Validation of SCALE4.4a-PC for High Enriched Uranium Systems

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1.0 Introduction

The SCALE4.4a KENO code [**Reference 1**] has been validated for enriched uranium systems using several different methods [**References 2** through **5**]. The objective of this evaluation is to establish that the CSAS25, CSAS26, and CSAS2X sequences will conservatively predict the multiplication factor (k_{eff}) of High Enriched Uranium (HEU) systems. In order to demonstrate the applicability of the SCALE4.4a KENO code for HEU systems, several critical experiments [**References 6** through **53**] using a variety of material forms were modeled with the SCALE4.4a KENO code and run on a desktop PC. The critical experiments were segregated into various groups based on the uranium system, and the results were evaluated using various statistical methods. Validations are performed using both KENO Va and KENO VI.

2.0 Methodology

2.1 Experiment Selection

Table 1 provides a summary of the critical experiments that were modeled. The critical experiments selected were chosen for analysis because they consist of HEU systems and are documented in sufficient detail to develop an accurate analytical model. Each critical experiment report provides comprehensive data on the materials of construction, dimensions, fissionable material, and experimental uncertainties.

The HEU experiments were selected and categorized into four distinct groups. These groupings consisted of:

Group 1: All experiments (161) used in this validation,
Group 2: Experiments (81) with ALCF ≤ 10^2 eV, data sets 1-82, and
Group 3: Experiments (56) with ALCF > 10^2 eV and ≤ 10^5 eV, data sets 83-138, and
Group 4: Experiments (24) with ALCF > 10^5 eV, data sets 139-162.

The experimental and calculated results were then compared based on a review of the k_{eff} distribution, enrichment (wt%^{235}U), average lethargy causing fission (ALCF), the hydrogen-to-fissile atom ratio (H/X), and the fissile material density (g ^{235}U/l).

2.2 SCALE4.4a Models

Each critical experiment was modeled exactly as described in **References 6** and **53**. All criticality calculations were run to convergence, which typically required 600 generations and 1000 neutrons per generation for a total of 600,000 histories. Default values were used for all other parameters. All calculations were performed using the SCALE4.4a KENO Va Code with the 44-Group Standard Cross Section Library [**Reference 1**]. **Appendix A** contains the input decks for each critical experiment modeled. All dimensional and material information is identical to that reported in **References 6** and **53**. C5TOC6 is then executed to generate the initial KENO VI cases. Each case is then reviewed and further edited by the analyst (incorporate evaluator specific traits) and then executed for the validation.

2.3 Methodology for Statistical Evaluation of Results

The results of the SCALE4.4a KENO calculations were compared with the experimental results of the critical experiments through the use of various statistical analyses. The multiplication factor for each critical experiment is equal to unity; therefore, an accurate prediction of the multiplication factor using

SCALE4.4a KENO must be equivalent to unity also. The KENO program uses a Monte Carlo probability-based method, and as a result of this method, the calculated multiplication factors of an infinite number of critical experiments should provide a normal distribution about a mean multiplication factor of unity. However, it is known that biases exist in the SCALE4.4a program that lead to over-estimation of the multiplication factor for specific groups of fissile systems. Therefore, the objective of the statistical evaluation is to determine whether or not the results for each Group are normally distributed about unity (KENO predicts accurately for the Group) with an acceptable deviation (KENO predicts precisely for the Group). If KENO does not provide an accurate prediction, further evaluations are provided to determine whether or not a bias exists. The methods used to calculate the SCALE4.4a KENO Va bias and bias uncertainty is outlined in **References 54** and **55**.

2.3.1 Accuracy measures: Comparison of the Means

The calculated multiplication factors and the experimental multiplication factors represent two populations having the means μ_1 and μ_2 and the variances σ_1 and σ_2. The objective of this comparison is to determine whether or not the means of the experimental and calculated data are statistically equivalent, and if they are not, whether or not there is an identifiable bias. A two-tailed t-test for the difference between two means [**Reference 55**] is used to test the hypothesis that the means of the two data sets are equal, or $\mu_1 = \mu_2$. The alternative hypothesis is $\mu_1 \neq \mu_2$, or the mean of the two populations are not equal, and that a bias exists in the calculated data. The t-value is calculated using Equation 1:

$$t = \frac{\mu_1 - \mu_2 - \delta}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}, \qquad \text{(Equation 1)}$$

where:

μ_1 is the mean of the standard data set,
μ_2 is the mean of the data set to be tested,
δ is the null hypothesis constant (0 here for the hypothesis of $\mu_1 = \mu_2$),
σ_1 is the standard deviation of the standard data set,
σ_2 is the standard deviation of the data set to be tested,
n_1 is the number of observation in the standard data set, and
n_2 is the number of observations in the data set to be tested.

2.3.2 Accuracy Measures: Determination Of Method Bias

The bias is defined as:

$$Bias = \bar{k}_{calc} - \bar{k}_{exp}, \qquad \text{(Equation 2)}$$

where k_{exp} and k_{calc} are the mean of the experimental and calculated (KENO) k_{eff} values, respectively.

2.3.3 Precision Measures: Determination Of Calculational Variance and Standard Deviation

The variance, S^2, of the calculated KENO k_{eff} is defined as:

$$S^2 = \frac{\sum(\overline{k_{calc}} - k_i)^2}{n-1}, \qquad \text{(Equation 3)}$$

where k_i is the calculated k_{eff} for the i^{th} critical experiment and n is the total number of experiments.

The standard deviation, σ_{calc}, of the KENO-calculated k_{eff} is the positive square root of the variance, S^2. Note that this is *not* the KENO-calculated standard deviation, $\sigma_{KENO\text{-}calc}$, presented in **Table 3**, which is an average value of the calculated k_{eff} uncertainties.

2.3.4 Precision Measures: Determination Of Experimental Variance and Standard Deviation

The variance of the experimental k_{eff} is generally ignored, since the uncertainty associated with the measured k_{eff} (the known standard) is typically very small. Values reported for various experiments range from 0.0004 to 0.0019. Since the experimental uncertainties are usually reported as standard deviations, the experimental variance, S_o, is simply the average standard deviation of the group of experiments, $\overline{\sigma_{\exp}}$, squared:

$$S_0^2 = (\overline{\sigma_{\exp}})^2 . \qquad \text{(Equation 4)}$$

2.3.5 Precision Measures: Determination Of Bias Uncertainty

According to **Reference 55**, the variance associated with the bias is given by the following equation:

$$V_B = \frac{S^2}{n} + S_0^2 , \qquad \text{(Equation 5)}$$

where S^2 is the calculated k_{eff} variance (Equation 3), and S_o^2 is the experimental k_{eff} variance (Equation 4).

