment IEU-MET-FAST-002 (1 case)	imf2-1	1.0000	0.003	1.0059	0.0006	1.2784
Experiment IEU-MET-FAST-003 (1 case)	imf3-1	1.0000	0.0017	0.9993	0.00076	1.3502
Experiment IEU-MET-FAST-004 (1 case)	imf4-1	1.0000	0.003	1.0105	0.00084	1.3071
Experiment IEU-MET-FAST-005 (1 case)	imf5-1	1.0000	0.0021	1.0088	0.00079	1.2852
Experiment IEU-MET-FAST-006 (1 case)	imf6-1	1.0000	0.0023	0.9960	0.00081	1.2892
Experiment IEU-MET-FAST-007 (1 case)	ieumf7	1.0045	0.0007	1.0125	0.0002	1.253
Experiment IEU-MET-FAST-008 (1 case)	imf8-1	1.0000	0.0018	1.0087	0.00084	1.365
Experiment IEU-MET-FAST-009 (1 case)	ieumf09-01	1.0000	0.0053	1.0081	0.0008	1.014
Experiment IEU-MET-FAST-010 (1 case)	ieumf10	0.9954	0.0024	0.9982	0.0002	1.149

Source: BSC2002a, Table 6-12

k_{eff} Values for Benchmark Experiments Applicable to Configurations of the Codisposal Waste Package Containing U Alloy (Enrico-Fermi) DOE SNF

Table II-13. k_{eff} Values for Benchmarks Applicable to Intact Moderated Configurations for Enrico Fermi DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment IEU-COMP-THERM-002 (6 cases)	ieuct2_1	1.0014	0.0039	0.9994	0.0008	0.044
	ieuct2_2	1.0019	0.004	1.0012	0.0008	0.047
	ieuct2_3	1.0017	0.0044	1.0026	0.0007	0.047
	ieuct2_4	1.0019	0.0044	1.0017	0.0007	0.049
	ieuct2_5	1.0014	0.0043	0.9950	0.0007	0.047
	ieuct2_6	1.0016	0.0044	0.9941	0.0007	0.049
Experiment IEU-COMP-	ieuct3/1	1.0006	0.0056	0.9975	0.0003	0.024

Table II-13. k_{eff} Values for Benchmarks Applicable to Intact Moderated Configurations for Enrico Fermi DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
THERM-003 (2 cases)	ieuct3/2	1.0046	0.0056	1.0017	0.0003	0.024
Experiment HEU-COMP-THERM-003 (15 cases)	hct3-1	1.0000	0.0044	0.9938	0.0014	0.0467
	hct3-2	1.0000	0.0044	0.9975	0.0014	0.0404
	hct3-3	1.0000	0.0044	0.9964	0.0014	0.0337
	hct3-4	1.0000	0.0044	0.9980	0.0015	0.0259
	hct3-5	1.0000	0.0044	1.0025	0.0014	0.0202
	hct3-6	1.0000	0.0044	1.0062	0.0015	0.0405
	hct3-7	1.0000	0.0044	1.0113	0.0014	0.0339
	hct3-8	1.0000	0.0044	1.0099	0.0016	0.0329
	hct3-9	1.0000	0.0044	1.0131	0.0015	0.0263
	hct3-10	1.0000	0.0044	1.0096	0.0014	0.0209
	hct3-11	1.0000	0.0044	1.0133	0.0014	0.0177
	hct3-12	1.0000	0.0044	0.9896	0.0013	0.0265
	hct3-13	1.0000	0.0044	0.9968	0.0012	0.0139
	hct3-14	1.0000	0.0044	1.0050	0.0016	0.03
	hct3-15	1.0000	0.0044	1.0078	0.0014	0.0183
Experiment HEU-COMP-THERM-004 (4 cases)	hct4-1	1.0000	0.0038	0.9876	0.0012	0.0744
	hct4-2	1.0000	0.0039	0.9889	0.0012	0.0736
	hct4-3	1.0000	0.0037	0.9916	0.0012	0.0756
	hct4-4	1.0000	0.0038	0.9912	0.0011	0.0742
Experiment HEU-COMP-THERM-005)(1 case)	hct5-2	1.0000	0.0094	0.9846	0.0013	0.0764
Experiment HEU-COMP-THERM-006 (3 cases)	hct6-t1	1.0000	0.0058	0.9895	0.0014	0.072
	hct6-t2	1.0000	0.002	1.0104	0.0013	0.0232
	hct6-t3	1.0000	0.0048	0.9956	0.0010	0.0104
Experiment HEU-COMP-THERM-007 (3 cases)	hct7-1	1.0000	0.0035	0.9927	0.0016	0.0347
	hct7-2	1.0000	0.0041	0.9947	0.0016	0.0455
	hct7-3	1.0000	0.0043	0.9920	0.0015	0.0485
Experiment IEU-COMP-THERM-001 (29 cases)	iect101	1.0000	0.004	0.9974	0.0009	0.21679
	iect102	1.0000	0.004	0.9960	0.0009	0.15817
	iect103	1.0000	0.004	0.9931	0.0010	0.10412
	iect104	1.0000	0.004	0.9974	0.0011	0.07405
	iect105	1.0000	0.004	1.0085	0.0009	0.04552
	iect106	1.0000	0.004	1.0003	0.0010	0.10793
	iect107	1.0000	0.004	0.9980	0.0010	0.11064
	iect108	1.0000	0.004	0.9960	0.0010	0.11867
	iect109	1.0000	0.004	1.0004	0.0008	0.1679
	iect110	1.0000	0.004	0.9967	0.0010	0.15756
	iect111	1.0000	0.004	0.9958	0.0010	0.15732
	iect112	1.0000	0.004	0.9964	0.0010	0.15568
	iect113	1.0000	0.004	0.9967	0.0010	0.0743
	iect114	1.0000	0.004	0.9979	0.0009	0.07375
	iect115	1.0000	0.004	0.9981	0.0010	0.074

Table II-13. k_{eff} Values for Benchmarks Applicable to Intact Moderated Configurations for Enrico Fermi DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	iect116	1.0000	0.004	1.0021	0.0009	0.05547
	iect117	1.0000	0.004	0.9965	0.0010	0.20814
	iect118	1.0000	0.004	0.9976	0.0011	0.13428
	iect119	1.0000	0.004	1.0045	0.0010	0.06114
	iect120	1.0000	0.004	1.0005	0.0009	0.15539
	iect121	1.0000	0.004	0.9988	0.0009	0.21334
	iect122	1.0000	0.004	0.9990	0.0011	0.19772
	iect123	1.0000	0.004	0.9952	0.0011	0.12826
	iect124a	1.0000	0.004	1.0004	0.0011	0.13305
	iect125	1.0000	0.004	0.9987	0.0009	0.05992
	iect126	1.0000	0.004	1.0044	0.0010	0.05663
	iect127	1.0000	0.004	1.0032	0.0009	0.05633
	iect128	1.0000	0.004	1.0051	0.0009	0.15824
	iect129	1.0000	0.004	1.0012	0.0010	0.15184

Source: BSC2002a, Table 6-13

Table II-14. k_{eff} Values for Benchmarks Applicable to Intact Non-moderated Configurations for Enrico Fermi DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment IEU-MET-FAST-001 (4 cases)	imf1-1	0.9988	0.0012	1.0022	0.00029	1.4394
	imf1-2	0.9988	0.0012	1.0023	0.00028	1.4398
	imf1-3	0.9990	0.001	1.0040	0.00029	1.386
	imf1-4	0.9990	0.001	1.0048	0.00028	1.3859
Experiment IEU-MET-FAST-002 (1 case)	imf2-1	1.0000	0.003	1.0059	0.0006	1.2784
Experiment IEU-MET-FAST-003 (1 case)	imf3-1	1.0000	0.0017	0.9993	0.00076	1.3502
Experiment IEU-MET-FAST-004 (1 case)	imf4-1	1.0000	0.003	1.0105	0.00084	1.3071
Experiment IEU-MET-FAST-005 (1 case)	imf5-1	1.0000	0.0021	1.0088	0.00079	1.2852
Experiment IEU-MET-FAST-006 (1 case)	imf6-1	1.0000	0.0023	0.9960	0.00081	1.2892
Experiment IEU-MET-FAST-007 (1 case)	ieumf7	1.0045	0.0007	1.0125	0.0002	1.253
Experiment IEU-MET-FAST-008 (1 case)	imf8-1	1.0000	0.0018	1.0087	0.00084	1.365
Experiment IEU-MET-FAST-009 (1 case)	ieumf09-01	1.0000	0.0053	1.0081	0.0008	1.014

Table II-14. k_{eff} Values for Benchmarks Applicable to Intact Non-moderated Configurations for Enrico Fermi DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment IEU-MET-FAST-010 (1 case)	ieumf10	0.9954	0.0024	0.9982	0.0002	1.149

Source: BSC 2002a, Table 6-14

Table II-15. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for Enrico Fermi DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment IEU-SOL-THERM-001 (4 cases)	ist1-1	1.0000	0.0052	0.9807	0.00108	0.0149
	ist1-2	1.0000	0.0052	0.9760	0.00121	0.0207
	ist1-3	1.0000	0.0052	0.9722	0.00119	0.0205
	ist1-4	1.0000	0.0052	0.9711	0.00124	0.0275
Experiment LEU-SOL-THERM-003 (9 cases)	lst3-1	0.9997	0.0039	0.9993	0.0004	0.0186
	lst3-2	0.9993	0.0042	0.9971	0.00038	0.0166
	lst3-3	0.9995	0.0042	1.0015	0.00037	0.0164
	lst3-4	0.9995	0.0042	0.9954	0.00038	0.0162
	lst3-5	0.9997	0.0048	0.9990	0.00031	0.0133
	lst3-6	0.9999	0.0049	0.9992	0.0003	0.0129
	lst3-7	0.9994	0.0049	0.9972	0.0003	0.0127
	lst3-8	0.9993	0.0052	1.0008	0.00025	0.0114
	lst3-9	0.9996	0.0052	0.9973	0.00025	0.0114
Experiment LEU-SOL-THERM-004 (7 cases)	lst4_1	0.9994	0.0008	1.0029	0.0007	0.0188
	lst4_29	0.9999	0.0009	1.0034	0.0006	0.0179
	lst4_33	0.9999	0.0009	1.0013	0.0007	0.017
	lst4_34	0.9999	0.001	1.0037	0.0006	0.0157
	lst4_46	0.9999	0.001	1.0032	0.0006	0.0154
	lst4_51	0.9994	0.0011	1.0023	0.0005	0.0148
	lst4_54	0.9996	0.0011	1.0026	0.0005	0.0142
Experiment LEU-SOL-THERM-006 (5 cases)	leust6_1	1.0000	0.0037	0.9996	0.0007	0.0245
	leust6_2	1.0000	0.0038	1.0075	0.0007	0.0251
	leust6_3	1.0000	0.0041	1.0014	0.0007	0.0253
	leust6_4	1.0000	0.0041	1.0020	0.0007	0.0254
	leust6_5	1.0000	0.0047	1.0039	0.0007	0.0257
Experiment LEU-SOL-THERM-007 (5 cases)	leust7_1	0.9961	0.0009	0.9966	0.0002	0.02
	leust7_2	0.9973	0.0009	0.9995	0.0002	0.0187
	leust7_3	0.9985	0.001	0.9979	0.0002	0.0173
	leust7_4	0.9988	0.0011	1.0005	0.0002	0.0166
	leust7_5	0.9983	0.0011	0.9989	0.0002	0.0159
Experiment LEU-SOL-	lst8_72	0.9999	0.0014	1.0038	0.0002	0.0152

Table II-15. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for Enrico Fermi DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
THERM-008 (4 cases)	lst8_74	1.0002	0.0015	1.0023	0.0002	0.0154
	lst8_76	0.9999	0.0014	1.0028	0.0002	0.0153
	lst8_78	0.9999	0.0014	1.0040	0.0002	0.0153
Experiment LEU-SOL-THERM-009 (3 cases)	lst9_92	0.9998	0.0014	1.0018	0.0005	0.0155
	lst9_93	0.9999	0.0014	1.0021	0.0002	0.0157
	lst9_94	0.9999	0.0014	1.0022	0.0002	0.0158
Experiment LEU-SOL-THERM-010 (4 cases)	lst10_83	0.9999	0.0153	1.0023	0.0003	0.0153
	lst10_85	0.9999	0.0154	1.0019	0.0003	0.0154
	lst10_86	1.0000	0.0153	1.0032	0.0003	0.0153
	lst10_88	1.0001	0.0154	1.0026	0.0003	0.0154
Experiment LEU-SOL-THERM-016 (7 cases)	lst16_05	0.9996	0.0013	1.0093	0.0007	0.0267
	lst16_13	0.9999	0.0013	1.0080	0.0006	0.0248
	lst16_25	0.9994	0.0014	1.0075	0.0006	0.0216
	lst16_29	0.9996	0.0014	1.0068	0.0006	0.0209
	lst16_31	0.9995	0.0014	1.0059	0.0005	0.0195
	lst16_40	0.9992	0.0015	1.0043	0.0005	0.0186
	lst16_96	0.9994	0.0015	1.0047	0.0005	0.018
Experiment LEU-SOL-THERM-017 (6 cases)	lst17_04	0.9981	0.0013	1.0051	0.0007	0.0275
	lst17_22	0.9986	0.0013	1.0049	0.0006	0.0258
	lst17_23	0.9989	0.0014	1.0052	0.0006	0.0224
	lst17_26	0.9992	0.0014	1.0043	0.0006	0.0212
	lst17_30	0.9987	0.0015	1.0043	0.0005	0.02
	lst17_47	0.9996	0.0015	1.0042	0.0006	0.0192
Experiment LEU-SOL-THERM-018 (6 cases)	RUN133	0.9992	0.001	1.0033	0.0002	0.0183
	RUN142	0.9996	0.001	1.0042	0.0003	0.0187
	RUN143	0.9996	0.001	1.0045	0.0003	0.0188
	RUN144	0.9997	0.001	1.0033	0.0003	0.0187
	RUN145	0.9992	0.001	1.0038	0.0003	0.0187
	RUN146	0.9996	0.001	1.0037	0.0003	0.0186
Experiment LEU-SOL-THERM-019 (6 cases)	RUN149	0.9997	0.0009	1.0043	0.0003	0.019
	RUN150	0.9995	0.0009	1.0043	0.0003	0.019
	RUN151	0.9999	0.0009	1.0049	0.0002	0.0191
	RUN152	0.9996	0.0009	1.0054	0.0003	0.0191
	RUN153	0.9998	0.0009	1.0050	0.0003	0.0191
	RUN183	0.9994	0.0009	1.0036	0.0003	0.0189
Experiment LEU-SOL-THERM-020 (4 cases)	LST20C1	0.9995	0.001	1.0014	0.0003	0.015
	LST20C2	0.9996	0.001	1.0000	0.0003	0.0143
	LST20C3	0.9997	0.0012	0.9993	0.0003	0.0131
	LST20C4	0.9998	0.0012	1.0004	0.0003	0.0125
Experiment LEU-SOL-THERM-021 (4 cases)	LST21C1	0.9983	0.0009	0.9991	0.0003	0.0154
	LST21C2	0.9985	0.001	0.9996	0.0003	0.0144
	LST21C3	0.9989	0.0011	0.9976	0.0003	0.0135
	LST21C4	0.9993	0.0012	0.9999	0.0003	0.0127

Table II-15. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for Enrico Fermi DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment IEU-COMP-THERM-001 (29 cases)	iect101	1.0000	0.004	0.9974	0.00092	0.216791
	iect102	1.0000	0.004	0.9960	0.00092	0.15817
	iect103	1.0000	0.004	0.9931	0.00104	0.10412
	iect104	1.0000	0.004	0.9974	0.00105	0.07405
	iect105	1.0000	0.004	1.0085	0.00091	0.04552
	iect106	1.0000	0.004	1.0003	0.00103	0.10793
	iect107	1.0000	0.004	0.9980	0.00101	0.11064
	iect108	1.0000	0.004	0.9960	0.00101	0.11867
	iect109	1.0000	0.004	1.0004	0.00084	0.1679
	iect110	1.0000	0.004	0.9967	0.00099	0.15756
	iect111	1.0000	0.004	0.9958	0.00096	0.15732
	iect112	1.0000	0.004	0.9964	0.00101	0.15568
	iect113	1.0000	0.004	0.9967	0.00103	0.0743
	iect114	1.0000	0.004	0.9979	0.00094	0.07375
	iect115	1.0000	0.004	0.9981	0.00099	0.074
	iect116	1.0000	0.004	1.0021	0.00093	0.05547
	iect117	1.0000	0.004	0.9965	0.00102	0.20814
	iect118	1.0000	0.004	0.9976	0.00113	0.13428
	iect119	1.0000	0.004	1.0045	0.00101	0.06114
	iect120	1.0000	0.004	1.0005	0.00094	0.15539
	iect121	1.0000	0.004	0.9988	0.00087	0.21334
	iect122	1.0000	0.004	0.9990	0.00109	0.19772
	iect123	1.0000	0.004	0.9952	0.00107	0.12826
	iect124a	1.0000	0.004	1.0004	0.00105	0.13305
	iect125	1.0000	0.004	0.9987	0.0009	0.05992
	iect126	1.0000	0.004	1.0044	0.00095	0.05663
	iect127	1.0000	0.004	1.0032	0.00086	0.05633
	iect128	1.0000	0.004	1.0051	0.00091	0.15824
	iect129	1.0000	0.004	1.0012	0.00099	0.15184

Source: BSC2002a, Table 6-15

Table II-16. k_{eff} Values for Benchmarks Applicable to Degraded Non-moderated Configurations for Enrico Fermi DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment IEU-MET-FAST-001 (4 cases)	imf1-1	0.9988	0.0012	1.0022	0.00029	1.4394
	imf1-2	0.9988	0.0012	1.0023	0.00028	1.4398
	imf1-3	0.9990	0.001	1.0040	0.00029	1.386
	imf1-4	0.9990	0.001	1.0048	0.00028	1.3859
Experiment IEU-MET-FAST-002 (1 case)	imf2-1	1.0000	0.003	1.0059	0.0006	1.2784

Table II-16. k_{eff} Values for Benchmarks Applicable to Degraded Non-moderated Configurations for Enrico Fermi DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment IEU-MET-FAST-003 (1 case)	imf3-1	1.0000	0.0017	0.9993	0.00076	1.3502
Experiment IEU-MET-FAST-004 (1 case)	imf4-1	1.0000	0.003	1.0105	0.00084	1.3071
Experiment IEU-MET-FAST-005 (1 case)	imf5-1	1.0000	0.0021	1.0088	0.00079	1.2852
Experiment IEU-MET-FAST-006 (1 case)	imf6-1	1.0000	0.0023	0.9960	0.00081	1.2892
Experiment IEU-MET-FAST-007 (1 case)	ieumf7	1.0045	0.0007	1.0125	0.0002	1.253
Experiment IEU-MET-FAST-008 (1 case)	imf8-1	1.0000	0.0018	1.0087	0.00084	1.365
Experiment IEU-MET-FAST-009 (1 case)	ieumf09-01	1.0000	0.0053	1.0081	0.0008	1.014
Experiment IEU-MET-FAST-010 (1 case)	ieumf10	0.9954	0.0024	0.9982	0.0002	1.149

Source: BSC2002a, Table 6-16

k_{eff} Values for Benchmark Experiments Applicable to Configurations of the Codisposal Waste Package Containing MOX (FFTF) DOE SNF

Table II-17. k_{eff} Values for Benchmarks Applicable to Intact Moderated Configurations for FFTF DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment MIX-COMP-THERM-001 (4 cases)	fftf001	1.0000	0.0026	1.0057	0.0034	0.1044
	fftf004	1.0000	0.0032	0.9933	0.0035	0.0816
	fftf005	1.0000	0.0025	0.9958	0.0036	0.1717
	fftf006	1.0000	0.0039	1.0129	0.0029	0.0635
Experiment MIX-COMP-THERM-003 (6 cases)	smr1	1.0000	0.0042	0.9963	0.0007	0.1707
	smr5	1.0000	0.0042	0.9944	0.0007	0.1928
	smr8	1.0000	0.0071	0.9986	0.0006	0.2045
	smr9	1.0000	0.0057	0.9947	0.0007	0.1683
	smr11	1.0000	0.0052	0.9983	0.0007	0.2049
	smr12	1.0000	0.0028	0.9987	0.0007	0.2041
Experiment MIX-COMP-THERM-004 (11 cases)	mixct-4-1	1.0000	0.0046	0.9957	0.0011	0.1218
	mixct-4-2	1.0000	0.0046	0.9987	0.0011	0.1208
	mixct-4-3	1.0000	0.0046	0.9970	0.0011	0.1208
	mixct-4-4	1.0000	0.0039	0.9957	0.0010	0.1066
	mixct-4-5	1.0000	0.0039	0.9986	0.0010	0.1059