For conservatism, an additional term is added to Equation 5 to incorporate the effect of the individual uncertainties of the KENO-calculated k_{eff} value for each critical experiment model. The variance of the KENO-calculated uncertainty, S_u^2, is defined as:

$$S_u^2 = \frac{\sum(\sigma_{calc,i})^2}{n}, \qquad \text{(Equation 6)}$$

where, $\sigma_{calc,i}$ is the uncertainty associated with the KENO results for experiment i, and n is the number of experiments. This equation is the square-weighted average of the individual KENO uncertainties. The standard deviation of the KENO-calculated uncertainties is the square root of the variance, S_u^2.

Incorporating Equation 6 into Equation 5, the final equation for the variance associated with the KENO-calculated k_{eff} bias is:

$$V = \frac{\left(S^2 + S_u^2\right)}{n} + S_0^2 . \qquad \text{(Equation 7)}$$

The standard deviation of the bias value is then simply the square root of the variance:

$$U = \kappa\sqrt{V}\ ,\qquad \text{(Equation 8)}$$

where, κ is the 95/95 one-sided tolerance factor that is applied to the bias uncertainty for the number of critical experiments **[Reference 54]**.

2.4 Methodology for Determination Applicable Limits

With the determination of the KENO bias and bias uncertainty associated with each Group of experiments, it is possible to calculate the Upper Subcritical Limits and the maximum allowable or biased KENO k_{eff} to maintain subcriticality for each system type.

2.4.1 Practical application: Calculation of an Upper Subcritical k_{eff} Limit

Starting at a multiplication factor of 1 (critical), the biases and uncertainties are subtracted, and the resulting number is the Upper Subcritical Limit for the system. At a 95% confidence level:

$$\textit{Upper Subcritical Limit} = 1 + \textit{bias} - U,\qquad \text{(Equation 9)}$$

where the *bias* and *U* are substituted from **Equations 2** and **8**, respectively. Values determined using this method are provided in **Table 3.** For systems with a positive bias, the second term of **Equation 9**, *bias,* is omitted.

In practice, the calculated system is considered to be subcritical if the following condition is met:

$$KENO_{-calc}\text{-}k_{eff} + \kappa(\sigma_{\text{KENO-calc}}) < \textit{Upper Subcritical Limit},\qquad \text{(Equation 10)}$$

where the system is subcritical at a 95% confidence level. A bounding κ factor of 1.645 is historically applied to the corresponding $\sigma_{\text{KENO-calc}}$ uncertainty for the calculation. This κ factor is different from that used in **Equation 8** for determination of the bias uncertainty.

2.4.2 Practical application: Calculation of the biased KENO Multiplication Factor

Alternatively starting with the calculated $\text{KENO}_{\text{-calc}}\text{-k}_{\text{eff}}$, a biased k_{eff} can be calculated:

$$\textit{Biased KENO-}k_{eff} = \text{KENO}_{\text{-calc}}\text{-k}_{\text{eff}} + \kappa(\sigma_{\text{KENO-calc}}) - \textit{bias} + U.\qquad \text{(Equation 11)}$$

And the system is considered to be subcritical if the following condition is met:

$$\textit{Biased KENO-}k_{eff} < 1.\qquad \text{(Equation 12)}$$

In the case where the bias is positive (KENO consistently over-estimates k_{eff}), the bias term is omitted for conservatism.

3.0 Calculation Results

Table 2 presents the multiplication factor (k_{eff}), standard deviation (σ), and average lethargy causing fission (ALCF) calculated for each critical experiment modeled using the SCALE4.4a code with the 44 group cross-section library. **Table 3** provides the results of the statistical evaluations from different groupings of critical experiment data sets. The Upper Limit Subcritical k_{eff} for each group was calculated using the mean KENO-calculated uncertainty for the Group. In practice, it is preferable to use the actual

KENO-calculated standard deviation for the calculation being performed. However, it is conservative to use the mean KENO-calculated uncertainty to establish the bias for the group and then use the actual KENO-calculated standard deviation for the calculation to ensure a margin below the established limit.

4.0 Discussion

In order to validate the SCALE4.4a code for use with high enriched uranium systems, it is necessary to determine if KENO predicts the multiplication factor in an accurate and precise manner throughout the range of fission energies of interest. To evaluate the accuracy of the code, the mean of each Group of experiments was compared to the mean of the experimental results. A t-test was performed for each Group to determine whether or not the average result of a KENO calculation (the mean calculated k_{eff} for each Group) is statistically the same as the experimental result (unity). Passing the t-test affirms that the KENO code predicts multiplication factors accurately for the Group being tested, without bias. Failure of the t-test indicates that the mean KENO k_{eff} is statistically different from the experimental mean, and that a bias exists in the data. Groups that failed the t-test were further evaluated for bias and uncertainty, and these parameters applied to provide an upper limit subcritical multiplication factor for the Group.

Each Group of KENO-calculated k_{eff}s are also graphed against key system parameters (Enrichment {wtg%^{235}U}, Energy of the Average Lethargy Causing Fission {ALCF}, Hydrogen-to-Fissile Atom Ratio {H/^{235}U}, and fissile material density {g ^{235}U/cc}) to identify trends within the data that may indicate inaccurate cross-sections or instabilities in the code. The normality of residuals is also tested using the Anderson-Darling method. The null hypothesis of a normality test is that there is no significant departure from normality. When the probability level, ρ is greater than 0.05, it fails to reject the null hypothesis and thus the assumption holds. Histogram, skewness and kurtosis plots are also provided for each group.

4.1 Comparison of the Means

The t-statistic for each Group evaluated against the experimental data is provided in **Table 3**. A two-tailed test at the 95% confidence limit was performed. All Groupings of the data were found to have statistically different means, and therefore, the mean KENO-calculated k_{eff} is biased.

4.2 Comparison of Uncertainty

In order to benchmark the performance of the code, the uncertainty associated with the KENO-calculated k_{eff}, must take into account the uncertainty associated with the critical experiment, since it is inherently a part of the result. The experimental uncertainty impacting the modeling of the experiment stems from material and geometric tolerances, rather than measurement of the experimental k_{eff}. Unfortunately, this type of uncertainty is not well evaluated or documented. Therefore, an average uncertainty of 0.0011 was assigned to those experiments that did not report an uncertainty value.

The bias uncertainty associated with Groups 1 though 4 are 0.0022, 0.0024, 0.0027, and 0.0037, respectively, at a 95% confidence level. For Groups 3 and 4, the uncertainty is higher than the bias. This fact leads to the conclusion that there is no detectable bias (either positive or negative) in the data, since application of the uncertainty obscures it. The uncertainty is lower than the bias for Groups 1 and 2 suggesting that there is a detectable bias in this data. However, as indicated in **Table 3** the bias is positive for all data groups.