Table II-17. k_{eff} Values for Benchmarks Applicable to Intact Moderated Configurations for FFTF DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	mixct-4-6	1.0000	0.0039	0.9992	0.0010	0.1061
	mixct-4-7	1.0000	0.004	0.9994	0.0010	0.0875
	mixct-4-8	1.0000	0.004	1.0030	0.0010	0.0869
	mixct-4-9	1.0000	0.004	1.0002	0.0011	0.0861
	mixct-4-10	1.0000	0.0051	1.0011	0.0009	0.0751
	mixct-4-11	1.0000	0.0051	1.0015	0.0009	0.0747
Experiment MIX-COMP-THERM-010 (MIX-MISC-THERM-001) (11 cases)	mct10-06	1.0000	0.0044	0.9954	0.0006	0.1390
	mct10-07	1.0000	0.0044	0.9953	0.0006	0.1453
	mct10-09	1.0000	0.0044	0.9976	0.0006	0.1397
	mct10-10	1.0000	0.0044	0.9954	0.0006	0.1382
	mct10-11	1.0000	0.0044	0.9987	0.0006	0.1536
	mct10-12	1.0000	0.0032	1.0033	0.0006	0.1514
	mct10-13	1.0000	0.0032	1.0041	0.0006	0.1509
	mct10-14	1.0000	0.0032	1.0033	0.0006	0.1477
	mct10-15	1.0000	0.0066	1.0041	0.0006	0.1470
	mct10-16	1.0000	0.0066	1.0060	0.0006	0.1455
	mct10-17	1.0000	0.0025	1.0051	0.0006	0.0326

Source: BSC2002a, Table 6-17

Table II-18. k_{eff} Values for Benchmarks Applicable to Intact Non-moderated Configurations for FFTF DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment PU-MET-FAST-003 (5 cases)	PMF003_101	1.0000	0.0030	0.9985	0.0006	1.8996
	PMF003_102	1.0000	0.0030	0.9924	0.0006	1.8231
	PMF003_103	1.0000	0.0030	0.9938	0.0005	1.9008
	PMF003_104	1.0000	0.0030	0.9946	0.0006	1.8053
	PMF003_105	1.0000	0.0030	0.9939	0.0006	1.9023
Experiment PU-MET-FAST-004 (9 cases)	PMF004_207	1.0000	0.0030	0.9954	0.0011	1.8968
	PMF004_208	1.0000	0.0030	0.9912	0.0013	1.8996
	PMF004_209	1.0000	0.0030	0.9944	0.0011	1.9040
	PMF004_210	1.0000	0.0030	0.9949	0.0012	1.8916
	PMF004_211	1.0000	0.0030	0.9921	0.0013	1.9049
	PMF004_212	1.0000	0.0030	0.9927	0.0012	1.9057
	PMF004_213	1.0000	0.0030	0.9952	0.0012	1.9060
	PMF004_214	1.0000	0.0030	0.9930	0.0012	1.9087
	PMF004_215	1.0000	0.0030	0.9943	0.0012	1.9137
Experiment PU-MET-FAST-016 (6 cases)	pmf016_1	0.9974	0.0042	1.0121	0.0008	1.2810
	pmf016_2	1.0000	0.0038	1.0022	0.0008	1.2540
	pmf016_3	1.0000	0.0033	1.0019	0.0008	1.2500
	pmf016_4	1.0000	0.0030	0.9987	0.0007	1.2540

Table II-18. k_{eff} Values for Benchmarks Applicable to Intact Non-moderated Configurations for FFTF DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	pmf016_5	1.0000	0.0034	0.9987	0.0008	1.2490
	pmf016_6	1.0000	0.0032	1.0027	0.0008	1.2440
Experiment PU-MET-FAST-017 (5 cases)	PMF017_201	1.0000	0.0030	0.9938	0.0013	1.7671
	PMF017_202	1.0000	0.0030	0.9955	0.0011	1.6515
	PMF017_203	1.0000	0.0030	1.0022	0.0014	1.5765
	PMF017_204	1.0000	0.0030	0.9974	0.0011	1.6423
	PMF017_205	1.0000	0.0030	1.0044	0.0012	1.4391
Experiment PU-MET-FAST-037 (16 cases)	pmf037_01	1.0000	0.0044	1.0022	0.0007	1.5348
	pmf037_02	1.0000	0.0044	0.9999	0.0008	1.4853
	pmf037_03	1.0000	0.0043	0.9977	0.0008	1.4798
	pmf037_04	1.0000	0.0043	1.0027	0.0007	1.4556
	pmf037_05	1.0000	0.0037	1.0000	0.0008	1.4200
	pmf037_06	1.0000	0.0040	0.9985	0.0007	1.3708
	pmf037_07	1.0000	0.0038	1.0001	0.0008	1.3642
	pmf037_08	1.0000	0.0033	1.0006	0.0008	1.3188
	pmf037_09	1.0000	0.0037	0.9998	0.0007	1.3182
	pmf037_10	1.0000	0.0034	1.0020	0.0008	1.3436
	pmf037_11	1.0000	0.0038	0.9942	0.0008	1.4671
	pmf037_12	1.0000	0.0040	0.9994	0.0007	1.3496
	pmf037_13	1.0000	0.0030	1.0000	0.0008	1.2816
	pmf037_14	1.0000	0.0032	1.0033	0.0008	1.3015
	pmf037_15	1.0000	0.0033	1.0018	0.0008	1.3163
	pmf037_16	1.0000	0.0039	1.0036	0.0008	1.3649
Experiment PU-COMP-MIXED-001 (5 cases)	pcm001_1	0.9986	0.0041	1.0286	0.0009	1.7020
	pcm001_2	1.0000	0.0068	1.0188	0.0013	0.6330
	pcm001_3	0.9990	0.0067	1.0150	0.0013	0.2750
	pcm001_4	1.0000	0.0066	0.9853	0.0014	0.2880
	pcm001_5	0.9989	0.0072	1.0101	0.0015	0.0988
Experiment PU-COMP-MIXED-002 (29 cases)	Pcm002_01	0.9990	0.0046	1.0318	0.0009	1.0460
	Pcm002_02	0.9990	0.0046	1.0309	0.0009	1.0300
	Pcm002_03	0.9990	0.0046	1.0253	0.0008	1.0090
	Pcm002_04	0.9990	0.0046	1.0199	0.0009	0.9810
	Pcm002_05	0.9990	0.0046	1.0139	0.0008	0.9430
	Pcm002_06	1.0000	0.0044	1.0188	0.0009	0.4390
	Pcm002_07	1.0000	0.0044	1.0185	0.0009	0.4320
	Pcm002_08	1.0000	0.0044	1.0174	0.0008	0.4220
	Pcm002_09	1.0000	0.0044	1.0192	0.0008	0.4110
	Pcm002_10	1.0000	0.0044	1.0290	0.0009	0.1840
	Pcm002_11	1.0000	0.0044	1.0257	0.0009	0.1880
	Pcm002_12	1.0000	0.0044	1.0241	0.0009	0.1900
	Pcm002_13	1.0000	0.0044	1.0228	0.0010	0.1940
	Pcm002_14	1.0000	0.0044	1.0272	0.0009	0.1940
	Pcm002_15	1.0000	0.0044	1.0241	0.0009	0.1940

Table II-18. k_{eff} Values for Benchmarks Applicable to Intact Non-moderated Configurations for FFTF DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	Pcm002_16	1.0000	0.0044	1.0206	0.0009	0.1910
	Pcm002_17	0.9988	0.0055	1.0060	0.0009	0.1955
	Pcm002_18	0.9988	0.0055	1.0081	0.0009	0.2037
	Pcm002_19	0.9988	0.0055	1.0064	0.0009	0.2044
	Pcm002_20	0.9988	0.0055	1.0063	0.0009	0.2050
	Pcm002_21	0.9988	0.0055	1.0084	0.0009	0.2068
	Pcm002_22	0.9988	0.0055	1.0110	0.0009	0.2054
	Pcm002_23	1.0000	0.0046	1.0058	0.0009	0.0770
	Pcm002_24	1.0000	0.0046	1.0090	0.0009	0.0770
	Pcm002_25	1.0000	0.0046	1.0081	0.0009	0.0780
	Pcm002_26	1.0000	0.0046	1.0103	0.0010	0.0770
	Pcm002_27	1.0000	0.0046	1.0090	0.0009	0.0780
	Pcm002_28	1.0000	0.0046	1.0095	0.0009	0.0780
	Pcm002_29	1.0000	0.0046	1.0104	0.0009	0.0780

Source: BSC2002a, Table 6-18

Table II-19. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for FFTF DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment MIX-SOL-THERM-001 (12 cases)	pnl3187	1.0000	0.0016	0.9976	0.0012	0.0417
	pnl3391	1.0000	0.0016	0.9943	0.0012	0.0411
	pnl3492	1.0000	0.0016	0.9975	0.0012	0.0431
	pnl3593	1.0000	0.0016	0.9973	0.0011	0.0459
	pnl3694	1.0000	0.0016	1.0026	0.0012	0.0445
	pnl3795	1.0000	0.0016	1.0017	0.0012	0.0400
	pnl3896	1.0000	0.0016	1.0024	0.0012	0.0232
	pnl3897	1.0000	0.0016	1.0045	0.0011	0.0142
	pnl3898	1.0000	0.0016	1.0029	0.0010	0.0299
	pnl3808	1.0000	0.0016	1.0020	0.0011	0.0213
	pnl3999	1.0000	0.0052	1.0092	0.0011	0.0296
	pnl5300	1.0000	0.0052	1.0080	0.0011	0.0288
Experiment MIX-SOL-THERM-002 (3 cases)	pnl1158	1.0000	0.0024	1.0069	0.0007	0.0038
	pnl1159	1.0000	0.0024	1.0074	0.0006	0.0037
	pnl1161	1.0000	0.0024	1.0079	0.0007	0.0061
Experiment MIX-SOL-THERM-003 (10 cases)	awre1	0.9985	0.002	1.0147	0.0010	0.0315
	awre2	0.996	0.002	1.0157	0.0012	0.0315
	awre3	0.9935	0.002	1.0120	0.0012	0.0320
	awre4	0.9909	0.002	1.0051	0.0012	0.0319
	awre5	0.9981	0.0022	1.0085	0.0010	0.0104
	awre6	0.9959	0.0022	1.0107	0.0010	0.0104

Table II-19. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for FFTF DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	awre7	0.9935	0.0022	1.0080	0.0010	0.0105
	awre8	0.9988	0.0025	1.0128	0.0008	0.0069
	awre9	0.9958	0.0025	1.0094	0.0009	0.0066
	awre10	0.9964	0.0025	1.0102	0.0008	0.0066
Experiment MIX-SOL-THERM-004 (9 cases)	pnl1577	1.0000	0.0033	0.9958	0.0012	0.0589
	pnl1678	1.0000	0.0033	0.9974	0.0012	0.0504
	pnl1783	1.0000	0.0078	0.9992	0.0012	0.0534
	pnl1868	1.0000	0.0078	1.0039	0.0013	0.0343
	pnl1969	1.0000	0.0033	1.0000	0.0012	0.0334
	pnl2070	1.0000	0.0033	0.9996	0.0014	0.0377
	pnl2565	1.0000	0.0033	1.0015	0.0012	0.0129
	pnl2666	1.0000	0.0033	1.0018	0.0011	0.0117
	pnl2767	1.0000	0.0078	1.0061	0.0011	0.0123
Experiment PU-SOL-THERM-001 (6 cases)	pust1t1	1.0000	0.005	1.0106	0.0010	0.0126
	pust1t2	1.0000	0.005	1.0128	0.0010	0.0172
	pust1t3	1.0000	0.005	1.0145	0.0011	0.0209
	pust1t4	1.0000	0.005	1.0077	0.0011	0.0237
	pust1t5	1.0000	0.005	1.0111	0.0010	0.0246
	pust1t6	1.0000	0.005	1.0100	0.0010	0.0488
Experiment PU-SOL-THERM-003 (8 cases)	pu003-1	1.0000	0.005	1.0089	0.0009	0.0063
	pu003-2	1.0000	0.005	1.0076	0.0009	0.0066
	pu003-3	1.0000	0.005	1.0116	0.0010	0.0070
	pu003-4	1.0000	0.005	1.0116	0.0010	0.0072
	pu003-5	1.0000	0.005	1.0116	0.0009	0.0077
	pu003-6	1.0000	0.005	1.0128	0.0010	0.0086
	pu003-7	1.0000	0.005	1.0144	0.0009	0.0067
	pu003-8	1.0000	0.005	1.0119	0.0009	0.0068
Experiment PU-SOL-THERM-004 (13 cases)	pu004-1	1.0000	0.0047	1.0117	0.0009	0.0052
	pu004-2	1.0000	0.0047	1.0067	0.0009	0.0053
	pu004-3	1.0000	0.0047	1.0087	0.0009	0.0056
	pu004-4	1.0000	0.0047	1.0056	0.0009	0.0056
	pu004-5	1.0000	0.0047	1.0068	0.0009	0.0054
	pu004-6	1.0000	0.0047	1.0087	0.0009	0.0057
	pu004-7	1.0000	0.0047	1.0118	0.0009	0.0058
	pu004-8	1.0000	0.0047	1.0079	0.0009	0.0059
	pu004-9	1.0000	0.0047	1.0091	0.0009	0.0062
	pu04-10	1.0000	0.0047	1.0098	0.0009	0.0072
	pu04-11	1.0000	0.0047	1.0080	0.0010	0.0085
	pu04-12	1.0000	0.0047	1.0103	0.0009	0.0057
	pu04-13	1.0000	0.0047	1.0063	0.0009	0.0057
Experiment PU-SOL-THERM-005 (9 cases)	pu005-1	1.0000	0.0047	1.0087	0.0009	0.0057
	pu005-2	1.0000	0.0047	1.0108	0.0009	0.0058
	pu005-3	1.0000	0.0047	1.0123	0.0009	0.0062

Table II-19. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for FFTF DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	pu005-4	1.0000	0.0047	1.0118	0.0009	0.0068
	pu005-5	1.0000	0.0047	1.0125	0.0009	0.0073
	pu005-6	1.0000	0.0047	1.0128	0.0009	0.0078
	pu005-7	1.0000	0.0047	1.0103	0.0009	0.0084
	pu005-8	1.0000	0.0047	1.0056	0.0009	0.0061
	pu005-9	1.0000	0.0047	1.0093	0.0009	0.0064
Experiment PU-SOL-THERM-007 (8 cases)	pu007-2	1.0000	0.0047	1.0136	0.0011	0.0410
	pu007-3	1.0000	0.0047	1.0054	0.0010	0.0397
	pu007-5	1.0000	0.0047	1.0144	0.0010	0.0175
	pu007-6	1.0000	0.0047	1.0081	0.0011	0.0177
	pu007-7	1.0000	0.0047	1.0104	0.0011	0.0177
	pu007-8	1.0000	0.0047	1.0051	0.0010	0.0180
	pu007-9	1.0000	0.0047	1.0027	0.0011	0.0180
	pu07-10	1.0000	0.0047	1.0064	0.0010	0.0171
Experiment PU-SOL-THERM-009 (3 cases)	pust9-1	1.0000	0.0033	1.0199	0.0008	0.0029
	pust9-2	1.0000	0.0033	1.0233	0.0008	0.0026
	pust9-3	1.0000	0.0033	1.0209	0.0008	0.0025
Experiment PU-SOL-THERM-010 (14 cases)	pu10091	1.0000	0.0048	1.0219	0.0011	0.0166
	pu10092	1.0000	0.0048	1.0193	0.0010	0.0127
	pu10093	1.0000	0.0048	1.0143	0.0010	0.0093
	pu10111	1.0000	0.0048	1.0183	0.0010	0.0103
	pu10112	1.0000	0.0048	1.0169	0.0010	0.0089
	pu10113	1.0000	0.0048	1.0138	0.0010	0.0087
	pu10114	1.0000	0.0048	1.0085	0.0009	0.0080
	pu10115	1.0000	0.0048	1.0100	0.0009	0.0075
	pu10116	1.0000	0.0048	1.0192	0.0010	0.0111
	pu10117	1.0000	0.0048	1.0097	0.0010	0.0090
	pu10121	1.0000	0.0048	1.0173	0.0010	0.0089
	pu10122	1.0000	0.0048	1.0153	0.0010	0.0080
	pu10123	1.0000	0.0048	1.0221	0.0010	0.0067
	pu10124	1.0000	0.0048	1.0170	0.0009	0.0059
Experiment PU-SOL-THERM-011 (12 cases)	pu11161	1.0000	0.0052	1.0167	0.0010	0.0074
	pu11162	1.0000	0.0052	1.0206	0.0010	0.0076
	pu11163	1.0000	0.0052	1.0255	0.0010	0.0083
	pu11164	1.0000	0.0052	1.0170	0.0010	0.0085
	pu11165	1.0000	0.0052	1.0132	0.0010	0.0096
	pu11181	1.0000	0.0052	1.0032	0.0009	0.0050
	pu11182	1.0000	0.0052	1.0089	0.0009	0.0053
	pu11183	1.0000	0.0052	1.0051	0.0009	0.0053
	pu11184	1.0000	0.0052	1.0020	0.0009	0.0053
	pu11185	1.0000	0.0052	1.0096	0.0010	0.0059
	pu11186	1.0000	0.0052	1.0072	0.0009	0.0063
	pu11187	1.0000	0.0052	1.0073	0.0009	0.0054

Table II-19. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for FFTF DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment PU-SOL-THERM-012 (23 cases)	pst012_01	1.0000	0.0043	1.0115	0.0009	0.0048
	pst012_02	1.0000	0.0043	1.0118	0.0008	0.0042
	pst012_03	1.0000	0.0058	1.0124	0.0007	0.0040
	pst012_04	1.0000	0.0058	1.0117	0.0007	0.0037
	pst012_05	1.0000	0.0058	1.0178	0.0006	0.0035
	pst012_06	1.0000	0.0007	1.0075	0.0013	0.0222
	pst012_07	1.0000	0.0013	1.0080	0.0013	0.0172
	pst012_08	1.0000	0.0013	1.0121	0.0012	0.0111
	pst012_09	1.0000	0.0043	1.0157	0.0011	0.0070
	pst012_10	1.0000	0.0043	1.0111	0.0009	0.0061
	pst012_11	1.0000	0.0043	1.0149	0.0010	0.0051
	pst012_12	1.0000	0.0043	1.0144	0.0008	0.0047
	pst012_13	1.0000	0.0058	1.0141	0.0006	0.0034
	pst012_14	1.0000	0.0013	1.0074	0.0011	0.0118
	pst012_15	1.0000	0.0043	1.0161	0.0011	0.0074
	pst012_16	1.0000	0.0043	1.0111	0.0010	0.0063
	pst012_17	1.0000	0.0043	1.0144	0.0009	0.0051
	pst012_18	1.0000	0.0043	1.0149	0.0009	0.0050
	pst012_19	1.0000	0.0043	1.0153	0.0009	0.0043
	pst012_20	1.0000	0.0058	1.0149	0.0008	0.0042
	pst012_21	1.0000	0.0058	1.0141	0.0007	0.0038
	pst012_22	1.0000	0.0058	1.0155	0.0007	0.0035
	pst012_23	1.0000	0.0058	1.0151	0.0006	0.0034
Experiment PU-SOL-THERM-013 (21cases)	pst13-01	0.998	0.004	1.0088	0.0008	0.0247
	pst13-02	0.998	0.004	1.0080	0.0008	0.0251
	pst13-04	0.9965	0.0052	1.0060	0.0008	0.0252
	pst13-05	0.9965	0.0052	1.0075	0.0008	0.0251
	pst13-06	0.9965	0.0052	1.0062	0.0009	0.0251
	pst13-07	0.9965	0.0052	1.0093	0.0008	0.0246
	pst13-08	0.9965	0.0052	1.0095	0.0008	0.0249
	pst13-09	0.9965	0.0052	1.0060	0.0009	0.0247
	pst13-10	0.9965	0.0052	1.0060	0.0009	0.0249
	pst13-11	0.9965	0.0052	1.0120	0.0008	0.0251
	pst13-12	0.9965	0.0052	1.0078	0.0008	0.0249
	pst13-13	0.9965	0.0052	1.0053	0.0008	0.0250
	pst13-14	0.9965	0.0052	1.0080	0.0008	0.0250
	pst13-15	0.9959	0.0062	1.0149	0.0008	0.0243
	pst13-16	0.9959	0.0062	1.0081	0.0008	0.0251
	pst13-17	0.9959	0.0062	1.0072	0.0008	0.0251
	pst13-18	0.9959	0.0062	1.0063	0.0008	0.0245
	pst13-19	0.9959	0.0062	1.0069	0.0008	0.0248
	pst13-20	0.9959	0.0062	1.0059	0.0008	0.0249
	pst13-21	0.9966	0.0043	1.0070	0.0008	0.0250