4.3 Comparison of System Behavior as a Function of the System Attributes

For hydrogen moderated ^{235}U systems, the fission energy is proportional to the degree of moderation. Variations in the bias over the data range for the fissile density ($g^{235}U/cc$), energy of the average lethargy causing fission (ALCF) and the hydrogen-to-fissile atomic ratio ($H/^{235}U$) should be similar. However, differences will be evident due to statistical variations in the experimental and calculated results.

4.3.1 Oxide and Solution Systems

Dry (non-hydrogenous moderated) UO_2 systems at any enrichment are fast (neutronic) systems. The results of the critical experiments documented elsewhere, as well as the results of the critical experiments modeled here; show that the typical average lethargy causing fission in a fast system ranges from 10^4 to 10^6 eV. Fast critical UO_2 systems enriched to less than 15wt% are not feasible due to the large quantity of material required. However, a few LEU fast critical systems (metal) have been performed ranging in enrichment from 10 – 15wt%. The neutronic attributes of these fast metal experiments are very similar to the fast metal experiments with enrichments ranging from 93 - 97wt%. Several of these types of experiments are evaluated in this validation. The only major difference between the experiments at these different enrichments is the fact that more material is required for the lower enriched systems to achieve criticality. Various analytical methods have shown that an infinite UO_2 mass system has sufficient ^{235}U density to achieve criticality for enrichments near 7.0 wt %. However, without moderation, the system is fast. A few low-enriched (<5wt%) metal critical experiments have been performed; however, these systems also required moderation (water) to achieve critical configurations and therefore were driven by intermediate and thermal energy neutrons.

As moderator is introduced to the system, the neutronics of the system changes. A fast system becomes an under-moderated intermediate system. The typical average lethargy causing fission in an intermediate system ranges from 10^0 to 10^4 eV. Very few low enriched intermediate critical experiments have been performed. These systems are difficult to construct and maintain due to the under-moderated configurations. However, a few intermediate experiments have been completed using mixtures of low-enriched metals and fissile solutions. Several of these types of experiments are evaluated in this validation.

With additional moderation the intermediate system becomes a thermal system. The typical average lethargy causing fission in a thermal system ranges from 10^{-2} to 10^0 eV. The large majority of critical experiments are thermal. These systems are easily constructed at all enrichments. For a low enriched UO_2 system approximately 5.0wt% water is required to change the neutronics of the system from fast to thermal. Little difference is observed for enrichments less than 5.0wt% and those ranging from 5 to 10wt%. However, for enrichments ranging from 90 to 97wt%, a large amount of water, approximately 90wt%, is necessary to change the neutronics of a fast system to an intermediate, and finally a thermal, system.

Given that the mechanics of hydrogen moderated critical systems are the same regardless of enrichment, analytical computer codes predicting the k_{eff} of enriched systems should perform equally well at all enrichments. Since the SCALE4.4a KENO Code has been validated as performing accurately over a large range of enrichments with a variety of moderators and moderation levels, it is reasonable that it should also perform accurately in the remaining ranges. The results of these calculations demonstrate that the SCALE4.4a KENO Code is accurate in the high enrichment range. These results also demonstrate that the level of accuracy is the same as the accuracy of the KENO Code at other enrichment ranges [**Reference 56**].

4.3.2 Metal Systems

Metal systems are typically fast due to experimental configurations involving single and arrays of units at high densities with little or no moderation. Several experiments display similar attributes when the fissile media is further diluted with non-fissile metals. A few metal (fast) experiments exist at 10wt% however the majority of these experiments are highly enriched. Several of these types of experiments are evaluated in this validation.

4.4 Comparison of the k_{eff} Distributions

The KENO-calculated, unbiased k_{eff} was plotted for Groups 1 through 4 using a histogram to demonstrate the relative distributions about the mean value, as shown in **Figures 1** through **4**, respectively. If the CSAS25 sequence performs accurately without systemic errors, then the k_{eff} results will be normally distributed about a mean k_{eff}. This is expected since KENO is a Monte Carlo probability-based program. Also, a k_{eff} of unity is expected since the experiments were reported as being critical. As shown in the histograms, the distribution appears to be normal, with a slight positive bias indicating that the CSAS25 sequence contains a systemic conservative bias.

The normality of residuals, using the Anderson-Darling method, indicated that the probability level ρ is greater than 0.05 for **Groups 2** through **4**. Therefore, the test fails to reject the null hypothesis and thus the assumption, normal data, holds. The null hypothesis of a normality test is that there is no significant departure from normality. Since the probability level ρ is greater than 0.05, it fails to reject the null hypothesis and thus the assumption holds. Histogram, skewness and kurtosis plots are also provided for each group in **Figures 1** through **3** for **Groups 2** through **4**, respectively.

4.5 Bias Trends with Enrichment

Figure 5 shows the KENO-calculated, unbiased k_{eff} plotted as a function of the system enrichment. The enrichments of the selected benchmarks ranged from 62.40 to 97.68 wt% ^{235}U. Based on this plot, there appears to be no distinct or observable bias in the k_{eff} as a function of enrichment. Based on this, the proposed enrichment range for the validation can be extended from 97.68 wt% to 100.00 wt%.

4.6 Bias Trends with Average Lethargy Causing Fission (ALCF)

Figure 6 shows the KENO-calculated unbiased k_{eff} plotted as a function of the energy of the average lethargy causing fission (ALCF). The ALCF plots use a logarithmic scale to distinguish between the different neutron energy ranges. Based on this plot, there appears to be no distinct or observable bias in the k_{eff} as a function of the ALCF. Considering all experiments presented in this validation, the ALCF covers a range of energies from 0.0291eV to 914,000eV, spanning the thermal, intermediate, and fast fission groups.

4.7 Bias Trends with Hydrogen-to-Fissile Atom Ratio (H/X)

Figure 7 shows the KENO-calculated unbiased k_{eff} plotted as a function of the hydrogen-to-fissile atom ratio (H/X, where X is ^{235}U). Considering all experiments, the H/X covers a range from 0 to 1,836. This spans the under-moderated (less than 200), optimum (200 to 300), and over-moderated (greater than 300) regions. The H/X plots use a logarithmic scale to distinguish the different ranges of H/X values for the experiments. Overall, there appears to be no distinct or observable bias in the k_{eff} as a function of the hydrogen-to-fissile atom ratio.

4.8 Fissile Density (g ^{235}U/cc)

Figure 8 shows the KENO-calculated unbiased k_{eff} plotted as a function of the fissile material density for all experiments. Considering all experiments, the fissile density covers a range from 0.014 to 18.36 g ^{235}U/cc. The plot of the fissile density is similar to the plot of the ALCF. Overall, there appears to be no distinct or observable bias in the k_{eff} as a function of the fissile density.

4.9 KENO VI and KENO Va Comparison

Figure 9 shows the KENO VI-calculated unbiased k_{eff} plotted as a function of the KENO Va-calculated unbiased k_{eff}. The KENO VI results appear to be slightly higher for k_{eff} results less than 1.00 and slightly lower for k_{eff} results greater than 1.00. However, these observed k_{eff} differences are less than 0.0025. The results of both code versions statistically give essentially the same result. The KENO VI results are further provided in Table 2. The statistical results (bias and bias uncertainty) are further provided in Table 3.

5.0 Conclusions

The SCALE4.4a KENO Code provides precise results (slight positive bias for Groups 1 through 4) using the 44-Group Standard Cross Section Library for high enrichments with a variety of material forms, geometry, neutron energy, water-to-fuel ratio, density and ALCF. The precision of the code varies somewhat depending upon the fissile system being analyzed, as demonstrated by the results of the statistical evaluations. For the Group 1 (all experiments) at a 95% confidence level, the bias uncertainty of the KENO results is ±0.0022. The overall bias (Group 1) associated with the KENO results is +0.0031.

Additionally, the results of the parametric studies indicate that there appears to be no distinct or observable trends with the energy of the average lethargy causing fission, the moderator-to-fissile atom ratio, fissile density or enrichment. The recommended application of the KENO-calculated standard deviation, uncertainty, and Upper Subcritical Limits will prevent a critical system from being mistakenly evaluated as subcritical. The Group 1 data is normally distributed about a mean k_{eff} value of 1.0030 such that a one-sided 95% confidence level can be used to establish the Upper Limit k_{eff}. Based on this validation, the Upper Limit k_{eff} for Group 1 (All Data) is 0.9969 (includes the bias and bias uncertainty at a 95% confidence level). This value does not include an arbitrary administrative margin.

Many of the critical experiments available for code validation do not document experimental uncertainties that may impact the modeling of the system; therefore, it is difficult to assess whether poor results are due to faulty code performance or simply poor modeling of the experiment due to lack of proper information.

The overall (Group 1) Upper Subcritical Limit is 0.9969. However, an Upper Subcritical Limit of 0.9966 should be used for Groups 2 and 3 for ALCF values to 10^5eV. An Upper Subcritical Limit of 0.9958 must be used (Group 4) for ALCF values greater than 10^5eV. For all cases, including both KENO VI and KENO Va, an Upper Subcritical Limit of 0.9958 is bounding for ALCF values ranging from less than 10^{-2}eV to greater than 10^5eV.

Based on these results, an administrative upper subcritical limit of 0.95 is overly restrictive. An administrative upper subcritical limit of 0.97 is justified based on this validation. This provides an arbitrary administrative margin of 3%. With a 3% margin the Upper Subcritical Limit is 0.9658. However, with a 5% margin the Upper Subcritical Limit is 0.9458. Values provided in Table 3 implement the Upper Subcritical Limit with a 5% margin. As applied to analyses, since the bias is positive in all cases and neglected, limiting the $k_{eff} + 2\sigma$ to less than or equal to 0.9458 (5% administrative margin) meets the intended requirements of this validation.

6.0 Area of Applicability

An essential portion of a code validation effort is to define the area of applicability for the code. The area of applicability defines the types of materials, options, and range of parameter values that were used or were bounded by the validation. This study has demonstrated that Scale 4.4a/KENO V.a with the ENDF/B-V 44 group cross-sectional data is accurate for use in evaluating the multiplication factor for high enriched uranium (60.0-100.0 wt%), moderated, reflected and unreflected systems or configurations. The $H/^{235}U$ values used in the benchmark experiments varied from 0 to 1,836. The fissile density (g ^{235}U/cc) ranges from 0.014 to 18.36. The average lethargy causing fission (ALCF) ranges from 0.0291eV to 914,000eV. This defines the range of applicability for the enrichment, $H/^{235}U$, ACLF, and fissile density of this validation.

The MULTIREGION and INFHOM cross-sectional modeling options were used in the benchmark modeling. This validation specifically covers uranium systems (homogeneous and heterogeneous) moderated by hydrogen (water- or poly-bound hydrogen) with carbon, nitrogen, fluorine and oxygen also present as a portion of the uranium compound. This validation further covers various moderator and reflector materials such as water, carbon, concrete, paraffin, plexiglas, aluminum, natural uranium and polyethylene. The basic geometry package consisting of cuboid, cylinder, sphere and hemisphere were used in modeling the benchmark critical experiments. Several other materials including boron, chlorine, gadolinium, stainless steel, and carbon steel were also used in modeling the benchmark experiments.

If the parameters of a fissile system or configuration being evaluated are outside of the boundaries or limits of this evaluation, then an additional margin of subcriticality determined from an alternate code or specific experimental benchmark will be used to ensure that the system remains subcritical.

7.0 References

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28) HEU-MET-MIXED-003, *Spherical Assembly of ^{235}U(90%) with Central Area of Polyethylene and 15.85-cm Polyethylene Reflector,* (NEA/NSC/DOC/(95)03/II), (September 2002).

29) HEU-MET-MIXED-006, *Two Heterogeneous Cylinders of Highly Enriched Uranium with Polyethylene,* (NEA/NSC/DOC/(95)03/II), (September 2002).

30) HEU-SOL-THERM-002, *Concrete Reflected Cylinders of Highly Enriched Solutions of Uranyl Nitrate,* (NEA/NSC/DOC/(95)03/II), (September 2002).

31) HEU-SOL-THERM-003, *Plexiglas Reflected Cylinders of Highly Enriched Solutions of Uranyl Nitrate,* (NEA/NSC/DOC/(95)03/II), (September 2002).

32) HEU-SOL-THERM-004, *Reflected Uranyl-Fluoride Solutions in Heavy Water,* (NEA/NSC/DOC/(95)03/II), (September 2002).

33) HEU-SOL-THERM-005, *Aqueous Solutions of 235 U Poisoned with Pyrex Glass* (NEA/NSC/DOC/(95)03/II), (September 2002).

34) HEU-SOL-THERM-006, *Experiments with Boron-Poisoned Highly Enriched Uranyl Nitrate Solution,* (NEA/NSC/DOC/(95)03/II), (September 2002).

35) HEU-SOL-THERM-007, *Concrete Reflected Arrays Highly Enriched Solutions of Uranyl Nitrate, (*NEA/NSC/DOC/(95)03/II), (September 2002).

36) HEU-SOL-THERM-008, *Plexiglas Reflected Arrays Highly Enriched Solutions of Uranyl Nitrate, (*NEA/NSC/DOC/(95)03/II), (September 2002).

37) HEU-SOL-THERM-009, *Water-Reflected 6.4 Liter Spheres of Enriched Uranium Oxfluoride Solutions,* (NEA/NSC/DOC/(95)03/II), (September 2002).