Table II-19. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for FFTF DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	pst13-22	0.9966	0.0043	1.0122	0.0008	0.0245
Experiment PU-SOL-THERM-014 (35 cases)	pst014_1	0.9980	0.0032	1.0104	0.0010	0.0240
	pst014_10	0.9980	0.0032	1.0072	0.0010	0.0240
	pst014_11	0.9980	0.0032	1.0109	0.0010	0.0250
	pst014_12	0.9980	0.0032	1.0115	0.0010	0.0250
	pst014_13	0.9980	0.0043	1.0118	0.0010	0.0250
	pst014_14	0.9980	0.0043	1.0084	0.0010	0.0250
	pst014_15	0.9980	0.0043	1.0087	0.0010	0.0250
	pst014_16	0.9980	0.0043	1.0086	0.0010	0.0250
	pst014_17	0.9980	0.0043	1.0100	0.0010	0.0240
	pst014_18	0.9980	0.0043	1.0116	0.0010	0.0240
	pst014_19	0.9980	0.0043	1.0092	0.0010	0.0250
	pst014_2	0.9980	0.0032	1.0094	0.0010	0.0240
	pst014_20	0.9980	0.0043	1.0095	0.0010	0.0240
	pst014_21	0.9980	0.0043	1.0091	0.0010	0.0240
	pst014_22	0.9980	0.0043	1.0070	0.0010	0.0240
	pst014_23	0.9980	0.0043	1.0080	0.0011	0.0240
	pst014_24	0.9980	0.0043	1.0114	0.0010	0.0240
	pst014_25	0.9980	0.0043	1.0083	0.0010	0.0250
	pst014_26	0.9980	0.0043	1.0096	0.0010	0.0240
	pst014_27	0.9980	0.0043	1.0078	0.0010	0.0240
	pst014_28	0.9980	0.0043	1.0099	0.0010	0.0240
	pst014_29	0.9980	0.0043	1.0059	0.0010	0.0250
	pst014_3	0.9980	0.0032	1.0100	0.0010	0.0250
	pst014_30	0.9980	0.0043	1.0091	0.0010	0.0250
	pst014_31	0.9980	0.0043	1.0084	0.0011	0.0240
	pst014_32	0.9980	0.0043	1.0084	0.0010	0.0250
	pst014_33	0.9980	0.0043	1.0075	0.0010	0.0250
	pst014_34	0.9980	0.0043	1.0095	0.0010	0.0250
	pst014_35	0.9980	0.0043	1.0084	0.0010	0.0250
	pst014_4	0.9980	0.0032	1.0103	0.0010	0.0240
	pst014_5	0.9980	0.0032	1.0110	0.0010	0.0250
	pst014_6	0.9980	0.0032	1.0088	0.0010	0.0240
	pst014_7	0.9980	0.0032	1.0104	0.0010	0.0250
	pst014_8	0.9980	0.0032	1.0090	0.0010	0.0250
	pst014_9	0.9980	0.0032	1.0110	0.0010	0.0250
Experiment PU-SOL-THERM-015 (17 cases)	pst015_1	0.9980	0.0038	1.0088	0.0010	0.0330
	pst015_10	0.9971	0.0047	1.0076	0.0010	0.0330
	pst015_11	0.9971	0.0047	1.0053	0.0010	0.0330
	pst015_12	0.9971	0.0047	1.0084	0.0010	0.0330
	pst015_13	0.9971	0.0047	1.0069	0.0010	0.0330
	pst015_14	0.9971	0.0047	1.0068	0.0010	0.0330
	pst015_15	0.9971	0.0047	1.0097	0.0010	0.0330

Table II-19. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for FFTF DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	pst015_16	0.9971	0.0047	1.0087	0.0010	0.0330
	pst015_17	0.9971	0.0047	1.0079	0.0010	0.0330
	pst015_2	0.9980	0.0038	1.0078	0.0010	0.0330
	pst015_3	0.9980	0.0038	1.0096	0.0010	0.0330
	pst015_4	0.9980	0.0038	1.0092	0.0010	0.0330
	pst015_5	0.9980	0.0038	1.0089	0.0010	0.0330
	pst015_6	0.9980	0.0038	1.0091	0.0010	0.0330
	pst015_7	0.9971	0.0047	1.0093	0.0010	0.0330
	pst015_8	0.9971	0.0047	1.0065	0.0010	0.0330
	pst015_9	0.9971	0.0047	1.0071	0.0010	0.0330
Experiment PU-SOL-THERM-016 (11 cases)	pst016_1	0.9980	0.0043	1.0076	0.0010	0.0330
	pst016_10	0.9963	0.0033	1.0106	0.0011	0.0242
	pst016_11	0.9963	0.0033	1.0101	0.0010	0.0242
	pst016_2	0.9980	0.0043	1.0071	0.0010	0.0330
	pst016_3	0.9980	0.0043	1.0089	0.0010	0.0325
	pst016_4	0.9980	0.0043	1.0100	0.0010	0.0328
	pst016_5	0.9969	0.0038	1.0086	0.0010	0.0241
	pst016_6	0.9969	0.0038	1.0096	0.0010	0.0246
	pst016_7	0.9969	0.0038	1.0103	0.0010	0.0247
	pst016_8	0.9969	0.0038	1.0091	0.0010	0.0244
	pst016_9	0.9963	0.0033	1.0107	0.0010	0.0245
Experiment PU-SOL-THERM-017 (18 cases)	pst017_1	0.9969	0.0038	1.0089	0.0010	0.0250
	pst017_10	0.9969	0.0038	1.0082	0.0010	0.0250
	pst017_11	0.9969	0.0038	1.0100	0.0010	0.0240
	pst017_12	0.9969	0.0038	1.0081	0.0010	0.0250
	pst017_13	0.9969	0.0038	1.0084	0.0010	0.0240
	pst017_14	0.9969	0.0038	1.0081	0.0010	0.0250
	pst017_15	0.9969	0.0038	1.0102	0.0010	0.0240
	pst017_16	0.9969	0.0038	1.0108	0.0010	0.0250
	pst017_17	0.9969	0.0038	1.0088	0.0010	0.0250
	pst017_18	0.9969	0.0038	1.0088	0.0010	0.0240
	pst017_2	0.9969	0.0038	1.0109	0.0011	0.0250
	pst017_3	0.9969	0.0038	1.0080	0.0010	0.0240
	pst017_4	0.9969	0.0038	1.0067	0.0010	0.0240
	pst017_5	0.9969	0.0038	1.0102	0.0010	0.0250
	pst017_6	0.9969	0.0038	1.0088	0.0010	0.0250
	pst017_7	0.9969	0.0038	1.0076	0.0010	0.0250
	pst017_8	0.9969	0.0038	1.0101	0.0010	0.0250
	pst017_9	0.9969	0.0038	1.0088	0.0010	0.0250
Experiment PU-SOL-THERM-020 (8 cases)	pst020_1.T8A	1.0000	0.0059	1.0105	0.0009	0.0078
	pst020_2.T8A	1.0000	0.0059	1.0144	0.0010	0.0078
	pst020_3.T8A	1.0000	0.0059	1.0077	0.0009	0.0067
	pst020_5.T8A	1.0000	0.0059	1.0080	0.0010	0.0100

Table II-19. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for FFTF DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	pst020_6.T8A	1.0000	0.0059	1.0103	0.0010	0.0106
	pst020_7.T8A	1.0000	0.0059	1.0046	0.0009	0.0067
	pst020_8.T8A	1.0000	0.0059	1.0109	0.0011	0.0146
	pst020_9.T8A	1.0000	0.0059	1.0044	0.0010	0.0096
Experiment PU-SOL-THERM-021 (6 cases)	pst021_1.T9A	1.0000	0.0032	1.0123	0.0010	0.0080
	pst021_2.T9A	1.0000	0.0032	1.0123	0.0010	0.0070
	pst021_3.T9A	1.0000	0.0065	1.0095	0.0012	0.0400
	pst021_4.T9A	1.0000	0.0025	1.0089	0.0009	0.0050
	pst021_5.T9A	1.0000	0.0025	1.0105	0.0009	0.0050
	pst021_6.T9A	1.0000	0.0044	1.0118	0.0009	0.0090
Experiment PU-SOL-THERM-022 (17 cases)	pst022_01	1.0000	0.002	1.0020	0.0011	0.0320
	pst022_02	1.0000	0.002	1.0071	0.0009	0.0210
	pst022_03	1.0000	0.002	1.0093	0.0010	0.0130
	pst022_04	1.0000	0.002	1.0083	0.0009	0.0110
	pst022_05	1.0000	0.002	1.0093	0.0009	0.0090
	pst022_06	1.0000	0.003	1.0113	0.0008	0.0080
	pst022_07	1.0000	0.003	1.0117	0.0007	0.0070
	pst022_08	1.0000	0.003	1.0124	0.0008	0.0070
	pst022_09	1.0000	0.003	1.0103	0.0008	0.0060
	pst022_10	1.0000	0.002	1.0024	0.0010	0.0340
	pst022_11	1.0000	0.002	0.9969	0.0010	0.0290
	pst022_12	1.0000	0.002	1.0035	0.0010	0.0210
	pst022_13	1.0000	0.002	1.0014	0.0010	0.0170
	pst022_14	1.0000	0.002	1.0017	0.0010	0.0150
	pst022_15	1.0000	0.002	0.9968	0.0009	0.0120
	pst022_16	1.0000	0.002	1.0007	0.0009	0.0110
	pst022_17	1.0000	0.002	1.0024	0.0009	0.0110
Experiment PU-SOL-THERM-023 (3 cases)	pst23-1	1.0000	0.0038	1.0011	0.0009	0.0212
	pst23-7	1.0000	0.0038	1.0036	0.0009	0.0234
	pst23-11	1.0000	0.0038	1.0012	0.0009	0.0214
Experiment PU-SOL-THERM-024 (23 cases)	pst024_1	1.0000	0.0062	1.0081	0.0020	0.0560
	pst024_10	1.0000	0.0053	1.0094	0.0019	0.0340
	pst024_11	1.0000	0.0053	1.0079	0.0019	0.0350
	pst024_12	1.0000	0.0053	1.0082	0.0020	0.0340
	pst024_13	1.0000	0.0053	1.0078	0.0019	0.0340
	pst024_14	1.0000	0.0053	1.0034	0.0021	0.0440
	pst024_15	1.0000	0.0053	1.0046	0.0018	0.0450
	pst024_16	1.0000	0.0053	1.0032	0.0019	0.0440
	pst024_17	1.0000	0.0053	1.0033	0.0018	0.0430
	pst024_18	1.0000	0.0051	1.0095	0.0019	0.0140
	pst024_19	1.0000	0.0051	1.0089	0.0018	0.0140
	pst024_2	1.0000	0.0062	0.9981	0.0019	0.0560
	pst024_20	1.0000	0.0051	1.0143	0.0018	0.0140

Table II-19. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for FFTF DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	pst024_21	1.0000	0.0051	1.0106	0.0018	0.0140
	pst024_22	1.0000	0.0051	1.0119	0.0017	0.0140
	pst024_23	1.0000	0.0051	1.0083	0.0017	0.0150
	pst024_3	1.0000	0.0062	1.0000	0.0020	0.0560
	pst024_4	1.0000	0.0062	1.0025	0.0019	0.0560
	pst024_5	1.0000	0.0062	0.9998	0.0019	0.0560
	pst024_6	1.0000	0.0077	0.9966	0.0019	0.1050
	pst024_7	1.0000	0.0053	1.0111	0.0018	0.0350
	pst024_8	1.0000	0.0053	1.0096	0.0018	0.0340
	pst024_9	1.0000	0.0053	1.0086	0.0021	0.0340
Experiment PU-SOL-THERM-025 (44 cases)	pst025_1	1.0000	0.0039	1.0176	0.0011	0.0110
	pst025_10	1.0000	0.0038	1.0071	0.0012	0.0130
	pst025_11	1.0000	0.0038	1.0053	0.0012	0.0130
	pst025_12	1.0000	0.0038	1.0093	0.0012	0.0140
	pst025_13	1.0000	0.0038	1.0053	0.0013	0.0130
	pst025_14	1.0000	0.004	1.0046	0.0013	0.0320
	pst025_15	1.0000	0.004	1.0051	0.0013	0.0310
	pst025_16	1.0000	0.004	1.0060	0.0013	0.0310
	pst025_17	1.0000	0.004	1.0044	0.0013	0.0310
	pst025_18	1.0000	0.004	1.0057	0.0013	0.0310
	pst025_19	1.0000	0.004	1.0043	0.0013	0.0320
	pst025_2	1.0000	0.0039	1.0170	0.0012	0.0110
	pst025_20	1.0000	0.004	1.0028	0.0014	0.0320
	pst025_21	1.0000	0.0044	0.9987	0.0012	0.0390
	pst025_22	1.0000	0.0044	0.9975	0.0013	0.0400
	pst025_23	1.0000	0.0044	1.0003	0.0013	0.0400
	pst025_24	1.0000	0.0044	0.9950	0.0014	0.0410
	pst025_25	1.0000	0.0044	0.9970	0.0013	0.0400
	pst025_26	1.0000	0.0044	0.9956	0.0014	0.0410
	pst025_27	1.0000	0.0044	0.9935	0.0013	0.0410
	pst025_28	1.0000	0.0048	0.9954	0.0013	0.0500
	pst025_29	1.0000	0.0048	0.9938	0.0013	0.0500
	pst025_3	1.0000	0.0039	1.0186	0.0012	0.0110
	pst025_30	1.0000	0.0048	0.9957	0.0013	0.0500
	pst025_31	1.0000	0.0048	0.9991	0.0013	0.0500
	pst025_32	1.0000	0.0048	0.9958	0.0013	0.0500
	pst025_33	1.0000	0.0048	0.9943	0.0013	0.0520
	pst025_34	1.0000	0.0049	0.9962	0.0013	0.0590
	pst025_35	1.0000	0.0049	0.9940	0.0012	0.0600
	pst025_36	1.0000	0.0049	0.9956	0.0012	0.0600
	pst025_37	1.0000	0.0049	0.9949	0.0012	0.0600
	pst025_38	1.0000	0.0049	0.9940	0.0013	0.0600
	pst025_39	1.0000	0.006	0.9961	0.0013	0.0940

Table II-19. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for FFTF DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	pst025_4	1.0000	0.0039	1.0157	0.0013	0.0110
	pst025_40	1.0000	0.006	0.9927	0.0013	0.0950
	pst025_41	1.0000	0.006	0.9929	0.0012	0.0950
	pst025_42	1.0000	0.006	0.9936	0.0012	0.0960
	pst025_43	1.0000	0.006	0.9894	0.0013	0.0960
	pst025_44	1.0000	0.006	0.9904	0.0012	0.0970
	pst025_5	1.0000	0.0039	1.0178	0.0012	0.0110
	pst025_6	1.0000	0.0039	1.0109	0.0012	0.0110
	pst025_7	1.0000	0.0038	1.0046	0.0013	0.0140
	pst025_8	1.0000	0.0038	1.0091	0.0012	0.0130
	pst025_9	1.0000	0.0038	1.0049	0.0012	0.0140
Experiment PU-SOL-THERM-026 (21 cases)	Pst026_01	1.0000	0.0052	1.0024	0.0010	0.0130
	Pst026_02	1.0000	0.0052	1.0001	0.0009	0.0130
	Pst026_03	1.0000	0.0051	1.0013	0.0009	0.0130
	Pst026_04	1.0000	0.0045	1.0024	0.0009	0.0150
	Pst026_05	1.0000	0.0044	1.0017	0.0009	0.0150
	Pst026_06	1.0000	0.0043	1.0008	0.0009	0.0150
	Pst026_07	1.0000	0.0041	1.0027	0.0009	0.0150
	Pst026_08	1.0000	0.0039	1.0033	0.0009	0.0150
	Pst026_09	1.0000	0.0049	0.9995	0.0010	0.0370
	Pst026_10	1.0000	0.0048	1.0021	0.0010	0.0370
	Pst026_11	1.0000	0.0047	1.0021	0.0010	0.0370
	Pst026_12	1.0000	0.0047	1.0023	0.0010	0.0370
	Pst026_13	1.0000	0.0045	1.0011	0.0010	0.0370
	Pst026_14	1.0000	0.0044	1.0054	0.0010	0.0370
	Pst026_15	1.0000	0.0046	0.9900	0.0010	0.0470
	Pst026_16	1.0000	0.0044	0.9961	0.0010	0.0470
	Pst026_17	1.0000	0.005	0.9949	0.0009	0.0590
	Pst026_18	1.0000	0.0049	0.9950	0.0010	0.0600
	Pst026_19	1.0000	0.0049	0.9954	0.0009	0.0590
	Pst026_20	1.0000	0.0049	0.9948	0.0009	0.0600
	Pst026_21	1.0000	0.0049	0.9948	0.0010	0.0600
Experiment PU-SOL-THERM-006 (3 cases)	pst006_1	1.0000	0.0035	1.0080	0.0009	0.0050
	pst006_2	1.0000	0.0035	1.0103	0.0009	0.0050
	pst006_3	1.0000	0.0035	1.0076	0.0009	0.0050
Experiment PU-SOL-THERM-008 (14 cases)	pst008_1.10A	1.0000	0.0033	1.0098	0.0005	0.0070
	pst008_10.10A	1.0000	0.0037	1.0291	0.0005	0.0090
	pst008_11.10A	1.0000	0.0031	1.0227	0.0005	0.0080
	pst008_12.10A	1.0000	0.0041	1.0215	0.0005	0.0140
	pst008_13.10A	1.0000	0.0041	1.0293	0.0005	0.0100
	pst008_14.10A	1.0000	0.0042	1.0114	0.0006	0.0160
	pst008_15.10A	1.0000	0.0041	1.0164	0.0005	0.0100
	pst008_2.10A	1.0000	0.0037	1.0111	0.0005	0.0100

Table II-19. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for FFTF DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	pst008_3.10A	1.0000	0.0040	1.0193	0.0005	0.0100
	pst008_4.10A	1.0000	0.0040	1.0238	0.0005	0.0100
	pst008_5.10A	1.0000	0.0028	1.0232	0.0005	0.0070
	pst008_7.10A	1.0000	0.0028	1.0184	0.0005	0.0060
	pst008_8.10A	1.0000	0.0040	1.0029	0.0005	0.0110
	pst008_9.10A	1.0000	0.0061	1.0072	0.0006	0.0540
Experiment PU-SOL-THERM-002 (7 cases)	pst002_1	1.0000	0.0047	1.0095	0.0010	0.0090
	pst002_2	1.0000	0.0047	1.0115	0.0010	0.0100
	pst002_3	1.0000	0.0047	1.0083	0.0010	0.0100
	pst002_4	1.0000	0.0047	1.0126	0.0010	0.0110
	pst002_5	1.0000	0.0047	1.0144	0.0010	0.0120
	pst002_6	1.0000	0.0047	1.0105	0.0010	0.0130
	pst002_7	1.0000	0.0047	1.0131	0.0010	0.0140
Experiment MIX-SOL-THERM-005 (7 cases)	msl5-63	1.0000	0.0037	0.9877	0.0008	0.0130
	msl5-64	1.0000	0.0037	1.0045	0.0007	0.0120
	msl5-71	1.0000	0.0037	1.0032	0.0008	0.0330
	msl5-72	1.0000	0.0037	1.0001	0.0008	0.0320
	msl5-74	1.0000	0.0037	0.9922	0.0009	0.0370
	msl5-75	1.0000	0.0037	0.9898	0.0009	0.0590
	msl5-76	1.0000	0.0037	0.9974	0.0007	0.0490

Source: BSC2002a, Table 6-19

Table II-20. k_{eff} Values for Benchmarks Applicable to Degraded Non-moderated Configurations for FFTF DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment MIX-MET-MIXED-001 (MIX-MET-INTER-002) (1 case)	mixmm1	0.9991	0.0013	0.9914	0.0004	0.7770
Experiment MIX-MET-FAST-001 (1 case)	mixmf1	1.0000	0.0016	0.9960	0.0020	1.8070
Experiment MIX-MET-FAST-002 (3 cases)	mixmf2-1	1.0000	0.0042	1.0061	0.0010	1.7130
	mixmf2-2	1.0000	0.0044	1.0080	0.0011	1.7050
	mixmf2-3	1.0000	0.0048	1.0067	0.0010	1.6990
Experiment MIX-MET-FAST-003 (1 case)	mixmf3	0.9993	0.0016	0.9993	0.0006	1.7740
Experiment MIX-MET-FAST-004 (2 cases)	mmf4-38	0.9993	0.0013	0.9986	0.0006	1.5470
	mmf4-39	0.9993	0.0013	1.0002	0.0006	1.5410
Experiment MIX-MET-FAST-005 (1 case)	mixmf5	0.999	0.0017	1.0005	0.0003	1.7400