38) HEU-SOL-THERM-010, *Water-Reflected 9.7 Liter Spheres of Enriched Uranium Oxfluoride Solutions,* (NEA/NSC/DOC/(95)03/II), (September 2002).

39) HEU-SOL-THERM-011, *Water-Reflected 17 Liter Spheres of Enriched Uranium Oxfluoride Solutions,* (NEA/NSC/DOC/(95)03/II), (September 2002).

40) HEU-SOL-THERM-012, *Water-Reflected 91 Liter Sphere of Enriched Uranium Oxfluoride Solution,* (NEA/NSC/DOC/(95)03/II), (September 2002).

41) HEU-SOL-THERM-014, *Uranium Nitrate Solution (70 gU/l) with Gadolinium,* (NEA/NSC/DOC/(95)03/II), (September 2002).

42) HEU-SOL-THERM-015, *Uranium Nitrate Solution (100 gU/l) with Gadolinium,* (NEA/NSC/DOC/(95)03/II), (September 2002).

43) HEU-SOL-THERM-020, *Unreflected Cylinders of Uranyl-Fluoride Solutions in Heavy Water,* (NEA/NSC/DOC/(95)03/II), (September 2002).

44) HEU-SOL-THERM-021, *Bare and Hydrogenous Reflected Arrays of Highly Enriched Solution of Uranyl Nitrate,* (NEA/NSC/DOC/(95)03/II), (September 2002).

45) HEU-SOL-THERM-025, *Uranium Nitrate Solutions with Gadolinium,* (NEA/NSC/DOC/(95)03/II), (September 2002).

46) HEU-SOL-THERM-027, *Uranium (89% ^{235}U) Nitrate Solution with Central Boron Carbide or Cadmium Absorber Rod,* (NEA/NSC/DOC/(95)03/II), (September 2002).

47) HEU-SOL-THERM-028, *Uranium (89% ^{235}U) Nitrate Solutions with Central Boron Carbide Absorber Rod,* (NEA/NSC/DOC/(95)03/II), (September 2002).

48) HEU-SOL-THERM-030, *Uranium (89% ^{235}U) Nitrate Solutions with Cluster of Several Boron Carbide Absorber Rods,* (NEA/NSC/DOC/(95)03/II), (September 2002).

49) HEU-SOL-THERM-032, *A 48-Inch-Diameter Unreflected Sphere of ^{235}U Nitrate Solution,* (NEA/NSC/DOC/(95)03/II), (September 2002).

50) HEU-SOL-THERM-033, *Highly Enriched Uranyl Nitrate in Annular Tanks with Concrete: Four Nested Tanks,* (NEA/NSC/DOC/(95)03/II), (September 2002).

51) HEU-SOL-THERM-035, *Boron Carbide Absorber Rods in Uranium (89% ^{235}U) Nitrate Solutions,* (NEA/NSC/DOC/(95)03/II), (September 2002).

52) HEU-SOL-THERM-036, *Square-Pitched Lattices of Boron Carbide Absorber Rods in Uranium (89% ^{235}U) Nitrate Solution,* (NEA/NSC/DOC/(95)03/II), (September 2002).

53) HEU-SOL-THERM-037, *Hexagonally Pitched Lattices of Boron Carbide Absorber Rods in Uranium Nitrate Solution,* (NEA/NSC/DOC/(95)03/II), (September 2002).

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Table 1 Summary of Critical Experiments Modeled

Case ID	Case Number	$H/^{235}U$ Atom Ratio	$g^{235}U/cc$	Material	Geometry	Moderator	Reflector	Enrichment
Heust-032-001	1	1836.68	0.01411	Uranyl Nitrate	Spherical	Water/NO3	Aluminum/Steel	93.21
Heust-002-009	2	458.76	0.05558	Uranyl Nitrate	Cylinder	Water/NO3	Concrete/Aluminum	93.17
Heust-012-001	3	1272.25	0.02047	Uranyl Fluoride	Spherical	Water/HF	Water/Aluminum	93.18
Heust-037-005	4	463.05	0.05469	Uranyl Nitrate	Cylinder	Water/NO3	Water	89.08
Heust-028-001	5	374.56	0.06770	Uranyl Nitrate	Cylinder	Water/NO3	Water	89.08
Heust-014-002	6	418.13	0.06064	Uranyl Nitrate	Cylinder	Water/NO3	Water/Steel	89.04
Heust-035-005	7	378.60	0.06670	Uranyl Nitrate	Cylinder	Water/NO3	Water/Steel	89.08
Heust-035-001	8	766.63	0.03341	Uranyl Nitrate	Cylinder	Water/NO3	Water/Steel	89.08
Heust-007-009	9	336.62	0.07520	Uranyl Nitrate	Cylinder	Water/NO3	Concrete/Aluminum/Stainless Steel	93.17
Heust-037-002	10	684.46	0.03732	Uranyl Nitrate	Cylinder	Water/NO3	Water	89.08
Heust-011-001	11	523.41	0.04940	Uranyl Fluoride	Spherical	Water/HF	Water/Aluminum	93.20
Heumt-006-012	12	0.00	0.72167	U-Al Metal	Cuboid	Aluminum	Water	93.17
Heust-025-006	13	586.11	0.04336	Uranyl Nitrate	Cylinder	Water/NO3	Water	89.04
Heust-008-007	14	453.75	0.05620	Uranyl Nitrate	Cylinder	Water/NO3	Plexiglass/Aluminum/ Stainless Steel	93.17
Heust-002-010	15	458.76	0.05558	Uranyl Nitrate	Cylinder	Water/NO3	Concrete/Aluminum	93.17

Table 1 Summary of Critical Experiments Modeled

Case ID	Case Number	$H/^{235}U$ Atom Ratio	$g^{235}U/cc$	Material	Geometry	Moderator	Reflector	Enrichment
Heust-003-001	16	453.75	0.05620	Uranyl Nitrate	Cylinder	Water/NO3	Plexiglass/Stainless Steel	93.17
Heumt-006-005	17	0.00	0.72167	U-Al Metal	Cuboid	Aluminum	Water	93.17
Heust-028-008	18	374.56	0.06770	Uranyl Nitrate	Cylinder	Water/NO3	Water	89.08
Heumt-006-016	19	0.00	0.72167	U-Al Metal	Cuboid	Aluminum	Water	93.17
Heust-007-010	20	325.16	0.07779	Uranyl Nitrate	Cylinder	Water/NO3	Concrete/Aluminum/Stainless Steel	93.17
Heust-037-009	21	339.68	0.07393	Uranyl Nitrate	Cylinder	Water/NO3	Water	89.08
Heust-010-003	22	245.70	0.10190	Uranyl Fluoride	Spherical	Water/HF	Water/Aluminum	93.13
Heust-036-002	23	302.47	0.08263	Uranyl Nitrate	Cuboid	Water/NO3	Steel	89.14
Heumt-006-018	24	0.00	0.72167	U-Al Metal	Cuboid	Aluminum	Water	93.17
Heust-015-003	25	278.39	0.08948	Uranyl Nitrate	Cylinder	Water/NO3	Water/Steel	89.04
Heumt-006-010	26	0.00	0.72167	U-Al Metal	Cuboid	Aluminum	Water	93.17
Heust-027-001	27	203.61	0.12115	Uranyl Nitrate	Cylinder	Water/NO3	None	89.08
Heust-027-005	28	203.61	0.12115	Uranyl Nitrate	Cylinder	Water/NO3	None	89.08
Heust-002-012	29	183.79	0.13452	Uranyl Nitrate	Cylinder	Water/NO3	Concrete/Aluminum	93.17
Heust-002-011	30	183.79	0.13452	Uranyl Nitrate	Cylinder	Water/NO3	Concrete/Aluminum	93.17

Table 1 Summary of Critical Experiments Modeled

Case ID	Case Number	$H/^{235}U$ Atom Ratio	$g^{235}U/cc$	Material	Geometry	Moderator	Reflector	Enrichment
Heuct-010-021	31	0.00	1.49407	Uranium Dioxide	Cylinder	Beryllium/Borated Uranyl Nitrate/Water	Water	62.40
Heuct-010-010	32	0.00	1.49410	Uranium Dioxide	Cylinder	Beryllium/Water	Water	62.40
Heuct-014-002	33	0.00	1.03792	Uranium Dioxide	Cylinder	Aluminum/Silicon Oxides	Water	79.38
Heuct-010-017	34	0.00	1.49407	Uranium Dioxide	Cylinder	Beryllium/Boric Acid/Water	Water	62.40
Heuct-010-015	35	0.00	1.49407	Uranium Dioxide	Cylinder	Beryllium/Water	Water	62.40
Heuct-010-008	36	0.00	1.49407	Uranium Dioxide	Cylinder	Beryllium/Water	Water	62.40
Heuct-014-001	37	0.00	1.03792	Uranium Dioxide	Cylinder	Aluminum/Silicon Oxides	Water	79.38
Heust-020-003	38	847.40	0.03010	Uranyl Fluoride	Cylinder	D2O/Water/HF	D2O/Water/Steel/Alu minum	93.65
Heuct-010-005	39	0.00	1.49407	Uranium Dioxide	Cylinder	Beryllium/Water	Water	62.40
Heuct-010-006	40	0.00	1.49407	Uranium Dioxide	Cylinder	Beryllium/Water	Water	62.40
Heust-030-004	41	91.14	0.25745	Uranyl Nitrate	Cylinder	Water/NO3	Water	89.08
Heust-025-017	42	62.68	0.35010	Uranyl Nitrate	Cylinder	Water/NO3	Water	89.04
Heust-025-016	43	61.85	0.35616	Uranyl Nitrate	Cylinder	Water/NO3	Water	89.04
Heuct-010-004	44	0.00	1.49407	Uranium Dioxide	Cylinder	Beryllium/Water	Water	62.40

Table 1 Summary of Critical Experiments Modeled

Case ID	Case Number	$H/^{235}U$ Atom Ratio	$g^{235}U/cc$	Material	Geometry	Moderator	Reflector	Enrichment
Heust-008-014	45	68.75	0.33164	Uranyl Nitrate	Cylinder	Water/NO3	Plexiglass/Aluminum/ Stainless Steel	93.17
Heust-021-006	46	58.78	0.38429	Uranyl Nitrate	Cylinder	Water/NO3	Paraffin	92.60
heust-005-015	47	80.26	0.28947	Uranyl Nitrate	Cylinder	Water/NO3	None	87.40
Heust-003-011	48	70.94	0.32175	Uranyl Nitrate	Cylinder	Water/NO3	Plexiglass/Aluminum	93.17
Heust-005-008	49	80.26	0.28947	Uranyl Nitrate	Cylinder	Water/NO3	Water	87.40
Heust-008-008	50	80.26	0.28947	Uranyl Nitrate	Cylinder	Water/NO3	Water	87.40
Heust-002-003	51	73.50	0.31191	Uranyl Nitrate	Cylinder	Water/NO3	Concrete/Stainless Steel	93.17
Heust-003-018	52	70.94	0.32175	Uranyl Nitrate	Cylinder	Water/NO3	Plexiglass/Aluminum	93.17
Heust-007-008	53	66.78	0.33925	Uranyl Nitrate	Cylinder	Water/NO3	Concrete/Aluminum/St ainless Steel	93.17
Heust-007-006	54	67.50	0.33576	Uranyl Nitrate	Cylinder	Water/NO3	Concrete/Aluminum/St ainless Steel	93.17
Heust-021-018	55	58.78	0.38429	Uranyl Nitrate	Cylinder	Water/NO3	top (paraffin), bottom (paraffin)	92.60
Heust-033-003	56	68.10	0.33317	Uranyl Nitrate	Annular	Water/NO3	Concrete	93.22
Heust-021-023	57	58.78	0.38429	Uranyl Nitrate	Cylinder	Water/NO3	top (plexiglass), bottom (plexiglass)	92.60

Table 1 Summary of Critical Experiments Modeled

Case ID	Case Number	H/^{235}U Atom Ratio	g^{235}U/cc	Material	Geometry	Moderator	Reflector	Enrichment
Heust-033-008	58	68.10	0.33317	Uranyl Nitrate	Annular	Water/NO3	Concrete	93.22
Heuct-013-002	59	0.00	1.03792	Uranium Dioxide	Cylinder	Aluminum/Silicon Oxides	Water	79.38
Heust-006-022	60	84.54	0.27481	Uranyl Nitrate	Cylinder	Water/NO3	Borated Water	93.06
Heust-009-002	61	47.23	0.50603	Uranyl Fluoride	Spherical	Water/HF	Water/Aluminum	93.19
Heuct-010-003	62	0.00	1.49407	Uranium Dioxide	Cylinder	Berrylium/Water	Water	62.40
Heucm-001-002	63	0.00	1.74728	Uranium Dioxide	Cylinder	Oxygen	Water/Plexiglass/Polyethylene	93.15
Heust-006-014	64	84.98	0.27452	Uranyl Nitrate	Cylinder	Water/NO3	Nickel	93.06
Heust-006-021	65	84.24	0.27360	Uranyl Nitrate	Cylinder	Water/NO3	Nickel/Borated Water	93.06
Heuct-013-001	66	0.00	1.03792	Uranium Dioxide	Cylinder	Aluminum/Silicon Oxides	Water	79.38
Heuct-011-002	67	0.00	1.03792	Uranium Dioxide	Cylinder	Aluminum/Silicon Oxides	Water	79.38
Heuct-012-001	68	0.00	1.03792	Uranium Dioxide	Cylinder	Aluminum/Silicon Oxides	Water	79.48
Heuct-011-001	69	0.00	1.03792	Uranium Dioxide	Cylinder	Aluminum/Silicon Oxides	Water	79.38
Heust-004-004	70	134.90	0.18499	Uranyl Fluoride	Spherical	D2O/Water/HF	D2O/Water/Steel	93.65