Table II-20. k_{eff} Values for Benchmarks Applicable to Degraded Non-moderated Configurations for FFTF DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment MIX-MET-FAST-009 (1 case)	mixmf9	1.0000	0.001	0.9977	0.0006	1.8510
Experiment MIX-MET-FAST-011 (4 cases)	mmf11-01	0.9897	0.0023	0.9926	0.0005	1.0750
	mmf11-02	0.9998	0.0023	0.9972	0.0005	1.0640
	mmf11-03	1.0018	0.0024	0.9999	0.0004	0.9620
	mmf11-04	1.0012	0.0024	1.0012	0.0005	0.9710
Experiment MIX-MET-FAST-010 (1 case)	mixmf10	1.0000	0.0009	0.9984	0.0006	1.7230
Experiment PU-MET-FAST-001 (1 case)	pumf01	1.0000	0.002	0.9987	0.0012	1.9150
Experiment PU-MET-FAST-002 (1 case)	pumf02	1.0000	0.002	0.9992	0.0011	1.9150
Experiment PU-MET-FAST-005 (1 case)	pumf05	1.0000	0.0013	1.0100	0.0013	1.6610
Experiment PU-MET-FAST-006 (1 case)	pmf006	1.0000	0.003	1.0047	0.0014	1.9010
Experiment PU-MET-FAST-009 (1 case)	pumf09	1.0000	0.0027	0.9999	0.0009	1.8030
Experiment PU-MET-FAST-010 (1 case)	pumf10	1.0000	0.0018	1.0004	0.0013	1.9010
Experiment PU-MET-FAST-011 (1 case)	pumf11	1.0000	0.001	0.9991	0.0014	1.5180
Experiment PU-MET-FAST-018 (1 case)	pumf18	1.0000	0.003	1.0002	0.0013	1.6660
Experiment PU-MET-FAST-019 (1 case)	pumf019	0.9992	0.0015	1.0005	0.0007	1.6200
Experiment PU-MET-FAST-021 (2 cases)	pumf021-1	1.0000	0.0026	1.0032	0.0007	1.6610
	pumf021-2	1.0000	0.0026	0.9979	0.0006	1.6671
Experiment PU-MET-FAST-035 (1 case)	pmf035	1.0000	0.0016	1.0085	0.0007	1.8240
Experiment PU-MET-FAST-036 (1 case)	pmf036	1.0000	0.0031	1.0029	0.0007	1.7160
Experiment PU-MET-FAST-039 (1 case)	pmf039	1.0000	0.0022	0.9870	0.0006	1.8110
Experiment PU-MET-FAST-040 (1 case)	pmf040	1.0000	0.0038	0.9912	0.0006	1.7940
Experiment PU-MET-FAST-041 (1 case)	pmf041	1.0000	0.0016	1.0092	0.0007	1.9440
Experiment PU-MET-FAST-020 (1 case)	PMF20	0.9987	0.0017	1.0009	0.0006	1.8895
Experiment PU-MET-FAST-022 (1 case)	PMF22	1.0000	0.002	0.9963	0.0006	1.8914
Experiment PU-MET-FAST-023 (1 case)	PMF23	1.0000	0.002	0.9974	0.0006	1.7988

Table II-20. k_{eff} Values for Benchmarks Applicable to Degraded Non-moderated Configurations for FFTF DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment PU-MET-FAST-024 (1 case)	PMF24	1.0000	0.002	0.9978	0.0007	1.7418
Experiment PU-MET-FAST-025 (1 case)	PMF25	1.0000	0.002	0.9984	0.0006	1.8293
Experiment PU-MET-FAST-026 (1 case)	PMF26	1.0000	0.0024	1.0017	0.0006	1.7250
Experiment PU-MET-FAST-027 (1 case)	PMF27	1.0000	0.0022	1.0018	0.0008	1.4726
Experiment PU-MET-FAST-028 (1 case)	PMF28	1.0000	0.0022	1.0032	0.0006	1.7100
Experiment PU-MET-FAST-029 (1 case)	PMF29	1.0000	0.0019	0.9931	0.0006	1.9154
Experiment PU-MET-FAST-030 (1 case)	PMF30	1.0000	0.0021	1.0008	0.0007	1.8138
Experiment PU-MET-FAST-031 (1 case)	PMF31	1.0000	0.0021	1.0021	0.0007	1.6057
Experiment PU-MET-FAST-032 (1 case)	PMF32	1.0000	0.002	0.9994	0.0006	1.8113
Experiment PU-MET-MIXED-001 (5 cases)	pmm1-2	1.0002	0.0025	1.0051	0.0006	0.3781
	pmm1-3	1.0000	0.0025	1.0088	0.0006	0.3392
	pmm1-4	1.0001	0.0025	1.0165	0.0006	0.2175
	pmm1-5	1.0003	0.0025	1.0159	0.0006	0.2157
	pmm1-a1	1.0002	0.0032	0.9983	0.0006	0.4510

Source: BSC2002a, Table 6-20

k_{eff} values for benchmark experiments applicable to configurations of the codisposal Waste Package containing Graphite/Carbide (Ft. St. Vrain HTGR) DOE SNF

Table II-21. k_{eff} Values for Benchmarks Applicable to Intact Moderated Configurations for Ft. St. Vrain HTGR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment HEU-COMP-THERM-002 (25 cases)	hct2_1	1.0011	0.0069	1.0095	0.0017	0.02439
	hct2_2	1.0011	0.0069	1.0157	0.0018	0.01948
	hct2_3	1.0011	0.0069	1.0161	0.0017	0.01643
	hct2_4	1.0011	0.0069	1.0186	0.0019	0.01449
	hct2_5	1.0011	0.0069	1.0181	0.0016	0.01295
	hct2_6	1.0011	0.0069	1.0182	0.0016	0.01208
	hct2_7	1.0011	0.0069	1.0171	0.0014	0.01181
	hct2_8	1.0011	0.0069	1.0178	0.0016	0.01054

Table II-21. k_{eff} Values for Benchmarks Applicable to Intact Moderated Configurations for Ft. St. Vrain HTGR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	hct2_9	1.0011	0.0069	1.0173	0.0013	0.00994
	hct2_10	1.0011	0.0069	1.016	0.0013	0.00986
	hct2_11	1.0011	0.0053	1.0155	0.0018	0.02013
	hct2_12	1.0011	0.0053	1.0171	0.0016	0.01411
	hct2_13	1.0011	0.0053	1.0219	0.0017	0.01249
	hct2_14	1.0011	0.0055	1.0179	0.0017	0.01201
	hct2_15	1.0011	0.0055	1.0181	0.0014	0.01122
	hct2_16	1.0011	0.0055	1.0161	0.0016	0.01024
	hct2_17	1.0011	0.0055	1.0196	0.0013	0.00978
	hct2_18	1.0020	0.0043	1.019	0.0018	0.02096
	hct2_19	1.0020	0.0043	1.0155	0.0016	0.01522
	hct2_20	1.0020	0.0043	1.0135	0.0017	0.01223
	hct2_21	1.0020	0.0043	1.0178	0.0014	0.01125
	hct2_22	1.0020	0.0043	1.0183	0.0015	0.00936
	hct2_23	1.0008	0.0085	1.0196	0.0018	0.01542
	hct2_24	1.0008	0.0085	1.0185	0.0016	0.01212
	hct2_25	1.0008	0.0085	1.0136	0.0017	0.0112
Experiment HEU-COMP-MIXED-001 (26 cases)	hcm-1	1.0000	0.0059	1.0027	0.001	0.1045
	hcm-2	1.0012	0.0059	1.0059	0.0011	0.1053
	hcm-5	0.9985	0.0056	0.9963	0.001	0.7833
	hcm-6	0.9953	0.0056	0.9899	0.001	0.7962
	hcm-7	0.9997	0.0038	0.9949	0.001	0.8015
	hcm-8	0.9984	0.0052	0.9915	0.0011	0.6872
	hcm-9	0.9983	0.0052	0.9931	0.0011	0.6536
	hcm-10	0.9979	0.0052	0.9941	0.001	0.6494
	hcm-11	0.9983	0.0052	0.9934	0.0011	0.6385
	hcm-12	0.9972	0.0052	0.996	0.0011	0.6358
	hcm-13	1.0032	0.0053	0.9977	0.0011	0.6309
	hcm-15	1.0083	0.005	0.9949	0.0011	0.4671
	hcm-16	1.0001	0.0046	0.9926	0.0011	0.4692
	hcm-17	0.9997	0.0046	1.0012	0.0011	0.4647
	hcm-18	1.0075	0.0046	1	0.001	0.4625
	hcm-19	1.0039	0.0047	1	0.0011	0.5191
	hcm-20	1.006	0.0065	1.0051	0.0015	0.5357
	hcm-21	1.0026	0.0064	1.0046	0.0016	0.5378
	hcm-22	1.0013	0.0064	0.9995	0.0016	0.5371
	hcm-23	0.9995	0.0053	1.0056	0.0015	0.535
	hcm-24	1.002	0.0053	1.0003	0.0016	0.5352
	hcm-25	0.9983	0.0053	0.997	0.0014	0.5333
	hcm-26	0.9998	0.0053	1.0001	0.0015	0.5283
	hcm-27	0.9991	0.0053	0.9978	0.0016	0.5302
	hcm-28	1.0037	0.0053	1.0033	0.0015	0.541
	hcm-29	0.9992	0.0052	0.9998	0.0014	0.5401

Table II-21. k_{eff} Values for Benchmarks Applicable to Intact Moderated Configurations for Ft. St. Vrain HTGR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment HEU-MET-INTER-006 (2 cases)	hmi06-01	0.9976	0.0008	0.9967	0.0003	0.342
	hmi06-02	0.9997	0.0008	0.9984	0.0003	0.386
Experiment U233-SOL-THERM-006 (12 cases)	m35	1.0000	0.0035	1.023	0.0008	0.0576
	m36	1.0000	0.0035	1.0113	0.0008	0.0583
	m37	1.0000	0.0035	0.9996	0.0008	0.0588
	m38	1.0000	0.0035	1.0011	0.0008	0.0584
	m45	1.0000	0.0035	1.0186	0.0011	0.059
	m61	1.0000	0.0035	1.0228	0.0008	0.0345
	m62	1.0000	0.0035	1.0132	0.0008	0.0346
	m63	1.0000	0.0035	0.9988	0.0008	0.0352
	m65	1.0000	0.0035	0.9939	0.0008	0.0350
	m77	1.0000	0.0035	0.9939	0.0011	0.0358
	m78	1.0000	0.0035	0.9932	0.0011	0.0358
	m79	1.0000	0.0035	0.9929	0.0011	0.0355
Experiments with SB cores (LWBR) (8 cases)	SB1m	1.0020	0.019	0.99953	0.0006	0.070228
	SB2m	1.0020	0.019	0.99714	0.0006	0.094981
	SB25m	1.0000	0.019	0.99795	0.0006	0.067624
	SB3m	1.0020	0.019	0.99516	0.0005	0.079284
	SB4m	1.0020	0.019	0.99984	0.0005	0.067017
	SB5m	1.0020	0.019	0.9966	0.0005	0.057312
	SB6m	1.0020	0.019	0.9903	0.0006	0.078802
	SB7m	1.0020	0.019	0.99509	0.0005	0.095296

Source: BSC2002a, Table 6-21, except SB cores experiments that are presented in Section 4 and 6.

Table II-22. k_{eff} Values for Benchmarks Applicable to Intact Non-Moderated Configurations for Ft. St. Vrain HTGR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment U233-MET-FAST-001 (1 case)	u2331a	1.0000	0.001	0.99297	0.00038	1.77385
Experiment U233-MET-FAST-002 (2 cases)	u2332a	1.0000	0.001	0.99547	0.00038	1.73702
	u2332b	1.0000	0.0011	0.99807	0.00039	1.70789
Experiment U233-MET-FAST-003 (2 cases)	u2333a	1.0000	0.001	0.99583	0.00041	1.74832
	u2333b	1.0000	0.001	0.99771	0.00041	1.76231
Experiment U233-MET-FAST-004 (2 cases)	u2334a1	1.0000	0.0007	1.00356	0.00041	1.61336
	u2334b1	1.0000	0.0008	1.00637	0.00043	1.51775
Experiment U233-MET-FAST-005 (2 cases)	u2335a	1.0000	0.003	0.99351	0.00043	1.6195
	u2335b	1.0000	0.003	0.99681	0.00045	1.51871
Experiment U233-MET-FAST-006 (1 case)	u2336a	1.0000	0.0014	1.00057	0.00045	1.77403

Table II-22. k_{eff} Values for Benchmarks Applicable to Intact Non-Moderated Configurations for Ft. St. Vrain HTGR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment HEU-MET-FAST-007 (43 cases)	hmf7_01	0.9971	0.0001	0.9941	0.0013	1.5855
	hmf7_02	0.9986	0.0001	0.9943	0.0013	1.4036
	hmf7_03	1.0012	0.0001	0.9929	0.0015	1.3617
	hmf7_04	0.9970	0.0001	0.9916	0.0015	1.3232
	hmf7_05	1.0000	0.0001	0.9909	0.0016	1.253
	hmf7_06	1.0028	0.0001	0.9995	0.0014	1.223
	hmf7_07	0.9996	0.0001	0.9945	0.0014	1.2195
	hmf7_08	0.9992	0.0001	0.9898	0.0014	1.2156
	hmf7_09	1.0017	0.0008	1.0003	0.0016	1.2192
	hmf7_10	1.0000	0.0001	0.9908	0.0019	0.9503
	hmf7_11	0.9982	0.0001	0.9887	0.0021	0.7392
	hmf7_12	0.9951	0.0001	0.9865	0.0015	0.7036
	hmf7_13	1.0009	0.0001	0.9956	0.0018	0.743
	hmf7_14	0.9983	0.0001	0.9891	0.0018	0.7021
	hmf7_15	0.9978	0.0001	0.9924	0.0019	0.7483
	hmf7_16	0.9988	0.0001	0.9911	0.0019	0.7497
	hmf7_17	0.9972	0.0001	0.9886	0.0021	0.521
	hmf7_18	0.9991	0.0001	0.9936	0.002	0.5176
	hmf7_19	0.9983	0.0001	0.9971	0.0014	1.5781
	hmf7_20	0.9981	0.0001	0.989	0.0015	1.264
	hmf7_21	0.9987	0.0001	0.9938	0.0014	1.2465
	hmf7_22	0.9994	0.0001	0.9935	0.0016	1.2323
	hmf7_23	0.9993	0.0001	0.9937	0.0014	1.1298
	hmf7_24	1.0001	0.0001	0.995	0.0017	1.1177
	hmf7_25	0.999	0.0001	0.9921	0.0018	1.0153
	hmf7_26	0.9997	0.0001	0.9894	0.0016	1.0067
	hmf7_27	0.9965	0.0002	0.9916	0.0014	1.3907
	hmf7_28	0.9987	0.0002	0.9913	0.0016	1.2784
	hmf7_29	0.9978	0.0002	0.9934	0.0015	1.1714
	hmf7_30	0.9981	0.0002	0.9936	0.0018	0.8973
	hmf7_31	1.0013	0.0002	0.9967	0.002	0.6162
	hmf7_32	0.9959	0.0001	0.9968	0.0013	1.4869
	hmf7_33	0.9995	0.0001	1.0061	0.0015	1.4324
	hmf7_34	0.9977	0.0001	1.0058	0.0014	1.3814
	hmf7_35	1.0011	0.0001	0.9894	0.0019	1.013
	hmf7_36	0.9999	0.0001	0.9976	0.0017	0.8594
	hmf7_37	0.9988	0.0001	0.9959	0.002	0.7462
	hmf7_38	1.0000	0.0001	0.9996	0.0017	0.7181
	hmf7_39	1.0018	0.0001	1.0009	0.0016	0.7182
	hmf7_40	1.0013	0.0001	0.9976	0.0019	0.7339
	hmf7_41	0.9994	0.0001	0.9968	0.0019	0.5383
	hmf7_42	1.0016	0.0001	0.9979	0.0017	0.5269
	hmf7_43	0.9998	0.0001	0.999	0.0018	0.3145

Table II-22. k_{eff} Values for Benchmarks Applicable to Intact Non-Moderated Configurations for Ft. St. Vrain HTGR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment HEU-MET-FAST-033 (2 cases)	heumf33c1	0.9991	0.0014	0.994	0.0004	0.85
	heumf33c2	0.9991	0.0014	0.9924	0.0004	0.717
Experiment HEU-MET-FAST-034 (3 cases)	heumf34c1	0.999	0.0012	0.9913	0.0004	0.958
	heumf34c2	0.999	0.0012	0.991	0.0004	0.958
	heumf34c3	0.999	0.0012	0.9929	0.0004	0.953
Experiment HEU-MET-FAST-036 (2 cases)	heumf36c1	0.9993	0.0015	0.9932	0.0004	0.866
	heumf36c2	0.9993	0.0013	0.9938	0.0004	1.097
Experiment HEU-MET-MIXED-001 (1 case)	heumm1c1	0.9995	0.0013	1.0044	0.0004	0.762
Experiment HEU-MET-MIXED-004 (1 case)	heumm4c1	0.9999	0.0009	1.0048	0.0004	0.914
Experiment HEU-MET-MIXED-005 (5 cases)	hmm5_1	1.0007	0.0027	1.01308	0.00057	0.307
	hmm5_2	1.0003	0.0028	1.0217	0.00055	0.247
	hmm5_3	1.0012	0.0029	1.01904	0.00052	0.212
	hmm5_4	1.0016	0.003	1.0145	0.0006	0.3175
	hmm5_5	1.0005	0.004	1.00682	0.00052	0.377
Experiment HEU-COMP-MIXED-001 (26 cases)	hcm-1	1.0000	0.0059	1.0027	0.001	0.1045
	hcm-2	1.0012	0.0059	1.0059	0.0011	0.1053
	hcm-5	0.9985	0.0056	0.9963	0.001	0.7833
	hcm-6	0.9953	0.0056	0.9899	0.001	0.7962
	hcm-7	0.9997	0.0038	0.9949	0.001	0.8015
	hcm-8	0.9984	0.0052	0.9915	0.0011	0.6872
	hcm-9	0.9983	0.0052	0.9931	0.0011	0.6536
	hcm-10	0.9979	0.0052	0.9941	0.001	0.6494
	hcm-11	0.9983	0.0052	0.9934	0.0011	0.6385
	hcm-12	0.9972	0.0052	0.996	0.0011	0.6358
	hcm-13	1.0032	0.0053	0.9977	0.0011	0.6309
	hcm-15	1.0083	0.005	0.9949	0.0011	0.4671
	hcm-16	1.0001	0.0046	0.9926	0.0011	0.4692
	hcm-17	0.9997	0.0046	1.0012	0.0011	0.4647
	hcm-18	1.0075	0.0046	1	0.001	0.4625
	hcm-19	1.0039	0.0047	1	0.0011	0.5191
	hcm-20	1.0060	0.0065	1.0051	0.0015	0.5357
	hcm-21	1.0026	0.0064	1.0046	0.0016	0.5378
	hcm-22	1.0013	0.0064	0.9995	0.0016	0.5371
	hcm-23	0.9995	0.0053	1.0056	0.0015	0.535
	hcm-24	1.0020	0.0053	1.0003	0.0016	0.5352
	hcm-25	0.9983	0.0053	0.997	0.0014	0.5333
	hcm-26	0.9998	0.0053	1.0001	0.0015	0.5283
	hcm-27	0.9991	0.0053	0.9978	0.0016	0.5302
	hcm-28	1.0037	0.0053	1.0033	0.0015	0.541
	hcm-29	0.9992	0.0052	0.9998	0.0014	0.5401

Source: BSC2002a, Table 6-22

Table II-23. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for Ft. St. Vrain HTGR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment U233-SOL-THERM-001 (5 cases)	ust001-1	1.0000	0.0031	1.0018	0.0005	0.0038
	ust001-2	1.0005	0.0033	1.0004	0.0006	0.0041
	ust001-3	1.0006	0.0033	0.9994	0.0006	0.0043
	ust001-4	0.9998	0.0033	0.9989	0.0006	0.0043
	ust001-5	0.9999	0.0033	0.9987	0.0006	0.0043
Experiment U233-SOL-THERM-002 (17 cases)	ust02-04	1.0040	0.0087	1.0103	0.0011	0.026
	ust02-05	1.0040	0.0087	0.9973	0.0011	0.0214
	ust02-08	1.0040	0.0087	1.0113	0.001	0.0173
	ust02-10	1.0040	0.0087	1.0096	0.0011	0.0138
	ust02-11	1.0040	0.0087	1.0126	0.001	0.0115
	ust02-12	1.0040	0.0087	1.0006	0.001	0.01
	ust02-14	1.0040	0.0087	0.9875	0.0009	0.0098
	ust02-15	1.0040	0.0087	1.0026	0.001	0.0083
	ust02-17	1.0040	0.0087	0.9897	0.0009	0.0072
	ust02-18	1.0040	0.0087	1.0029	0.0008	0.0066
	ust02-19	1.0040	0.0087	1.0102	0.0008	0.0056
	ust02-22	1.0040	0.0087	0.9967	0.0011	0.0356
	ust02-24	1.0040	0.0087	0.9976	0.0012	0.049
	ust02-34	1.0040	0.0087	1.0038	0.0011	0.0223
	ust02-35	1.0040	0.0087	1.0103	0.0009	0.0155
	ust02-36	1.0040	0.0087	1.0115	0.0009	0.0096
	ust02-38	1.0040	0.0087	1.0097	0.0008	0.0075
Experiment U233-SOL-THERM-003 (10 cases)	ust03-40	0.9995	0.0087	1.008	0.001	0.0387
	ust03-41	0.9991	0.0151	1.026	0.0011	0.0397
	ust03-42	1.0007	0.0087	1.0044	0.0011	0.04
	ust03-45	1.0015	0.0126	1.014	0.0011	0.061
	ust03-55	1.0006	0.0122	1.0197	0.0011	0.0693
	ust03-57	1.0012	0.0087	1.0244	0.001	0.0209
	ust03-58	1.0016	0.0087	1.0167	0.001	0.0138
	ust03-61	1.0016	0.0087	1.0133	0.001	0.0108
	ust03-62	1.0018	0.0087	1.0107	0.001	0.0095
	ust03-65	1.0008	0.0087	1.0073	0.0008	0.0056
Experiment U233-SOL-THERM-004 (8 cases)	ust04-03	1.0039	0.0088	1.0086	0.0011	0.0257
	ust04-06	1.0034	0.0086	1.0113	0.001	0.0208
	ust04-20	1.0041	0.0089	1.0006	0.0011	0.0353
	ust04-25	1.0051	0.0089	0.9936	0.0011	0.0493
	ust04-27	1.0020	0.0105	1.0119	0.0011	0.0479
	ust04-28	1.0020	0.0104	1.0063	0.0011	0.0425
	ust04-30	1.0037	0.009	0.9988	0.0011	0.043
	ust04-33	1.0020	0.0102	1.0087	0.0011	0.0215
	ust05-01	1.0000	0.004	1.0054	0.0009	0.0094