Table 1 Summary of Critical Experiments Modeled

Case ID	Case Number	$H/^{235}U$ Atom Ratio	$g^{235}U/cc$	Material	Geometry	Moderator	Reflector	Enrichment
Heust-020-001	71	227.70	0.10940	Uranyl Fluoride	Cylinder	D2O/Water/HF	D2O/Water/Steel/Alu minum	93.65
Heust-004-003	72	80.96	0.30200	Uranyl Fluoride	Spherical	D2O/Water/HF	D2O/Water/Steel	93.65
Heumt-003-005	73	0.00	17.69982	U-Metal	Cuboid	None	Water	94.52
Heust-004-002	74	53.54	0.44298	Uranyl Fluoride	Spherical	D2O/Water/HF	D2O/Water/Steel	93.65
Heust-004-001	75	34.10	0.67902	Uranyl Fluoride	Spherical	D2O/Water/HF	D2O/Water/Steel	93.65
Heucm-001-018	76	34.10	0.67902	Uranyl Fluoride	Spherical	D2O/Water/HF	D2O/Water/Steel	93.65
Heucm-001-017	77	0.00	4.49781	Uranium Dioxide	Cylinder	Oxygen	Water/Plexiglass/Polye thylene	93.15
Heucm-001-015	78	0.00	4.49781	Uranium Dioxide	Cylinder	Oxygen	Water/Plexiglass/Polye thylene	93.15
Heucm-001-016	79	0.00	4.49781	Uranium Dioxide	Cylinder	Oxygen	Water/Plexiglass/Polye thylene	93.15
Heumf-007-043	80	0.00	4.49781	Uranium Dioxide	Cylinder	Oxygen	Water/Plexiglass/Polye thylene	93.15
Heucm-001-019	81	0.00	17.18152	U-Metal	Cuboid	None	Polyethylene	93.15
Heuci-004-001	82	0.00	4.49781	Uranium Dioxide	Cylinder	Oxygen	Water/Plexiglass/Polye thylene	93.15
Heucm-001-013	83	0.45	0.09763	Uranium Dioxide	Cuboid	Graphite/Water	None	92.28

Table 1 Summary of Critical Experiments Modeled

Case ID	Case Number	$H/^{235}U$ Atom Ratio	$g^{235}U/cc$	Material	Geometry	Moderator	Reflector	Enrichment
Heucm-001-011	84	0.00	4.49781	Uranium Dioxide	Cylinder	Oxygen	Water/Plexiglass/Polyethylene	93.15
Heucm-001-012	85	0.00	4.49781	Uranium Dioxide	Cylinder	Oxygen	Water/Plexiglass/Polyethylene	93.15
Heumf-007-042	86	0.00	17.18338	U-Metal	Cuboid	None	Polyethylene	93.15
Heumf-007-041	87	0.00	17.21505	U-Metal	Cuboid	None	Polyethylene	93.15
Heucm-001-009	88	0.00	4.49781	Uranium Dioxide	Cylinder	Oxygen	Water/Plexiglass/Polyethylene	93.15
Heumf-007-018	89	0.00	17.23368	U-Metal	Cuboid	None	Polyethylene	93.15
Heucm-001-010	90	0.00	4.49781	Uranium Dioxide	Cylinder	Oxygen	Water/Plexiglass/Polyethylene	93.15
Heumf-007-017	91	0.00	17.23554	U-Metal	Cuboid	None	Polyethylene	93.15
Heucm-001-027	92	1.56	5.41384	Uranium Dioxide	Cylinder	Alcohol	Alcohol/Plexiglass/Polyethylene	93.15
Heucm-001-026	93	1.56	5.41384	Uranium Dioxide	Cylinder	Alcohol	Alcohol/Plexiglass/Polyethylene	93.15
Heucm-001-025	94	1.56	5.41384	Uranium Dioxide	Cylinder	Alcohol	Alcohol/Plexiglass/Polyethylene	93.15
Heucm-001-023	95	1.56	5.41384	Uranium Dioxide	Cylinder	Alcohol	Alcohol/Plexiglass/Polyethylene	93.15

Table 1 Summary of Critical Experiments Modeled

Case ID	Case Number	H/^{235}U Atom Ratio	g^{235}U/cc	Material	Geometry	Moderator	Reflector	Enrichment
Heucm-001-024	96	1.56	5.41384	Uranium Dioxide	Cylinder	Alcohol	Alcohol/Plexiglass/Polyethylene	93.15
Heucm-001-029	97	1.56	5.41384	Uranium Dioxide	Cylinder	Alcohol	Alcohol/Plexiglass/Polyethylene	93.15
Heucm-001-028	98	1.56	5.41384	Uranium Dioxide	Cylinder	Alcohol	Alcohol/Plexiglass/Polyethylene	93.15
Heucm-001-022	99	1.56	5.41384	Uranium Dioxide	Cylinder	Alcohol	Alcohol/Plexiglass/Polyethylene	93.15
Heucm-001-021	100	1.56	5.41384	Uranium Dioxide	Cylinder	Alcohol	Alcohol/Plexiglass/Polyethylene	93.15
Heucm-001-020	101	1.56	5.41384	Uranium Dioxide	Cylinder	Alcohol	Alcohol/Plexiglass/Polyethylene	93.15
Heucm-001-008	102	0.00	4.49781	Uranium Dioxide	Cylinder	Oxygen	Water/Plexiglass/Polyethylene	93.15
Heumm-002-001	103	0.00	16.52425	U-Metal	Sphere	None	Polyethylene	90.00
Heumm-003-001	104	0.00	16.52425	U-Metal	Sphere	None	Polyethylene	90.00
Heucm-001-005	105	0.00	4.49781	Uranium Dioxide	Cylinder	Oxygen	Water/Plexiglass/Polyethylene	93.15
Heumf-007-031	106	0.00	17.37061	U-Metal	Cuboid	None	Plexiglass	93.15
Heumf-007-039	107	0.00	17.24859	U-Metal	Cuboid	None	Polyethylene	93.15