Table II-23. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for Ft. St. Vrain HTGR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment U233-SOL-THERM-005 (2 cases)	ust05-01	1.0000	0.004	1.0054	0.0009	0.0094
	ust05-02	1.0000	0.0049	1.0075	0.0009	0.0078
Experiment U233-SOL-THERM-008 (1 case)	ust008	1.0006	0.0029	0.9986	0.0004	0.003
Experiment U233-SOL-THERM-006 (12 cases)	m35	1.0000	0.0035	1.023	0.0008	0.0576
	m36	1.0000	0.0035	1.0113	0.0008	0.0583
	m37	1.0000	0.0035	0.9996	0.0008	0.0588
	m38	1.0000	0.0035	1.0011	0.0008	0.0584
	m45	1.0000	0.0035	1.0186	0.0011	0.059
	m61	1.0000	0.0035	1.0228	0.0008	0.0345
	m62	1.0000	0.0035	1.0132	0.0008	0.0346
	m63	1.0000	0.0035	0.9988	0.0008	0.0352
	m65	1.0000	0.0035	0.9939	0.0008	0.0350
	m77	1.0000	0.0035	0.9939	0.0011	0.0358
	m78	1.0000	0.0035	0.9932	0.0011	0.0358
	m79	1.0000	0.0035	0.9929	0.0011	0.0355
Experiment HEU-COMP-THERM-002 (25 cases)	hct2_1	1.0011	0.0069	1.0095	0.0017	0.02439
	hct2_2	1.0011	0.0069	1.0157	0.0018	0.01948
	hct2_3	1.0011	0.0069	1.0161	0.0017	0.01643
	hct2_4	1.0011	0.0069	1.0186	0.0019	0.01449
	hct2_5	1.0011	0.0069	1.0181	0.0016	0.01295
	hct2_6	1.0011	0.0069	1.0182	0.0016	0.01208
	hct2_7	1.0011	0.0069	1.0171	0.0014	0.01181
	hct2_8	1.0011	0.0069	1.0178	0.0016	0.01054
	hct2_9	1.0011	0.0069	1.0173	0.0013	0.00994
	hct2_10	1.0011	0.0069	1.016	0.0013	0.00986
	hct2_11	1.0011	0.0053	1.0155	0.0018	0.02013
	hct2_12	1.0011	0.0053	1.0171	0.0016	0.01411
	hct2_13	1.0011	0.0053	1.0219	0.0017	0.01249
	hct2_14	1.0011	0.0055	1.0179	0.0017	0.01201
	hct2_15	1.0011	0.0055	1.0181	0.0014	0.01122
	hct2_16	1.0011	0.0055	1.0161	0.0016	0.01024
	hct2_17	1.0011	0.0055	1.0196	0.0013	0.00978
	hct2_18	1.0020	0.0043	1.019	0.0018	0.02096
	hct2_19	1.0020	0.0043	1.0155	0.0016	0.01522
	hct2_20	1.0020	0.0043	1.0135	0.0017	0.01223
	hct2_21	1.0020	0.0043	1.0178	0.0014	0.01125
	hct2_22	1.0020	0.0043	1.0183	0.0015	0.00936
	hct2_23	1.0008	0.0085	1.0196	0.0018	0.01542
	hct2_24	1.0008	0.0085	1.0185	0.0016	0.01212
	hct2_25	1.0008	0.0085	1.0136	0.0017	0.0112
Experiment HEU-COMP-MIXED-001 (26 cases)	hcm-1	1.0000	0.0059	1.0027	0.001	0.1045
	hcm-2	1.0012	0.0059	1.0059	0.0011	0.1053

Table II-23. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for Ft. St. Vrain HTGR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	hcm-5	0.9985	0.0056	0.9963	0.001	0.7833
	hcm-6	0.9953	0.0056	0.9899	0.001	0.7962
	hcm-7	0.9997	0.0038	0.9949	0.001	0.8015
	hcm-8	0.9984	0.0052	0.9915	0.0011	0.6872
	hcm-9	0.9983	0.0052	0.9931	0.0011	0.6536
	hcm-10	0.9979	0.0052	0.9941	0.001	0.6494
	hcm-11	0.9983	0.0052	0.9934	0.0011	0.6385
	hcm-12	0.9972	0.0052	0.996	0.0011	0.6358
	hcm-13	1.0032	0.0053	0.9977	0.0011	0.6309
	hcm-15	1.0083	0.005	0.9949	0.0011	0.4671
	hcm-16	1.0001	0.0046	0.9926	0.0011	0.4692
	hcm-17	0.9997	0.0046	1.0012	0.0011	0.4647
	hcm-18	1.0075	0.0046	1	0.001	0.4625
	hcm-19	1.0039	0.0047	1	0.0011	0.5191
	hcm-20	1.006	0.0065	1.0051	0.0015	0.5357
	hcm-21	1.0026	0.0064	1.0046	0.0016	0.5378
	hcm-22	1.0013	0.0064	0.9995	0.0016	0.5371
	hcm-23	0.9995	0.0053	1.0056	0.0015	0.535
	hcm-24	1.0020	0.0053	1.0003	0.0016	0.5352
	hcm-25	0.9983	0.0053	0.997	0.0014	0.5333
	hcm-26	0.9998	0.0053	1.0001	0.0015	0.5283
	hcm-27	0.9991	0.0053	0.9978	0.0016	0.5302
	hcm-28	1.0037	0.0053	1.0033	0.0015	0.541
	hcm-29	0.9992	0.0052	0.9998	0.0014	0.5401
Experiment HEU-MET-INTER-006 (2 cases)	hmi06-01	0.9976	0.0008	0.9967	0.0003	0.342
	hmi06-02	0.9997	0.0008	0.9984	0.0003	0.386

Source: BSC2002a, Table 6-23

Table II-24. k_{eff} Values for Benchmarks Applicable to Degraded Non-Moderated Configurations for Ft. St. Vrain HTGR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment U233-SOL-INTER -001 (33 cases)	usi01-01m	1.0000	0.0083	0.986	0.0003	0.1068
	usi01-02m	1.0000	0.0085	0.9814	0.0004	0.1136
	usi01-03m	1.0000	0.0066	0.9838	0.0005	0.1185
	usi01-04m	1.0000	0.0061	0.9952	0.0006	0.1092
	usi01-05m	1.0000	0.0082	0.9868	0.0007	0.1236
	usi01-06m	1.0000	0.0061	0.9895	0.0007	0.1146
	usi01-07m	1.0000	0.0059	0.9851	0.0007	0.1269
	usi01-08m	1.0000	0.0056	0.983	0.0007	0.118

Table II-24. k_{eff} Values for Benchmarks Applicable to Degraded Non-Moderated Configurations for Ft. St. Vrain HTGR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	usi01-09m	1.0000	0.0068	0.9821	0.0007	0.1246
	usi01-10m	1.0000	0.0053	0.9822	0.0007	0.1325
	usi01-11m	1.0000	0.0057	0.9814	0.0007	0.1291
	usi01-12m	1.0000	0.0091	0.9835	0.0007	0.0922
	usi01-13m	1.0000	0.0071	0.9835	0.0007	0.0973
	usi01-14m	1.0000	0.0052	0.9929	0.0007	0.0914
	usi01-15m	1.0000	0.0075	0.9811	0.0007	0.1018
	usi01-16m	1.0000	0.0028	0.9847	0.0007	0.0906
	usi01-17m	1.0000	0.0055	0.9907	0.0007	0.0947
	usi01-19m	1.0000	0.0057	0.9782	0.0003	0.1104
	usi01-18m	1.0000	0.0083	0.9794	0.0007	0.1069
	usi01-20m	1.0000	0.0056	0.9818	0.0008	0.1018
	usi01-21m	1.0000	0.005	0.9773	0.0007	0.1147
	usi01-22m	1.0000	0.0049	0.9802	0.0007	0.1181
	usi01-23m	1.0000	0.0047	0.9939	0.0008	0.1118
	usi01-24m	1.0000	0.0081	0.9932	0.0008	0.0685
	usi01-25m	1.0000	0.0081	0.9855	0.0007	0.0733
	usi01-26m	1.0000	0.0065	0.9897	0.0007	0.0759
	usi01-27m	1.0000	0.0051	0.9931	0.0007	0.0713
	usi01-28m	1.0000	0.0061	0.9856	0.0007	0.0798
	usi01-29m	1.0000	0.0098	0.9784	0.0007	0.0829
	usi01-30m	1.0000	0.0053	0.9795	0.0007	0.0766
	usi01-31m	1.0000	0.0071	0.9923	0.0007	0.0852
	usi01-32m	1.0000	0.0053	0.9794	0.0008	0.0888
	usi01-33m	1.0000	0.0046	0.9953	0.0008	0.0836
Experiment U233-MET-FAST-001 (1 case)	u2331a	1.0000	0.001	0.99297	0.00038	1.77385
Experiment U233-MET-FAST-002 (2 cases)	u2332a	1.0000	0.001	0.99547	0.00038	1.73702
	u2332b	1.0000	0.0011	0.99807	0.00039	1.70789
Experiment U233-MET-FAST-003 (2 cases)	u2333a	1.0000	0.001	0.99583	0.00041	1.74832
	u2333b	1.0000	0.001	0.99771	0.00041	1.76231
Experiment U233-MET-FAST-004 (2 cases)	u2334a1	1.0000	0.0007	1.00356	0.00041	1.61336
	u2334b1	1.0000	0.0008	1.00637	0.00043	1.51775
Experiment U233-MET-FAST-005 (2 cases)	u2335a	1.0000	0.003	0.99351	0.00043	1.6195
	u2335b	1.0000	0.003	0.99681	0.00045	1.51871
Experiment U233-MET-FAST-006 (1 case)	u2336a	1.0000	0.0014	1.00057	0.00045	1.77403
Experiment HEU-MET-FAST-007 (43 cases)	hmf7_01	0.9971	0.0001	0.9941	0.0013	1.5855
	hmf7_02	0.9986	0.0001	0.9943	0.0013	1.4036
	hmf7_03	1.0012	0.0001	0.9929	0.0015	1.3617
	hmf7_04	0.9970	0.0001	0.9916	0.0015	1.3232
	hmf7_05	1.0000	0.0001	0.9909	0.0016	1.253
	hmf7_06	1.0028	0.0001	0.9995	0.0014	1.223

Table II-24. k_{eff} Values for Benchmarks Applicable to Degraded Non-Moderated Configurations for Ft. St. Vrain HTGR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	hmf7_07	0.9996	0.0001	0.9945	0.0014	1.2195
	hmf7_08	0.9992	0.0001	0.9898	0.0014	1.2156
	hmf7_09	1.0017	0.0008	1.0003	0.0016	1.2192
	hmf7_10	1.0000	0.0001	0.9908	0.0019	0.9503
	hmf7_11	0.9982	0.0001	0.9887	0.0021	0.7392
	hmf7_12	0.9951	0.0001	0.9865	0.0015	0.7036
	hmf7_13	1.0009	0.0001	0.9956	0.0018	0.743
	hmf7_14	0.9983	0.0001	0.9891	0.0018	0.7021
	hmf7_15	0.9978	0.0001	0.9924	0.0019	0.7483
	hmf7_16	0.9988	0.0001	0.9911	0.0019	0.7497
	hmf7_17	0.9972	0.0001	0.9886	0.0021	0.521
	hmf7_18	0.9991	0.0001	0.9936	0.002	0.5176
	hmf7_19	0.9983	0.0001	0.9971	0.0014	1.5781
	hmf7_20	0.9981	0.0001	0.989	0.0015	1.264
	hmf7_21	0.9987	0.0001	0.9938	0.0014	1.2465
	hmf7_22	0.9994	0.0001	0.9935	0.0016	1.2323
	hmf7_23	0.9993	0.0001	0.9937	0.0014	1.1298
	hmf7_24	1.0001	0.0001	0.995	0.0017	1.1177
	hmf7_25	0.999	0.0001	0.9921	0.0018	1.0153
	hmf7_26	0.9997	0.0001	0.9894	0.0016	1.0067
	hmf7_27	0.9965	0.0002	0.9916	0.0014	1.3907
	hmf7_28	0.9987	0.0002	0.9913	0.0016	1.2784
	hmf7_29	0.9978	0.0002	0.9934	0.0015	1.1714
	hmf7_30	0.9981	0.0002	0.9936	0.0018	0.8973
	hmf7_31	1.0013	0.0002	0.9967	0.002	0.6162
	hmf7_32	0.9959	0.0001	0.9968	0.0013	1.4869
	hmf7_33	0.9995	0.0001	1.0061	0.0015	1.4324
	hmf7_34	0.9977	0.0001	1.0058	0.0014	1.3814
	hmf7_35	1.0011	0.0001	0.9894	0.0019	1.013
	hmf7_36	0.9999	0.0001	0.9976	0.0017	0.8594
	hmf7_37	0.9988	0.0001	0.9959	0.002	0.7462
	hmf7_38	1.0000	0.0001	0.9996	0.0017	0.7181
	hmf7_39	1.0018	0.0001	1.0009	0.0016	0.7182
	hmf7_40	1.0013	0.0001	0.9976	0.0019	0.7339
	hmf7_41	0.9994	0.0001	0.9968	0.0019	0.5383
	hmf7_42	1.0016	0.0001	0.9979	0.0017	0.5269
	hmf7_43	0.9998	0.0001	0.999	0.0018	0.3145
Experiment HEU-MET-FAST-011 (1 case)	HMF11	0.9989	0.0015	0.99348	0.00079	1.1607
Experiment HEU-MET-FAST-019 (1 case)	HMF19	1.0000	0.0028	1.00277	0.0006	1.4793
Experiment HEU-MET-FAST-020 (1 case)	HMF20	1.0000	0.0028	0.99574	0.00061	1.4341

Table II-24. k_{eff} Values for Benchmarks Applicable to Degraded Non-Moderated Configurations for Ft. St. Vrain HTGR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment HEU-MET-FAST-024 (1 case)	HMF24	0.9990	0.0015	0.99521	0.00109	1.2553
Experiment HEU-MET-FAST-031 (1 case)	heumf31c1	1.0000	0.0059	0.9964	0.0007	0.966
Experiment HEU-MET-FAST-033 (2 cases)	heumf33c1	0.9991	0.0014	0.994	0.0004	0.85
	heumf33c2	0.9991	0.0014	0.9924	0.0004	0.717
Experiment HEU-MET-FAST-034 (3 cases)	heumf34c1	0.9990	0.0012	0.9913	0.0004	0.958
	heumf34c2	0.9990	0.0012	0.991	0.0004	0.958
	heumf34c3	0.9990	0.0012	0.9929	0.0004	0.953
Experiment HEU-MET-FAST-036 (2 cases)	heumf36c1	0.9993	0.0015	0.9932	0.0004	0.866
	heumf36c2	0.9993	0.0013	0.9938	0.0004	1.097
Experiment HEU-MET-FAST-041 (6 cases)	heumf41c1	1.0013	0.003	0.9991	0.0007	1.331
	heumf41c2	1.0022	0.0043	0.9973	0.0007	1.128
	heumf41c3	1.0006	0.0029	0.9984	0.0006	1.466
	heumf41c4	1.0006	0.0025	1.0009	0.0007	1.402
	heumf41c5	1.0006	0.0031	0.9966	0.0008	1.354
	heumf41c6	1.0006	0.0045	0.9993	0.0007	1.315
HEU-MET-MIXED-001 (1 case)	heumm1c1	0.9995	0.0013	1.0044	0.0004	0.762
Experiment HEU-MET-MIXED-002 (1 case)	heumm2c1	1.0000	0.0037	1.0032	0.0007	0.788
Experiment HEU-MET-MIXED-003 (1 case)	heumm3c1	1.0000	0.0038	1.0039	0.0008	0.784
HEU-MET-MIXED-004 (1 case)	heumm4c1	0.9999	0.0009	1.0048	0.0004	0.914
HEU-MET-MIXED-005 (5 cases)	hmm5_1	1.0007	0.0027	1.01308	0.00057	0.307
	hmm5_2	1.0003	0.0028	1.0217	0.00055	0.247
	hmm5_3	1.0012	0.0029	1.01904	0.00052	0.212
	hmm5_4	1.0016	0.003	1.0145	0.0006	0.3175
	hmm5_5	1.0005	0.004	1.00682	0.00052	0.377
Experiment HEU-COMP-MIXED-001 (26 cases)	hcm-1	1.0000	0.0059	1.0027	0.001	0.1045
	hcm-2	1.0012	0.0059	1.0059	0.0011	0.1053
	hcm-5	0.9985	0.0056	0.9963	0.001	0.7833
	hcm-6	0.9953	0.0056	0.9899	0.001	0.7962
	hcm-7	0.9997	0.0038	0.9949	0.001	0.8015
	hcm-8	0.9984	0.0052	0.9915	0.0011	0.6872
	hcm-9	0.9983	0.0052	0.9931	0.0011	0.6536
	hcm-10	0.9979	0.0052	0.9941	0.001	0.6494
	hcm-11	0.9983	0.0052	0.9934	0.0011	0.6385
	hcm-12	0.9972	0.0052	0.996	0.0011	0.6358
	hcm-13	1.0032	0.0053	0.9977	0.0011	0.6309
	hcm-15	1.0083	0.005	0.9949	0.0011	0.4671
	hcm-16	1.0001	0.0046	0.9926	0.0011	0.4692

Table II-24. k_{eff} Values for Benchmarks Applicable to Degraded Non-Moderated Configurations for Ft. St. Vrain HTGR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	hcm-17	0.9997	0.0046	1.0012	0.0011	0.4647
	hcm-18	1.0075	0.0046	1	0.001	0.4625
	hcm-19	1.0039	0.0047	1	0.0011	0.5191
	hcm-20	1.006	0.0065	1.0051	0.0015	0.5357
	hcm-21	1.0026	0.0064	1.0046	0.0016	0.5378
	hcm-22	1.0013	0.0064	0.9995	0.0016	0.5371
	hcm-23	0.9995	0.0053	1.0056	0.0015	0.535
	hcm-24	1.002	0.0053	1.0003	0.0016	0.5352
	hcm-25	0.9983	0.0053	0.997	0.0014	0.5333
	hcm-26	0.9998	0.0053	1.0001	0.0015	0.5283
	hcm-27	0.9991	0.0053	0.9978	0.0016	0.5302
	hcm-28	1.0037	0.0053	1.0033	0.0015	0.541
	hcm-29	0.9992	0.0052	0.9998	0.0014	0.5401

Source: BSC2002a, Table 6-24.

k_{eff} Values for Benchmark Experiments Applicable to Configurations of the Codisposal Waste Package Containing Th/U (Shippingport LWBR) DOE SNF

Table II-25. k_{eff} Values for Benchmarks Applicable to Intact Moderated Configurations for Shippingport LWBR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment HEU-COMP-MIXED-001 (26 cases)	hcm-1	1.0000	0.0059	1.0027	0.0010	0.1045
	hcm-2	1.0012	0.0059	1.0059	0.0011	0.1053
	hcm-5	0.9985	0.0056	0.9963	0.0010	0.7833
	hcm-6	0.9953	0.0056	0.9899	0.0010	0.7962
	hcm-7	0.9997	0.0038	0.9949	0.0010	0.8015
	hcm-8	0.9984	0.0052	0.9915	0.0011	0.6872
	hcm-9	0.9983	0.0052	0.9931	0.0011	0.6536
	hcm-10	0.9979	0.0052	0.9941	0.0010	0.6494
	hcm-11	0.9983	0.0052	0.9934	0.0011	0.6385
	hcm-12	0.9972	0.0052	0.9960	0.0011	0.6358
	hcm-13	1.0032	0.0053	0.9977	0.0011	0.6309
	hcm-15	1.0083	0.0050	0.9949	0.0011	0.4671
	hcm-16	1.0001	0.0046	0.9926	0.0011	0.4692
	hcm-17	0.9997	0.0046	1.0012	0.0011	0.4647
	hcm-18	1.0075	0.0046	1.0000	0.0010	0.4625
	hcm-19	1.0039	0.0047	1.0000	0.0011	0.5191
	hcm-20	1.0060	0.0065	1.0051	0.0015	0.5357
	hcm-21	1.0026	0.0064	1.0046	0.0016	0.5378

Table II-25. k_{eff} Values for Benchmarks Applicable to Intact Moderated Configurations for Shippingport LWBR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	hcm-22	1.0013	0.0064	0.9995	0.0016	0.5371
	hcm-23	0.9995	0.0053	1.0056	0.0015	0.5350
	hcm-24	1.0020	0.0053	1.0003	0.0016	0.5352
	hcm-25	0.9983	0.0053	0.9970	0.0014	0.5333
	hcm-26	0.9998	0.0053	1.0001	0.0015	0.5283
	hcm-27	0.9991	0.0053	0.9978	0.0016	0.5302
	hcm-28	1.0037	0.0053	1.0033	0.0015	0.5410
	hcm-29	0.9992	0.0052	0.9998	0.0014	0.5401
Experiment U233-SOL-THERM-006 (12 cases)	m35	1.0000	0.0035	1.0230	0.0008	0.0576
	m36	1.0000	0.0035	1.0113	0.0008	0.0583
	m37	1.0000	0.0035	0.9996	0.0008	0.0588
	m38	1.0000	0.0035	1.0011	0.0008	0.0584
	m45	1.0000	0.0035	1.0186	0.0011	0.0590
	m61	1.0000	0.0035	1.0228	0.0008	0.0345
	m62	1.0000	0.0035	1.0132	0.0008	0.0346
	m63	1.0000	0.0035	0.9988	0.0008	0.0352
	m65	1.0000	0.0035	0.9939	0.0008	0.0350
	m77	1.0000	0.0035	0.9939	0.0011	0.0358
	m78	1.0000	0.0035	0.9932	0.0011	0.0358
	m79	1.0000	0.0035	0.9929	0.0011	0.0355
Experiment HEU-COMP-THERM-003 (15 cases)	hct3-1	1.0000	0.0044	0.9938	0.0014	0.0467
	hct3-2	1.0000	0.0044	0.9975	0.0014	0.0404
	hct3-3	1.0000	0.0044	0.9964	0.0014	0.0337
	hct3-4	1.0000	0.0044	0.9980	0.0015	0.0259
	hct3-5	1.0000	0.0044	1.0025	0.0014	0.0202
	hct3-6	1.0000	0.0044	1.0062	0.0015	0.0405
	hct3-7	1.0000	0.0044	1.0113	0.0014	0.0339
	hct3-8	1.0000	0.0044	1.0099	0.0016	0.0329
	hct3-9	1.0000	0.0044	1.0131	0.0015	0.0263
	hct310	1.0000	0.0044	1.0096	0.0014	0.0209
	hct311	1.0000	0.0044	1.0133	0.0014	0.0177
	hct312	1.0000	0.0044	0.9896	0.0013	0.0265
	hct313	1.0000	0.0044	0.9968	0.0012	0.0139
	hct314	1.0000	0.0044	1.0050	0.0016	0.0300
	hct315	1.0000	0.0044	1.0078	0.0014	0.0183
Experiment HEU-COMP-THERM-005 (1 case)	hct5-1	1.0000	0.0094	0.9846	0.0013	0.0764
Experiment HEU-COMP-THERM-006 (3 cases)	hct6-t1	1.0000	0.0058	0.9895	0.0014	0.0720
	hct6-t2	1.0000	0.0020	1.0104	0.0013	0.0232
	hct6-t3	1.0000	0.0048	0.9956	0.0010	0.0104
Experiment HEU-COMP-THERM-007 (3 cases)	hct7-4	1.0000	0.0035	0.9993	0.0016	0.0339
	hct7-5	1.0000	0.0041	0.9949	0.0016	0.0458
	hct7-6	1.0000	0.0043	0.9949	0.0015	0.0475

Table II-25. k_{eff} Values for Benchmarks Applicable to Intact Moderated Configurations for Shippingport LWBR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment HEU-COMP-THERM-011 (3 cases)	hct11_1	0.9988	0.0042	0.9868	0.0009	0.0533
	hct11_2	0.9988	0.0043	0.9875	0.0009	0.0503
	hct11_3	0.9988	0.0044	0.9881	0.0010	0.0470
Experiment HEU-COMP-THERM-012 (2 cases)	hct12_1	0.9987	0.0032	0.9858	0.0010	0.0551
	hct12_2	0.9987	0.0034	0.9895	0.0009	0.0509
Experiment HEU-COMP-THERM-013 (2 cases)	hct13_1	0.9988	0.0042	0.9883	0.0008	0.0481
	hct13_2	0.9988	0.0043	0.9902	0.0009	0.0432
Experiments with SB cores (LWBR) (8 cases)	SB1m	1.0020	0.019	0.99953	0.0006	0.070228
	SB2m	1.0020	0.019	0.99714	0.0006	0.094981
	SB25m	1.0000	0.019	0.99795	0.0006	0.067624
	SB3m	1.0020	0.019	0.99516	0.0005	0.079284
	SB4m	1.0020	0.019	0.99984	0.0005	0.067017
	SB5m	1.0020	0.019	0.9966	0.0005	0.057312
	SB6m	1.0020	0.019	0.9903	0.0006	0.078802
	SB7m	1.0020	0.019	0.99509	0.0005	0.095296

Source: BSC2002a, Table 6-25, except SB Experiments (8 cases) that are presented in Section 4 and 6 of this report.

Table II-26. k_{eff} Values for Benchmarks Applicable to Intact Non-moderated Configurations for Shippingport LWBR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment U233-MET-FAST-001 (1 case)	u2331a	1.0000	0.001	0.99297	0.00038	1.77385
Experiment U233-MET-FAST-002 (2 cases)	u2332a	1.0000	0.001	0.99547	0.00038	1.73702
	u2332b	1.0000	0.0011	0.99807	0.00039	1.70789
Experiment U233-MET-FAST-003 (2 cases)	u2333a	1.0000	0.001	0.99583	0.00041	1.74832
	u2333b	1.0000	0.001	0.99771	0.00041	1.76231
Experiment U233-MET-FAST-004 (2 cases)	u2334a1	1.0000	0.0007	1.00356	0.00041	1.61336
	u2334b1	1.0000	0.0008	1.00637	0.00043	1.51775
Experiment U233-MET-FAST-005 (2 cases)	u2335a	1.0000	0.003	0.99351	0.00043	1.6195
	u2335b	1.0000	0.003	0.99681	0.00045	1.51871
Experiment U233-MET-FAST-006 (1 case)	u2336a	1.0000	0.0014	1.00057	0.00045	1.77403
Experiment HEU-COMP-MIXED-001 (26 cases)	hcm-1	1.0000	0.0059	1.0027	0.001	0.1045
	hcm-2	1.0012	0.0059	1.0059	0.0011	0.1053
	hcm-5	0.9985	0.0056	0.9963	0.001	0.7833
	hcm-6	0.9953	0.0056	0.9899	0.001	0.7962
	hcm-7	0.9997	0.0038	0.9949	0.001	0.8015
	hcm-8	0.9984	0.0052	0.9915	0.0011	0.6872
	hcm-9	0.9983	0.0052	0.9931	0.0011	0.6536

Table II-26. k_{eff} Values for Benchmarks Applicable to Intact Non-moderated Configurations for Shippingport LWBR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	hcm-10	0.9979	0.0052	0.9941	0.001	0.6494
	hcm-11	0.9983	0.0052	0.9934	0.0011	0.6385
	hcm-12	0.9972	0.0052	0.996	0.0011	0.6358
	hcm-13	1.0032	0.0053	0.9977	0.0011	0.6309
	hcm-15	1.0083	0.005	0.9949	0.0011	0.4671
	hcm-16	1.0001	0.0046	0.9926	0.0011	0.4692
	hcm-17	0.9997	0.0046	1.0012	0.0011	0.4647
	hcm-18	1.0075	0.0046	1	0.001	0.4625
	hcm-19	1.0039	0.0047	1	0.0011	0.5191
	hcm-20	1.006	0.0065	1.0051	0.0015	0.5357
	hcm-21	1.0026	0.0064	1.0046	0.0016	0.5378
	hcm-22	1.0013	0.0064	0.9995	0.0016	0.5371
	hcm-23	0.9995	0.0053	1.0056	0.0015	0.535
	hcm-24	1.002	0.0053	1.0003	0.0016	0.5352
	hcm-25	0.9983	0.0053	0.997	0.0014	0.5333
	hcm-26	0.9998	0.0053	1.0001	0.0015	0.5283
	hcm-27	0.9991	0.0053	0.9978	0.0016	0.5302
	hcm-28	1.0037	0.0053	1.0033	0.0015	0.541
	hcm-29	0.9992	0.0052	0.9998	0.0014	0.5401
Experiment HEU-MET-FAST-007 (43 cases)	hmf7_01	0.9971	0.0001	0.9941	0.0013	1.5855
	hmf7_02	0.9986	0.0001	0.9943	0.0013	1.4036
	hmf7_03	1.0012	0.0001	0.9929	0.0015	1.3617
	hmf7_04	0.9970	0.0001	0.9916	0.0015	1.3232
	hmf7_05	1.0000	0.0001	0.9909	0.0016	1.253
	hmf7_06	1.0028	0.0001	0.9995	0.0014	1.223
	hmf7_07	0.9996	0.0001	0.9945	0.0014	1.2195
	hmf7_08	0.9992	0.0001	0.9898	0.0014	1.2156
	hmf7_09	1.0017	0.0008	1.0003	0.0016	1.2192
	hmf7_10	1.0000	0.0001	0.9908	0.0019	0.9503
	hmf7_11	0.9982	0.0001	0.9887	0.0021	0.7392
	hmf7_12	0.9951	0.0001	0.9865	0.0015	0.7036
	hmf7_13	1.0009	0.0001	0.9956	0.0018	0.743
	hmf7_14	0.9983	0.0001	0.9891	0.0018	0.7021
	hmf7_15	0.9978	0.0001	0.9924	0.0019	0.7483
	hmf7_16	0.9988	0.0001	0.9911	0.0019	0.7497
	hmf7_17	0.9972	0.0001	0.9886	0.0021	0.521
	hmf7_18	0.9991	0.0001	0.9936	0.002	0.5176
	hmf7_19	0.9983	0.0001	0.9971	0.0014	1.5781
	hmf7_20	0.9981	0.0001	0.989	0.0015	1.264
	hmf7_21	0.9987	0.0001	0.9938	0.0014	1.2465
	hmf7_22	0.9994	0.0001	0.9935	0.0016	1.2323
	hmf7_23	0.9993	0.0001	0.9937	0.0014	1.1298
	hmf7_24	1.0001	0.0001	0.995	0.0017	1.1177

Table II-26. k_{eff} Values for Benchmarks Applicable to Intact Non-moderated Configurations for Shippingport LWBR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	hmf7_25	0.999	0.0001	0.9921	0.0018	1.0153
	hmf7_26	0.9997	0.0001	0.9894	0.0016	1.0067
	hmf7_27	0.9965	0.0002	0.9916	0.0014	1.3907
	hmf7_28	0.9987	0.0002	0.9913	0.0016	1.2784
	hmf7_29	0.9978	0.0002	0.9934	0.0015	1.1714
	hmf7_30	0.9981	0.0002	0.9936	0.0018	0.8973
	hmf7_31	1.0013	0.0002	0.9967	0.002	0.6162
	hmf7_32	0.9959	0.0001	0.9968	0.0013	1.4869
	hmf7_33	0.9995	0.0001	1.0061	0.0015	1.4324
	hmf7_34	0.9977	0.0001	1.0058	0.0014	1.3814
	hmf7_35	1.0011	0.0001	0.9894	0.0019	1.013
	hmf7_36	0.9999	0.0001	0.9976	0.0017	0.8594
	hmf7_37	0.9988	0.0001	0.9959	0.002	0.7462
	hmf7_38	1.0000	0.0001	0.9996	0.0017	0.7181
	hmf7_39	1.0018	0.0001	1.0009	0.0016	0.7182
	hmf7_40	1.0013	0.0001	0.9976	0.0019	0.7339
	hmf7_41	0.9994	0.0001	0.9968	0.0019	0.5383
	hmf7_42	1.0016	0.0001	0.9979	0.0017	0.5269
	hmf7_43	0.9998	0.0001	0.999	0.0018	0.3145
Experiment HEU-MET-FAST-033 (2 cases)	heumf33c1	0.9991	0.0014	0.994	0.0004	0.85
	heumf33c2	0.9991	0.0014	0.9924	0.0004	0.717
Experiment HEU-MET-FAST-034 (3 cases)	heumf34c1	0.999	0.0012	0.9913	0.0004	0.958
	heumf34c2	0.999	0.0012	0.991	0.0004	0.958
	heumf34c3	0.999	0.0012	0.9929	0.0004	0.953
Experiment HEU-MET-FAST-036 (2 cases)	heumf36c1	0.9993	0.0015	0.9932	0.0004	0.866
	heumf36c2	0.9993	0.0013	0.9938	0.0004	1.097
Experiment HEU-MET-MIXED-001 (1 case)	heumm1c1	0.9995	0.0013	1.0044	0.0004	0.762
HEU-MET-MIXED-004 (1 case)	heumm4c1	0.9999	0.0009	1.0048	0.0004	0.914
HEU-MET-MIXED-005 (5 cases)	hmm5_1	1.0007	0.0027	1.01308	0.00057	0.307
	hmm5_2	1.0003	0.0028	1.0217	0.00055	0.247
	hmm5_3	1.0012	0.0029	1.01904	0.00052	0.212
	hmm5_4	1.0016	0.003	1.0145	0.0006	0.3175
	hmm5_5	1.0005	0.004	1.00682	0.00052	0.377
Experiment HEU-COMP-INTER-002 (5 cases)	hci2-1	1.0000	0.0004	0.99236	0.00081	0.243
	hci2-2	1.0000	0.0004	0.99339	0.00107	0.2439
	hci2-3	1.0000	0.0004	0.99603	0.00101	0.2377
	hci2-4	1.0000	0.0004	0.99676	0.00101	0.2394
	hci2-5	1.0000	0.0004	0.99736	0.001	0.2391

Source: BSC2002a, Table 6-26

Table II-27. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for Shippingport LWBR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment U233-SOL-THERM-001 (5 cases)	ust001-1	1.0000	0.0031	1.0018	0.0005	0.0038
	ust001-2	1.0005	0.0033	1.0004	0.0006	0.0041
	ust001-3	1.0006	0.0033	0.9994	0.0006	0.0043
	ust001-4	0.9998	0.0033	0.9989	0.0006	0.0043
	ust001-5	0.9999	0.0033	0.9987	0.0006	0.0043
Experiment U233-SOL-THERM-002 (17 cases)	ust02-04	1.0040	0.0087	1.0103	0.0011	0.026
	ust02-05	1.0040	0.0087	0.9973	0.0011	0.0214
	ust02-08	1.0040	0.0087	1.0113	0.001	0.0173
	ust02-10	1.0040	0.0087	1.0096	0.0011	0.0138
	ust02-11	1.0040	0.0087	1.0126	0.001	0.0115
	ust02-12	1.0040	0.0087	1.0006	0.001	0.01
	ust02-14	1.0040	0.0087	0.9875	0.0009	0.0098
	ust02-15	1.0040	0.0087	1.0026	0.001	0.0083
	ust02-17	1.0040	0.0087	0.9897	0.0009	0.0072
	ust02-18	1.0040	0.0087	1.0029	0.0008	0.0066
	ust02-19	1.0040	0.0087	1.0102	0.0008	0.0056
	ust02-22	1.0040	0.0087	0.9967	0.0011	0.0356
	ust02-24	1.0040	0.0087	0.9976	0.0012	0.049
	ust02-34	1.0040	0.0087	1.0038	0.0011	0.0223
	ust02-35	1.0040	0.0087	1.0103	0.0009	0.0155
	ust02-36	1.0040	0.0087	1.0115	0.0009	0.0096
	ust02-38	1.0040	0.0087	1.0097	0.0008	0.0075
Experiment U233-SOL-THERM-003 (10 cases)	ust03-40	0.9995	0.0087	1.008	0.001	0.0387
	ust03-41	0.9991	0.0151	1.026	0.0011	0.0397
	ust03-42	1.0007	0.0087	1.0044	0.0011	0.04
	ust03-45	1.0015	0.0126	1.014	0.0011	0.061
	ust03-55	1.0006	0.0122	1.0197	0.0011	0.0693
	ust03-57	1.0012	0.0087	1.0244	0.001	0.0209
	ust03-58	1.0016	0.0087	1.0167	0.001	0.0138
	ust03-61	1.0016	0.0087	1.0133	0.001	0.0108
	ust03-62	1.0018	0.0087	1.0107	0.001	0.0095
	ust03-65	1.0008	0.0087	1.0073	0.0008	0.0056
Experiment U233-SOL-THERM-003 (10 cases)	ust04-03	1.0039	0.0088	1.0086	0.0011	0.0257
	ust04-06	1.0034	0.0086	1.0113	0.001	0.0208
	ust04-20	1.0041	0.0089	1.0006	0.0011	0.0353
	ust04-25	1.0051	0.0089	0.9936	0.0011	0.0493
	ust04-27	1.0020	0.0105	1.0119	0.0011	0.0479
	ust04-28	1.0020	0.0104	1.0063	0.0011	0.0425
	ust04-30	1.0037	0.009	0.9988	0.0011	0.043
	ust04-33	1.0020	0.0102	1.0087	0.0011	0.0215
Experiment U233-SOL-THERM-005 (2 cases)	ust05-01	1.0000	0.004	1.0054	0.0009	0.0094
	ust05-02	1.0000	0.0049	1.0075	0.0009	0.0078

Table II-27. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for Shippingport LWBR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment U233-SOL-THERM-008 (1 case)	ust008	1.0006	0.0029	0.9986	0.0004	0.003
Experiment U233-SOL-THERM-006 (12 cases)	m35	1.0000	0.0035	1.023	0.0008	0.0576
	m36	1.0000	0.0035	1.0113	0.0008	0.0583
	m37	1.0000	0.0035	0.9996	0.0008	0.0588
	m38	1.0000	0.0035	1.0011	0.0008	0.0584
	m45	1.0000	0.0035	1.0186	0.0011	0.059
	m61	1.0000	0.0035	1.0228	0.0008	0.0345
	m62	1.0000	0.0035	1.0132	0.0008	0.0346
	m63	1.0000	0.0035	0.9988	0.0008	0.0352
	m65	1.0000	0.0035	0.9939	0.0008	0.0350
	m77	1.0000	0.0035	0.9939	0.0011	0.0358
	m78	1.0000	0.0035	0.9932	0.0011	0.0358
	m79	1.0000	0.0035	0.9929	0.0011	0.0355
Experiment HEU-COMP-MIXED-001 (26 cases)	hcm-1	1.0000	0.0059	1.0027	0.001	0.1045
	hcm-2	1.0012	0.0059	1.0059	0.0011	0.1053
	hcm-5	0.9985	0.0056	0.9963	0.001	0.7833
	hcm-6	0.9953	0.0056	0.9899	0.001	0.7962
	hcm-7	0.9997	0.0038	0.9949	0.001	0.8015
	hcm-8	0.9984	0.0052	0.9915	0.0011	0.6872
	hcm-9	0.9983	0.0052	0.9931	0.0011	0.6536
	hcm-10	0.9979	0.0052	0.9941	0.001	0.6494
	hcm-11	0.9983	0.0052	0.9934	0.0011	0.6385
	hcm-12	0.9972	0.0052	0.996	0.0011	0.6358
	hcm-13	1.0032	0.0053	0.9977	0.0011	0.6309
	hcm-15	1.0083	0.005	0.9949	0.0011	0.4671
	hcm-16	1.0001	0.0046	0.9926	0.0011	0.4692
	hcm-17	0.9997	0.0046	1.0012	0.0011	0.4647
	hcm-18	1.0075	0.0046	1	0.001	0.4625
	hcm-19	1.0039	0.0047	1	0.0011	0.5191
	hcm-20	1.0060	0.0065	1.0051	0.0015	0.5357
	hcm-21	1.0026	0.0064	1.0046	0.0016	0.5378
	hcm-22	1.0013	0.0064	0.9995	0.0016	0.5371
	hcm-23	0.9995	0.0053	1.0056	0.0015	0.535
	hcm-24	1.0020	0.0053	1.0003	0.0016	0.5352
	hcm-25	0.9983	0.0053	0.997	0.0014	0.5333
	hcm-26	0.9998	0.0053	1.0001	0.0015	0.5283
	hcm-27	0.9991	0.0053	0.9978	0.0016	0.5302
	hcm-28	1.0037	0.0053	1.0033	0.0015	0.541
	hcm-29	0.9992	0.0052	0.9998	0.0014	0.5401

Source: BSC2002a, Table 6-27

Table II-28. k_{eff} Values for Benchmarks Applicable to Degraded Non-Moderated Configurations for Shippingport LWBR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment U233-SOL-INTER -001 (33 cases)	usi01-01m	1.0000	0.0083	0.986	0.0003	0.1068
	usi01-02m	1.0000	0.0085	0.9814	0.0004	0.1136
	usi01-03m	1.0000	0.0066	0.9838	0.0005	0.1185
	usi01-04m	1.0000	0.0061	0.9952	0.0006	0.1092
	usi01-05m	1.0000	0.0082	0.9868	0.0007	0.1236
	usi01-06m	1.0000	0.0061	0.9895	0.0007	0.1146
	usi01-07m	1.0000	0.0059	0.9851	0.0007	0.1269
	usi01-08m	1.0000	0.0056	0.983	0.0007	0.118
	usi01-09m	1.0000	0.0068	0.9821	0.0007	0.1246
	usi01-10m	1.0000	0.0053	0.9822	0.0007	0.1325
	usi01-11m	1.0000	0.0057	0.9814	0.0007	0.1291
	usi01-12m	1.0000	0.0091	0.9835	0.0007	0.0922
	usl01-13m	1.0000	0.0071	0.9835	0.0007	0.0973
	usi01-14m	1.0000	0.0052	0.9929	0.0007	0.0914
	usi01-15m	1.0000	0.0075	0.9811	0.0007	0.1018
	usi01-16m	1.0000	0.0028	0.9847	0.0007	0.0906
	usi01-17m	1.0000	0.0055	0.9907	0.0007	0.0947
	usi01-19m	1.0000	0.0057	0.9782	0.0003	0.1104
	usi01-18m	1.0000	0.0083	0.9794	0.0007	0.1069
	usi01-20m	1.0000	0.0056	0.9818	0.0008	0.1018
	usi01-21m	1.0000	0.005	0.9773	0.0007	0.1147
	usi01-22m	1.0000	0.0049	0.9802	0.0007	0.1181
	usi01-23m	1.0000	0.0047	0.9939	0.0008	0.1118
	usi01-24m	1.0000	0.0081	0.9932	0.0008	0.0685
	usi01-25m	1.0000	0.0081	0.9855	0.0007	0.0733
	usi01-26m	1.0000	0.0065	0.9897	0.0007	0.0759
	usi01-27m	1.0000	0.0051	0.9931	0.0007	0.0713
	usi01-28m	1.0000	0.0061	0.9856	0.0007	0.0798
	usi01-29m	1.0000	0.0098	0.9784	0.0007	0.0829
	usi01-30m	1.0000	0.0053	0.9795	0.0007	0.0766
	usi01-31m	1.0000	0.0071	0.9923	0.0007	0.0852
	usi01-32m	1.0000	0.0053	0.9794	0.0008	0.0888
	usi01-33m	1.0000	0.0046	0.9953	0.0008	0.0836
Experiment U233-MET-FAST-001 (1 case)	u2331a	1.0000	0.001	0.99297	0.00038	1.77385
Experiment U233-MET-FAST-002 (2 cases)	u2332a	1.0000	0.001	0.99547	0.00038	1.73702
	u2332b	1.0000	0.0011	0.99807	0.00039	1.70789
Experiment U233-MET-FAST-003 (2 cases)	u2333a	1.0000	0.001	0.99583	0.00041	1.74832
	u2333b	1.0000	0.001	0.99771	0.00041	1.76231
Experiment U233-MET-FAST-004 (2 cases)	u2334a1	1.0000	0.0007	1.00356	0.00041	1.61336
	u2334b1	1.0000	0.0008	1.00637	0.00043	1.51775
Experiment U233-MET-FAST-005 (2 cases)	u2335a	1.0000	0.003	0.99351	0.00043	1.6195
	u2335b	1.0000	0.003	0.99681	0.00045	1.51871

Table II-28. k_{eff} Values for Benchmarks Applicable to Degraded Non-Moderated Configurations for Shippingport LWBR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment U233-MET-FAST-006 (1 case)	u2336a	1.0000	0.0014	1.00057	0.00045	1.77403
Experiment HEU-MET-FAST-007 (43 cases)	hmf7_01	0.9971	0.0001	0.9941	0.0013	1.5855
	hmf7_02	0.9986	0.0001	0.9943	0.0013	1.4036
	hmf7_03	1.0012	0.0001	0.9929	0.0015	1.3617
	hmf7_04	0.9970	0.0001	0.9916	0.0015	1.3232
	hmf7_05	1.0000	0.0001	0.9909	0.0016	1.253
	hmf7_06	1.0028	0.0001	0.9995	0.0014	1.223
	hmf7_07	0.9996	0.0001	0.9945	0.0014	1.2195
	hmf7_08	0.9992	0.0001	0.9898	0.0014	1.2156
	hmf7_09	1.0017	0.0008	1.0003	0.0016	1.2192
	hmf7_10	1.0000	0.0001	0.9908	0.0019	0.9503
	hmf7_11	0.9982	0.0001	0.9887	0.0021	0.7392
	hmf7_12	0.9951	0.0001	0.9865	0.0015	0.7036
	hmf7_13	1.0009	0.0001	0.9956	0.0018	0.743
	hmf7_14	0.9983	0.0001	0.9891	0.0018	0.7021
	hmf7_15	0.9978	0.0001	0.9924	0.0019	0.7483
	hmf7_16	0.9988	0.0001	0.9911	0.0019	0.7497
	hmf7_17	0.9972	0.0001	0.9886	0.0021	0.521
	hmf7_18	0.9991	0.0001	0.9936	0.002	0.5176
	hmf7_19	0.9983	0.0001	0.9971	0.0014	1.5781
	hmf7_20	0.9981	0.0001	0.989	0.0015	1.264
	hmf7_21	0.9987	0.0001	0.9938	0.0014	1.2465
	hmf7_22	0.9994	0.0001	0.9935	0.0016	1.2323
	hmf7_23	0.9993	0.0001	0.9937	0.0014	1.1298
	hmf7_24	1.0001	0.0001	0.995	0.0017	1.1177
	hmf7_25	0.999	0.0001	0.9921	0.0018	1.0153
	hmf7_26	0.9997	0.0001	0.9894	0.0016	1.0067
	hmf7_27	0.9965	0.0002	0.9916	0.0014	1.3907
	hmf7_28	0.9987	0.0002	0.9913	0.0016	1.2784
	hmf7_29	0.9978	0.0002	0.9934	0.0015	1.1714
	hmf7_30	0.9981	0.0002	0.9936	0.0018	0.8973
	hmf7_31	1.0013	0.0002	0.9967	0.002	0.6162
	hmf7_32	0.9959	0.0001	0.9968	0.0013	1.4869
	hmf7_33	0.9995	0.0001	1.0061	0.0015	1.4324
	hmf7_34	0.9977	0.0001	1.0058	0.0014	1.3814
	hmf7_35	1.0011	0.0001	0.9894	0.0019	1.013
	hmf7_36	0.9999	0.0001	0.9976	0.0017	0.8594
	hmf7_37	0.9988	0.0001	0.9959	0.002	0.7462
	hmf7_38	1.0000	0.0001	0.9996	0.0017	0.7181
	hmf7_39	1.0018	0.0001	1.0009	0.0016	0.7182
	hmf7_40	1.0013	0.0001	0.9976	0.0019	0.7339
	hmf7_41	0.9994	0.0001	0.9968	0.0019	0.5383

Table II-28. k_{eff} Values for Benchmarks Applicable to Degraded Non-Moderated Configurations for Shippingport LWBR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	hmf7_42	1.0016	0.0001	0.9979	0.0017	0.5269
	hmf7_43	0.9998	0.0001	0.999	0.0018	0.3145
Experiment HEU-MET-FAST-011 (1 case)	HMF11	0.9989	0.0015	0.99348	0.00079	1.1607
Experiment HEU-MET-FAST-019 (1 case)	HMF19	1.0000	0.0028	1.00277	0.0006	1.4793
Experiment HEU-MET-FAST-020 (1 case)	HMF20	1.0000	0.0028	0.99574	0.00061	1.4341
Experiment HEU-MET-FAST-024 (1 case)	HMF24	0.9990	0.0015	0.99521	0.00109	1.2553
Experiment HEU-MET-FAST-031 (1 case)	heumf31c1	1.0000	0.0059	0.9964	0.0007	0.966
Experiment HEU-MET-FAST-033 (2 cases)	heumf33c1	0.9991	0.0014	0.994	0.0004	0.85
	heumf33c2	0.9991	0.0014	0.9924	0.0004	0.717
Experiment HEU-MET-FAST-034 (3 cases)	heumf34c1	0.999	0.0012	0.9913	0.0004	0.958
	heumf34c2	0.999	0.0012	0.991	0.0004	0.958
	heumf34c3	0.999	0.0012	0.9929	0.0004	0.953
Experiment HEU-MET-FAST-036 (2 cases)	heumf36c1	0.9993	0.0015	0.9932	0.0004	0.866
	heumf36c2	0.9993	0.0013	0.9938	0.0004	1.097
Experiment HEU-MET-FAST-041 (6 cases)	heumf41c1	1.0013	0.003	0.9991	0.0007	1.331
	heumf41c2	1.0022	0.0043	0.9973	0.0007	1.128
	heumf41c3	1.0006	0.0029	0.9984	0.0006	1.466
	heumf41c4	1.0006	0.0025	1.0009	0.0007	1.402
	heumf41c5	1.0006	0.0031	0.9966	0.0008	1.354
	heumf41c6	1.0006	0.0045	0.9993	0.0007	1.315
HEU-MET-MIXED-001 (1 case)	heumm1c1	0.9995	0.0013	1.0044	0.0004	0.762
Experiment HEU-MET-MIXED-002 (1 case)	heumm2c1	1.0000	0.0037	1.0032	0.0007	0.788
Experiment HEU-MET-MIXED-003 (1 case)	heumm3c1	1.0000	0.0038	1.0039	0.0008	0.784
HEU-MET-MIXED-004 (1 case)	heumm4c1	0.9999	0.0009	1.0048	0.0004	0.914
HEU-MET-MIXED-005 (5 cases)	hmm5_1	1.0007	0.0027	1.01308	0.00057	0.307
	hmm5_2	1.0003	0.0028	1.0217	0.00055	0.247
	hmm5_3	1.0012	0.0029	1.01904	0.00052	0.212
	hmm5_4	1.0016	0.003	1.0145	0.0006	0.3175
	hmm5_5	1.0005	0.004	1.00682	0.00052	0.377
Experiment HEU-COMP-MIXED-001 (26 cases)	hcm-1	1.0000	0.0059	1.0027	0.001	0.1045
	hcm-2	1.0012	0.0059	1.0059	0.0011	0.1053
	hcm-5	0.9985	0.0056	0.9963	0.001	0.7833
	hcm-6	0.9953	0.0056	0.9899	0.001	0.7962
	hcm-7	0.9997	0.0038	0.9949	0.001	0.8015

Table II-28. k_{eff} Values for Benchmarks Applicable to Degraded Non-Moderated Configurations for Shippingport LWBR DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	hcm-8	0.9984	0.0052	0.9915	0.0011	0.6872
	hcm-9	0.9983	0.0052	0.9931	0.0011	0.6536
	hcm-10	0.9979	0.0052	0.9941	0.001	0.6494
	hcm-11	0.9983	0.0052	0.9934	0.0011	0.6385
	hcm-12	0.9972	0.0052	0.996	0.0011	0.6358
	hcm-13	1.0032	0.0053	0.9977	0.0011	0.6309
	hcm-15	1.0083	0.005	0.9949	0.0011	0.4671
	hcm-16	1.0001	0.0046	0.9926	0.0011	0.4692
	hcm-17	0.9997	0.0046	1.0012	0.0011	0.4647
	hcm-18	1.0075	0.0046	1	0.001	0.4625
	hcm-19	1.0039	0.0047	1	0.0011	0.5191
	hcm-20	1.0060	0.0065	1.0051	0.0015	0.5357
	hcm-21	1.0026	0.0064	1.0046	0.0016	0.5378
	hcm-22	1.0013	0.0064	0.9995	0.0016	0.5371
	hcm-23	0.9995	0.0053	1.0056	0.0015	0.535
	hcm-24	1.0020	0.0053	1.0003	0.0016	0.5352
	hcm-25	0.9983	0.0053	0.997	0.0014	0.5333
	hcm-26	0.9998	0.0053	1.0001	0.0015	0.5283
	hcm-27	0.9991	0.0053	0.9978	0.0016	0.5302
	hcm-28	1.0037	0.0053	1.0033	0.0015	0.541
	hcm-29	0.9992	0.0052	0.9998	0.0014	0.5401
PU-MET-FAST-008 (1 case)(detailed model evaluated)	pmf8-2	1.0000	0.0006	1.006	0.0009	1.7677

Source: BSC2002a, Table 6-28

k_{eff} Values for Benchmark Experiments Applicable to Configurations of the Codisposal Waste Package Containing U-Metal (N-Reactor) DOE SNF

Table II-29. k_{eff} Values for Benchmarks Applicable to Intact Moderated Configurations for N-reactor DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment with N-reactor Mark IA fuel elements (3 cases)	subc2p8h	1.0000	0.005	1.0048	0.00294	0.4085
	subc3p1h	1.0000	0.005	1.03902	0.00248	0.3516
	subc3p4h	1.0000	0.005	1.02088	0.00277	0.3145
Experiment LEU-COMP-THERM-001 (8 cases)	Case_1	0.9998	0.0031	0.9987	0.00191	0.1239
	Case_2	0.9998	0.0031	0.99557	0.00185	0.1208
	Case_3	0.9998	0.0031	0.9957	0.00175	0.122
	Case_4	0.9998	0.0031	0.99907	0.00144	0.1208

Table II-29. k_{eff} Values for Benchmarks Applicable to Intact Moderated Configurations for N-reactor DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	Case_5	0.9998	0.0031	0.99313	0.00157	0.1218
	Case_6	0.9998	0.0031	0.99882	0.00143	0.1208
	Case_7	0.9998	0.0031	0.99677	0.00143	0.1186
	Case_8	0.9998	0.0031	1.00246	0.00162	0.1201
Experiment with 2.35 wt% ^{235}U and absorber plates (see also LEU-COMP-THERM-016) (4 cases)	exp1	1.0000	0.0031	0.99958	0.00087	0.12037
	exp2	1.0000	0.0031	0.99762	0.00086	0.12291
	exp3	1.0000	0.0031	1.00103	0.00091	0.12005
	exp4	1.0000	0.0031	1.00241	0.00091	0.12057
Experiment with 4.31 wt% ^{235}U subcritical clusters and reflecting walls (see also LEU-COMP-THERM-010) (3 cases)	exp5	1.0000	0.0028	0.9969	0.00103	0.28386
	exp6	1.0000	0.0028	0.99772	0.00105	0.17775
	exp7	1.0000	0.0028	0.99821	0.0011	0.17822
Experiment LEU-COMP-THERM-042 (7 cases)	lct42-01	1.0000	0.0016	0.9944	0.0008	0.169
	lct42-02	1.0000	0.0016	0.9927	0.0008	0.172
	lct42-03	1.0000	0.0016	0.9933	0.0008	0.175
	lct42-04	1.0000	0.0017	0.995	0.0008	0.174
	lct42-05	1.0000	0.0033	0.9948	0.0008	0.173
	lct42-06	1.0000	0.0016	0.9947	0.0008	0.169
	lct42-07	1.0000	0.0018	0.9938	0.0008	0.171

Source: BSC2002a, Table 6-29

Table II-30. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for N-reactor DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiments with LEU UO3-H2O solutions (12 cases)	sphu9a	0.9920	0.006	0.99004	0.00249	0.2541
	sphu9b	0.9925	0.005	0.99269	0.00249	0.2163
	sphu9c	0.9875	0.0058	0.97871	0.00256	0.1883
	sphu9d	0.9821	0.0054	0.97914	0.00242	0.1737
	sphu9e	0.9702	0.007	0.96607	0.00163	0.1591
	sphu9f	1.0063	0.0073	1.00952	0.00261	0.2511
	sphu9g	1.0064	0.0078	1.0136	0.00246	0.1839
	sphu9h	0.9957	0.0061	0.99713	0.00198	0.1651
	sphu9i	1.0298	0.0056	1.03372	0.00274	0.2495
	sphu9j	1.0330	0.0051	1.04207	0.00224	0.1783
	sphu9k	1.0313	0.0032	1.02951	0.00216	0.1661
	sphu9l	1.0209	0.0051	1.02281	0.0021	0.1549
Experiment LEU-SOL-THERM-001 (1 case)	Leust1	0.9991	0.0029	1.01182	0.00101	0.05186
Experiment LEU-SOL-THERM-002 (3 cases)	leust21	1.0038	0.004	0.99855	0.00058	0.02513
	leust22	1.0024	0.0037	0.99659	0.00064	0.0283
	leust23	1.0024	0.0044	1.0009	0.0006	0.02684

Table II-30. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for N-reactor DOE SNF

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment LEU-SOL-THERM-005 (3 cases)	CASE_1	1.0000	0.0042	0.999	0.0005	0.0255
	CASE_2	1.0000	0.0051	0.9985	0.0005	0.0254
	CASE_3	1.0000	0.0064	0.9983	0.0005	0.026
Experiment LEU-COMP-THERM-049 (18 cases)	lct49-01	1.0000	0.0034	0.9923	0.0006	0.294
	lct49-02	1.0000	0.0034	0.9937	0.0006	0.293
	lct49-03	1.0000	0.0034	0.9929	0.0006	0.297
	lct49-04	1.0000	0.0034	0.9931	0.0006	0.3
	lct49-05	1.0000	0.0042	0.9944	0.0007	0.255
	lct49-06	1.0000	0.0042	0.9946	0.0007	0.256
	lct49-07	1.0000	0.0042	0.9932	0.0007	0.253
	lct49-08	1.0000	0.0042	0.9921	0.0007	0.258
	lct49-09	1.0000	0.0037	0.9933	0.0006	0.227
	lct49-10	1.0000	0.0037	0.9946	0.0007	0.227
	lct49-11	1.0000	0.0037	0.9933	0.0006	0.227
	lct49-12	1.0000	0.0037	0.9924	0.0007	0.231
	lct49-13	1.0000	0.0036	0.9935	0.0006	0.271
	lct49-14	1.0000	0.0036	0.9941	0.0006	0.272
	lct49-15	1.0000	0.0036	0.9937	0.0006	0.271
	lct49-16	1.0000	0.0036	0.9938	0.0007	0.254
	lct49-17	1.0000	0.0036	0.9929	0.0007	0.258
	lct49-18	1.0000	0.003	0.997	0.0006	0.251

Source: BSC2002a, Table 6-30

Table II-31. k_{eff} Values for Benchmarks Applicable to Intact Moderated Configurations for TMI Waste Form

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiment LEU-COMP-THERM-001 (8 cases)	Case_1	0.9998	0.0031	0.9987	0.00191	0.1239
	Case_2	0.9998	0.0031	0.99557	0.00185	0.1208
	Case_3	0.9998	0.0031	0.9957	0.00175	0.122
	Case_4	0.9998	0.0031	0.99907	0.00144	0.1208
	Case_5	0.9998	0.0031	0.99313	0.00157	0.1218
	Case_6	0.9998	0.0031	0.99882	0.00143	0.1208
	Case_7	0.9998	0.0031	0.99677	0.00143	0.1186
	Case_8	0.9998	0.0031	1.00246	0.00162	0.1201
Experiment LEU-COMP-THERM-027 (1 case)	Lct27-1	1.0000	0.001	1.0139	0.0005	0.1024
Experiment LEU-COMP-THERM-042 (7 cases)	lct42-01	1.0000	0.0016	0.9944	0.0008	0.169
	lct42-02	1.0000	0.0016	0.9927	0.0008	0.172
	lct42-03	1.0000	0.0016	0.9933	0.0008	0.175

Table II-31. k_{eff} Values for Benchmarks Applicable to Intact Moderated Configurations for TMI Waste Form

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	lct42-04	1.0000	0.0017	0.995	0.0008	0.174
	lct42-05	1.0000	0.0033	0.9948	0.0008	0.173
	lct42-06	1.0000	0.0016	0.9947	0.0008	0.169
	lct42-07	1.0000	0.0018	0.9938	0.0008	0.171
Experiment LEU-COMP-THERM-041 (5 cases)	lct41-01	1.1990	0.0062	1.2048	0.0006	0.118
	lct41-02	1.1060	0.0062	1.1045	0.0006	0.131
	lct41-03	0.8820	0.0079	0.8749	0.0008	0.168
	lct41-04	0.8360	0.0091	0.8256	0.0008	0.18
	lct41-05	0.8140	0.0103	0.7999	0.0007	0.185
Experiment with 2.35 wt% ^{235}U and absorber plates (see also LEU-COMP-THERM-016) (4 cases)	exp1	1.0000	0.0031	0.99958	0.00087	0.12037
	exp2	1.0000	0.0031	0.99762	0.00086	0.12291
	exp3	1.0000	0.0031	1.00103	0.00091	0.12005
	exp4	1.0000	0.0031	1.00241	0.00091	0.12057
Experiment with 4.31 wt% ^{235}U subcritical clusters and reflecting walls (see also LEU-COMP-THERM-010) (3 cases)	exp5	1.0000	0.0028	0.9969	0.00103	0.28386
	exp6	1.0000	0.0028	0.99772	0.00105	0.17775
	exp7	1.0000	0.0028	0.99821	0.0011	0.17822
Experiment with 4.31 wt% ^{235}U rods in highly borated water lattices (4 cases)	exp8	1.0000	0.0028	1.007	0.00102	0.17807
	exp9	1.0000	0	1.00687	0.00109	0.22393
	exp10	1.0000	0	1.00499	0.00173	0.2225
	exp11	1.0000	0	1.00046	0.00177	0.26803
Experiment with urania-gadolinia (19 cases)	ugd1	1.0000	0	0.99717	0.0014	0.20069
	ugd2	1.0000	0	0.99892	0.0015	0.20018
	ugd3	1.0000	0	0.99846	0.00145	0.19736
	ugd4	1.0000	0	0.99911	0.00144	0.19744
	ugd5	1.0000	0	0.99958	0.00147	0.20041
	ugd6	1.0000	0	1.00229	0.00149	0.19897
	ugd7	1.0000	0	0.99807	0.00144	0.19896
	ugd8	1.0000	0	0.99904	0.00151	0.19942
	ugd9	1.0000	0	1.00042	0.00159	0.19963
	ugd10	1.0000	0	1.00115	0.00145	0.20029
	ugd12	1.0000	0	1.00178	0.00146	0.20785
	ugd13	1.0000	0	0.99887	0.00166	0.20937
	ugd14	1.0000	0	1.00069	0.00144	0.20585
	ugd15	1.0000	0	0.99927	0.00147	0.20333
	ugd16	1.0000	0	0.99904	0.0015	0.20947
	ugd17	1.0000	0	0.99909	0.00153	0.20572
	ugd18	1.0000	0	0.99741	0.00156	0.21013
	ugd19	1.0000	0	0.99908	0.00155	0.20757
	ugd20	1.0000	0	1.00179	0.00159	0.20624

Source: BSC2002a, Table 6-31

Table II-32. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for TMI Waste Form

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
Experiments with LEU UO3-H2O solutions (12 cases)	sphu9a	0.9920	0.006	0.99004	0.00249	0.2541
	sphu9b	0.9925	0.005	0.99269	0.00249	0.2163
	sphu9c	0.9875	0.0058	0.97871	0.00256	0.1883
	sphu9d	0.9821	0.0054	0.97914	0.00242	0.1737
	sphu9e	0.9702	0.007	0.96607	0.00163	0.1591
	sphu9f	1.0063	0.0073	1.00952	0.00261	0.2511
	sphu9g	1.0064	0.0078	1.0136	0.00246	0.1839
	sphu9h	0.9957	0.0061	0.99713	0.00198	0.1651
	sphu9i	1.0298	0.0056	1.03372	0.00274	0.2495
	sphu9j	1.0330	0.0051	1.04207	0.00224	0.1783
	sphu9k	1.0313	0.0032	1.02951	0.00216	0.1661
	sphu9l	1.0209	0.0051	1.02281	0.0021	0.1549
Experiment LEU-SOL-THERM-001 (1 case)	Leust1	0.9991	0.0029	1.01182	0.00101	0.05186
Experiment LEU-SOL-THERM-002 (3 cases)	leust21	1.0038	0.004	0.99855	0.00058	0.02513
	leust22	1.0024	0.0037	0.99659	0.00064	0.0283
	leust23	1.0024	0.0044	1.0009	0.0006	0.02684
Experiment LEU-SOL-THERM-004 (7 cases)	lst4_1	0.9994	0.0008	1.0029	0.0007	0.0188
	lst4_29	0.9999	0.0009	1.0034	0.0006	0.0179
	lst4_33	0.9999	0.0009	1.0013	0.0007	0.017
	lst4_34	0.9999	0.001	1.0037	0.0006	0.0157
	lst4_46	0.9999	0.001	1.0032	0.0006	0.0154
	lst4_51	0.9994	0.0011	1.0023	0.0005	0.0148
	lst4_54	0.9996	0.0011	1.0026	0.0005	0.0142
Experiment LEU-SOL-THERM-005 (3 cases)	CASE_1	1.0000	0.0042	0.999	0.0005	0.0255
	CASE_2	1.0000	0.0051	0.9985	0.0005	0.0254
	CASE_3	1.0000	0.0064	0.9983	0.0005	0.026
Experiment LEU-SOL-THERM-007 (5 cases)	leust7_1	0.9961	0.0009	0.9966	0.0002	0.02
	leust7_2	0.9973	0.0009	0.9995	0.0002	0.0187
	leust7_3	0.9985	0.001	0.9979	0.0002	0.0173
	leust7_4	0.9988	0.0011	1.0005	0.0002	0.0166
	leust7_5	0.9983	0.0011	0.9989	0.0002	0.0159
Experiment LEU-COMP-THERM-049 (18 cases)	lct49-01	1.0000	0.0034	0.9923	0.0006	0.294
	lct49-02	1.0000	0.0034	0.9937	0.0006	0.293
	lct49-03	1.0000	0.0034	0.9929	0.0006	0.297
	lct49-04	1.0000	0.0034	0.9931	0.0006	0.3
	lct49-05	1.0000	0.0042	0.9944	0.0007	0.255
	lct49-06	1.0000	0.0042	0.9946	0.0007	0.256
	lct49-07	1.0000	0.0042	0.9932	0.0007	0.253
	lct49-08	1.0000	0.0042	0.9921	0.0007	0.258
	lct49-09	1.0000	0.0037	0.9933	0.0006	0.227
	lct49-10	1.0000	0.0037	0.9946	0.0007	0.227
	lct49-11	1.0000	0.0037	0.9933	0.0006	0.227

Table II-32. k_{eff} Values for Benchmarks Applicable to Degraded Moderated Configurations for TMI Waste Form

Experiment	Case name	Benchmark values		Calculated values (MCNP)		
		k_{eff}	σ_{exp}	k_{eff}	σ_{calc}	AENCF
	lct49-12	1.0000	0.0037	0.9924	0.0007	0.231
	lct49-13	1.0000	0.0036	0.9935	0.0006	0.271
	lct49-14	1.0000	0.0036	0.9941	0.0006	0.272
	lct49-15	1.0000	0.0036	0.9937	0.0006	0.271
	lct49-16	1.0000	0.0036	0.9938	0.0007	0.254
	lct49-17	1.0000	0.0036	0.9929	0.0007	0.258
	lct49-18	1.0000	0.003	0.997	0.0006	0.251

Source: BSC2002a, Table 6-32

ATTACHMENT III

Table III-1. Files Contained on the Electronic Media (Attachment I)

File Name/Directory Denomination	File Size (bytes)	Date of Last Update	Time
Directory of :CD\Clreg			
FFTF_Degraded_Thermal.csv	10,963	1/28/03	11:23a
FFTF_Degraded_Thermal.utl	18,500	2/11/03	5:04a
FFTF_Degraded_ThermalOut.csv	32,421	2/11/03	5:04a
FFTF_Intact_Fast.csv	2,161	1/23/03	10:46a
FFTF_Intact_Fast.utl	4,545	1/23/03	10:48a
FFTF_Intact_FastOut.csv	6,381	1/23/03	10:48a
FSVrain_intact_ThermalOut.csv	6,213	2/13/03	6:48a
FSVrain_Intact_Thermal.utl	4,461	2/13/03	6:48a
FSVrain_Degraded_Thermal.utl	6,038	2/5/03	5:22a
FSVrain_Intact_Thermal.csv	2,299	2/13/03	6:45a
FSVrain_Degraded_Thermal.csv	3,417	2/5/03	5:13a
FSVrain_Degraded_ThermalOut.csv	9,153	2/5/03	5:22a
NReactor_Intact_ThermalOut.csv	2,181	1/24/03	4:56a
NReactor_Intact_Thermal.utl	2,302	1/24/03	4:56a
NReactor_Intact_Thermal.csv	718	1/24/03	4:55a
SPWR_Intact_Thermal.csv	2,184	2/3/03	6:47a
SPWR_Intact_Thermal.utl	4,638	2/3/03	6:48a
SPWR_Intact_ThermalOut.csv	6,549	2/3/03	6:48a
TMI_Degraded_ThermalOut.csv	4,197	2/4/03	6:51a
TMI_Degraded_Thermal.utl	3,379	2/4/03	6:51a
TMI_Degraded_Thermal.csv	1,430	1/30/03	9:13a
TRIGA_Intact_Thermal.csv	3,174	1/30/03	9:15a
TRIGA_Intact_Thermal.utl	6,034	1/31/03	9:55a
TRIGA_Intact_ThermalOut.csv	9,153	1/31/03	9:55a
Directory of :CD\MCNP			
SB1m	14,235	2/7/03	9:26a
SB1m.out	2,345,558	2/6/03	4:44p
SB25m	7,979	2/7/03	12:17p
SB25m.out	1,023,241	2/10/03	4:16a
SB2m	12,124	2/7/03	10:10a
SB2m.out	2,306,613	2/7/03	6:06p
SB3m	16,444	2/7/03	12:29p

File Name/Directory Denomination	File Size (bytes)	Date of Last Update	Time
SB3m.out	2,289,055	2/10/03	4:17a
SB4m	26,250	2/7/03	12:38p
SB4m.out	2,298,306	2/10/03	4:17a
SB5m	12,459	2/7/03	12:43p
SB5m.out	2,444,157	2/10/03	4:17a
SB6m	12,780	2/7/03	12:52p
SB6m.out	2,445,646	2/10/03	4:18a
SB7m	12,963	2/7/03	12:52p
SB7m.out	2,444,378	2/10/03	4:18a
Directory of :CD\CLresults			
SPWR_deg_mod.xls	275,968	2/28/03	2:24p
SPWR_deg_nonmod.xls	58,880	2/19/03	5:21a
SPWR_int_nonmod.xls	94,208	2/28/03	1:47p
SPWR_int_mod.xls	178,688	2/28/03	10:50a
TRIGA_int_nonmod.xls	136,192	2/19/03	5:38a
TRIGA_deg_nonmod.xls	59,904	2/19/03	5:55a
TRIGA_int_mod.xls	266,752	2/28/03	4:14p
TRIGA_deg_mod.xls	362,496	2/28/03	2:22p
MD-deg_mod.xls	206,848	2/19/03	10:02a
MD_deg_nonmod.xls	39,424	2/19/03	10:05a
MD_int_mod.xls	59,904	2/19/03	9:56a
MD_int_nonmod.xls	39,424	2/19/03	9:58a
EF_deg_mod.xls	207,872	2/19/03	11:04a
EF_deg_nonmod.xls	50,688	2/19/03	6:32a
EF_int_mod.xls	106,496	2/19/03	6:24a
EF_int_nonmod.xls	49,152	2/19/03	6:26a
FFTF_deg_mod.xls	910,848	2/28/03	2:26p
FFTF_deg_nonmod.xls	58,368	2/19/03	6:52a
FFTF_int_mod.xls	46,080	2/19/03	6:34a
FFTF_int_nonmod.xls	109,568	2/28/03	2:39p
FSV_deg_nonmod.xls	300,544	2/19/03	9:14a
FSV_deg_mod.xls	240,128	2/28/03	4:28p
FSV_int_nonmod.xls	143,360	2/19/03	9:07a
FSV_int_mod.xls	216,576	2/28/03	2:56p
SLWBR_int_mod.xls	137,216	2/19/03	9:27a
SLWBR_deg_nonmod.xls	304,640	2/19/03	9:36a
SLWBR_int_nonmod.xls	154,112	2/19/03	9:30a

File Name/Directory Denomination	File Size (bytes)	Date of Last Update	Time
SLWBR_deg_mod.xls	152,064	2/19/03	9:33a
NReactor_int_mod.xls	76,800	2/20/03	6:41a
NReactor_deg_mod.xls	62,976	2/19/03	10:19a
TMI_deg_mod.xls	145,408	2/20/03	6:42a
TMI_int_mod.xls	79,872	1/30/03	6:26a

T-001 P.002/005 F-805

JUL-01-2003 02:07PM FROM-

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
DOCUMENT INPUT REFERENCE SHEET

QA: QA

1. Document Identifier No./Rev.:	Change:	Title:
CAL-DSD-NU-000003 Rev. 0 (as of 01-Jul-2003 13:17:40)	N/A	ANALYSIS OF CRITICAL BENCHMARK EXPERIMENTS AND CRITICAL LIMIT CALCULATION FOR DOE SNF

D R [illegible] 07/02/03
M. Saglam 07/02/03
Originator's Signature Date

Input Document			4. Input Status	5. Specifically Used In:	6. Input/TBV/TBD Description	7. TBV/TBD Proposed Resolution/Due Date
2a.	2. Technical Product Input Source Title and Identifier(s) with Version	3. Specifically Used From:				
1	Briesmeister, J.F., ed. 1997. *MCNP-A General Monte Carlo N-Particle Transport Code.* LA-12625-M, Version 4B. Los Alamos, New Mexico: Los Alamos National Laboratory. ACC: MOL.19980624.0328.	Entire	Reference Only	4, 5	Reference to the MCNP software manual	N/A
2	BSC (Bechtel SAIC Company) 2002. *Benchmark and Critical Limit Calculation for DOE SNF.* CAL-EDC-NU-000008 REV 00. Las Vegas, Nevada: Bechtel SAIC Company. ACC: MOL.20020416.0053.	Entire	Product Output	1, 5, Attachment II	Experimental and Calculated Results of Criticality Benchmark Experiments	N/A
3	BSC (Bechtel SAIC Company) 2002. *CLREG.* V1.0. PC-Windows 1995. 10528-1.0-00.	Entire	Qualified Software	2, 4	CLREG software used to calculate critical limit (CL)	N/A
4	BSC (Bechtel SAIC Company) 2003. *Criticality Model Report.* MDL-EBS-NU-000003 REV 00 ICN 01. Las Vegas, Nevada: Bechtel SAIC Company. ACC: DOC.20030319.0001.	Entire	Reference Only	5	Reference to the components of the criticality model	NA
5	BSC (Bechtel SAIC Company) 2003. *Technical Work Plan for: Department of Energy Spent Nuclear Fuel Criticality and TSPA Work Packages.* TWP-MGR-MD-000031 REV 00. Las Vegas, Nevada: Bechtel SAIC Company. ACC: DOC.20030328.0006.	Entire	Reference Only	1, 2	Reference to the work plan and activity evaluation for the calculation	N/A

T-001 P.003/005 F-805

JUL-01-2003 02:07PM FROM-

6	CRWMS M&O 1998. *Software Code: MCNP.* 4B2LV. HP. 30033 V4B2LV.	Entire	Qualified Software	1, 2, 4	MCNP software used to calculate k(effective)	N/A
7	CRWMS M&O 1998. *Software Qualification Report for MCNP Version 4B2, A General Monte Carlo N-Particle Transport Code.* CSCI: 30033 V4B2LV. DI: 30033-2003, Rev. 01. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980622.0637.	Entire	Reference Only	1, 2, 4	Reference to the MCNP software documentation	N/A
8	CRWMS M&O 1999. *Evaluation of Codisposal Viability for MOX (FFTF) DOE-Owned Fuel.* BBA000000-01717-5705-00023 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19991014.0235.	Entire	Reference Only	1, 5	Reference to the MOX DOE SNF group and the specific benchmark experiments used for establishing the interim criticality limit	N/A
9	CRWMS M&O 2000. *Evaluation of Codisposal Viability for HEU Oxide (Shippingport PWR) DOE-Owned Fuel.* TDR-EDC-NU-000003 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000227.0240.	Entire	Reference Only	1, 5	Reference to the HEU Oxide DOE SNF group and the specific benchmark experiments used for establishing the interim criticality limit	N/A
10	CRWMS M&O 2000. *Evaluation of Codisposal Viability for Th/U Oxide (Shippingport LWBR) DOE-Owned Fuel.* TDR-EDC-NU-000005 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20001023.0055.	Entire	Reference Only	1, 5	Reference to the Th/U Oxide DOE SNF group and the specific benchmark experiments used for establishing the interim criticality limit	N/A
11	CRWMS M&O 2000. *Evaluation of Codisposal Viability for U-Zr/U-Mo Alloy (Enrico Fermi) DOE-Owned Fuel.* TDR-EDC-NU-000002 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000815.0317.	Entire	Reference Only	1, 5	Reference to the UZrH DOE SNF group and the specific benchmark experiments used for establishing the interim criticality limit	N/A
12	CRWMS M&O 2000. *Evaluation of Codisposal Viability for UZrH (TRIGA) DOE-Owned Fuel.* TDR-EDC-NU-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000207.0689.	Entire	Reference Only	1, 5	Reference to the UZrH DOE SNF group and the specific benchmark experiments used for establishing the interim criticality limit	N/A
13	CRWMS M&O 2001. *Evaluation of Codisposal Viability for U-Metal (N Reactor) DOE-Owned Fuel.* TDR-EDC-NU-000004 REV 00. Las Vegas,	Entire	Reference Only	1, 5	Reference to the U-Metal DOE SNF group and the specific benchmark experiments used for	N/A

T-001 P.004/005 F-805

JUL-01-2003 02:08PM FROM-

	Nevada: CRWMS M&O. ACC: MOL.20010314.0004.				establishing the interim criticality limit	
14	D'Agostino, R.B. and Stephens, M.A., eds. 1986. *Goodness-Of-Fit Techniques.* Statistics, Textbooks and Monographs Volume 68. New York, New York: Marcel Dekker. TIC: 253256.	Section 4, 9 p.123, pp.372-373	Technical Information	5	Algorithms for omnibus normality tests	N/A
15	Dean, J.C. and Tayloe, R.W., Jr. 2001. *Guide for Validation of Nuclear Criticality Safety Calculational Methodology.* NUREG/CR-6698. Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 254004.	Entire	Technical Information	2, 5	Methods for analyzing the k (effective) data	N/A
16	DOE (U.S. Department of Energy) 2003. *Quality Assurance Requirements and Description.* DOE/RW-0333P, Rev. 13. Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: DOC.20030422.0003.	Entire	Reference Only	1	Quality Requirements	NA
17	Lichtenwalter, J.J.; Bowman, S.M.; DeHart, M.D.; and Hopper, C.M. 1997. *Criticality Benchmark Guide for Light-Water-Reactor Fuel in Transportation and Storage Packages.* NUREG/CR-6361. Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 233099.	pp. 159-160	Reference Only	2, 5	Definition of the standard deviation of the pool of data and "no positive bias" rule	N/A
18	Natrella, M.G. 1963. *Experimental Statistics.* National Bureau of Standards Handbook 91. Washington, D.C.: U.S. Department of Commerce, National Bureau of Standards. TIC: 245911.	pp.1-14 and 1-15	Technical Information	5	Multipliers for NDTL method	N/A
19	Putman, V.L. 2003. *Criticality Safety Code Validation with LWBR's SB Cores.* INEEL/EXT-02-00304. Idaho Falls, Idaho: Idaho National Engineering and Environmental Laboratory. TIC: 253902.	Entire	Technical Information	1, 5, 6	U233 criticality benchmark experiments description and results	N/A
20	Radulescu, H.R. 2001. *Evaluation of Codisposal Viability for Melt and Dilute DOE-Owned Fuel.* TDR-EDC-NU-000006 REV 00. Las Vegas, Nevada:	Entire	Reference Only	1, 5	Reference to the Melt and Dilute DOE SNF group and the specific benchmark experiments used for	N/A

T-001 P.005/005 F-805

JUL-01-2003 02:08PM FROM-

	Bechtel SAIC Company. ACC: MOL.20010809.0070.				establishing the interim criticality limit	
21	Radulescu, H.R. 2001. *Evaluation of Codisposal Viability for Th/U Carbide (Fort Saint Vrain HTGR) DOE-Owned Fuel.* TDR-EDC-NU-000007 REV 00. Las Vegas, Nevada: Bechtel SAIC Company. ACC: MOL.20011017.0092.	Entire	Reference Only	1, 5	Reference to the Th/U Carbide DOE SNF group and the specific benchmark experiments used for establishing the interim criticality limit	N/A
22	Scheaffer, R.L. and McClave, J.T. 1990. *Probability and Statistics for Engineers.* 3rd Edition. Boston, Massachusetts: PWS-Kent. TIC: 249631.	Entire	Technical Information	5, 6	Reference to the definitions of terms used in regression analysis. Table of percentage points of the t-Distribution	N/A
23	YMP (Yucca Mountain Site Characterization Project) 2000. *Disposal Criticality Analysis Methodology Topical Report.* YMP/TR-004Q, Rev. 01. Las Vegas, Nevada: Yucca Mountain Site Characterization Office. ACC: MOL.20001214.0001.	Entire	Reference Only	1, 2, 5	Reference to the disposal criticality analysis methodology	N/A