Table 1 Summary of Critical Experiments Modeled

Case ID	Case Number	$H/^{235}U$ Atom Ratio	$g^{235}U/cc$	Material	Geometry	Moderator	Reflector	Enrichment
Heumf-007-040	108	0.00	17.28957	U-Metal	Cuboid	None	Polyethylene	93.15
Heucm-001-007	109	0.00	4.49781	Uranium Dioxide	Cylinder	Oxygen	Water/Plexiglass/Polyethylene	93.15
Heumf-007-038	110	0.00	17.17034	U-Metal	Cuboid	None	Polyethylene	93.15
Heucm-001-006	111	0.00	4.49781	Uranium Dioxide	Cylinder	Oxygen	Water/Plexiglass/Polyethylene	93.15
Heumf-007-037	112	0.00	17.18897	U-Metal	Cuboid	None	Polyethylene	93.15
Heumm-001-001	113	0.00	17.83457	U-Metal	Cylinder/Slab	None	Titanium/Polyethylene	95.98
Heumf-007-013	114	0.00	17.20853	U-Metal	Cuboid	None	Polyethylene	93.15
Heumf-007-016	115	0.00	17.28212	U-Metal	Cuboid	None	Polyethylene	93.15
Heumf-007-015	116	0.00	17.28957	U-Metal	Cuboid	None	Polyethylene	93.15
Heumf-007-014	117	0.00	17.17872	U-Metal	Cuboid	None	Polyethylene	93.15
Heumf-007-036	118	0.00	17.34639	U-Metal	Cuboid	None	Polyethylene	93.15
Heumf-023-020	119	0.00	17.48432	U-Metal	Cylinder	None	Polyethylene	93.20
Heumf-007-011	120	0.00	17.20853	U-Metal	Cuboid	None	Polyethylene	93.15
Heumf-031	121	0.00	17.83087	U-Metal	Cylinder	Carbon/Iron/Tungsten	Polyethylene	95.96
Heumf-007-035	122	0.00	17.11072	U-Metal	Cuboid	None	Polyethylene	93.15

Table 1 Summary of Critical Experiments Modeled

Case ID	Case Number	H/^{235}U Atom Ratio	g^{235}U/cc	Material	Geometry	Moderator	Reflector	Enrichment
Heumf-026-004	123	0.00	17.48432	U-Metal	Cylinder	None	Paraffin	93.20
Heumf-034-003	124	0.00	17.83087	U-Metal	Cylinder	Carbon/Iron/Tungsten	Titanium/Polyethylene /Aluminum	95.96
Heumf-034-001	125	0.00	17.60018	U-Metal	Cuboid	None	Water	94.01
Heumf-034-002	126	0.00	17.83087	U-Metal	Cylinder	Carbon/Iron/Tungsten	Titanium/Polyethylene /Aluminum	95.96
Heumf-026-006	127	0.00	17.48432	U-Metal	Cylinder	None	Paraffin	93.20
Heumf-007-030	128	0.00	17.37806	U-Metal	Cuboid	None	Plexiglass	93.15
Heumt-003-001	129	0.00	17.60018	U-Metal	Cuboid	None	Water	94.01
Heumf-007-026	130	0.00	17.27374	U-Metal	Cuboid	None	Polyethylene	93.15
Heumf-007-010	131	0.00	17.24113	U-Metal	Cuboid	None	Polyethylene	93.15
Heumf-007-025	132	0.00	17.28212	U-Metal	Cuboid	None	Polyethylene	93.15
Heumf-026-003	133	0.00	17.48432	U-Metal	Cylinder	None	Paraffin	93.20
Heumf-004-002	134	0.00	18.35603	U-Metal	Sphere	None	Water	97.68
Heumf-004-001	135	0.00	18.35603	U-Metal	Sphere	None	Water, Plexiglass	97.68
Heumf-007-024	136	0.00	0.44400	U-Metal	Cylinder	Iron/Nickel/Chromium	Carbon Steel	93.18
Heumf-007-023	137	0.00	17.27933	U-Metal	Cuboid	None	Polyethylene	93.15

Table 1 Summary of Critical Experiments Modeled

Case ID	Case Number	$H/^{235}U$ Atom Ratio	$g^{235}U/cc$	Material	Geometry	Moderator	Reflector	Enrichment
Heumf-007-006	138	0.00	17.31752	U-Metal	Cuboid	None	Polyethylene	93.15
Heumf-007-022	139	0.00	17.30541	U-Metal	Cuboid	None	Polyethylene	93.15
Heumf-007-009	140	0.00	17.27001	U-Metal	Cuboid	None	Polyethylene	93.15
Heumf-007-008	141	0.00	17.27839	U-Metal	Cuboid	None	Polyethylene	93.15
Heumf-007-005	142	0.00	17.26442	U-Metal	Cuboid	None	Polyethylene	93.15
Heumf-007-003	143	0.00	17.26256	U-Metal	Cuboid	None	Polyethylene	93.15
Heumf-020	144	0.00	17.29423	U-Metal	Cuboid	None	Plexiglass	93.15
Heumf-007-002	145	0.00	16.58525	U-Metal	Sphere	Carbon/Iron/Tungsten	Polyethylene	89.65
Heumf-003-004	146	0.00	17.53125	U-Metal	Sphere	None	Tungsten Carbide	93.50
Heumf-041	147	0.00	17.37150	U-Metal	Cuboid	None	Beryillum	93.90
Heumf-003-003	148	0.00	17.53125	U-Metal	Sphere	None	Tungsten Carbide	93.50
Heumf-003-002	149	0.00	17.53125	U-Metal	Sphere	None	Tungsten Carbide	93.50
Heumf-007-034	150	0.00	17.13215	U-Metal	Cuboid	None	Teflon	93.15
Heumf-003-001	151	0.00	17.53125	U-Metal	Sphere	None	Tungsten Carbide	93.50
Heumf-007-033	152	0.00	17.17779	U-Metal	Cuboid	None	Teflon	93.15
Heumf-007-032	153	0.00	17.17779	U-Metal	Cuboid	None	Teflon	93.15

Table 1 Summary of Critical Experiments Modeled

Case ID	Case Number	$H/^{235}U$ Atom Ratio	$g^{235}U/cc$	Material	Geometry	Moderator	Reflector	Enrichment
Heumf-019	154	0.00	16.54912	U-Metal	Sphere	Carbon/Iron/Tungsten	Graphite	89.60
Heumf-027	155	0.00	16.29293	U-Metal	Sphere	Carbon/Iron/Tungsten	Lead/Iron	89.47
Heumf-023-016	156	0.00	17.48430	U-Metal	Cylinder	None	Polyethylene	93.20
Heumf-018	157	0.00	16.33423	U-Metal	Sphere	Carbon/Iron/Tungsten	None	89.65
Heumf-026-001	158	0.00	17.48432	U-Metal	Cylinder	None	None	93.20
Heumf-001-001	159	0.00	17.65883	U-Metal	Sphere	None	None	93.90
Heumf-007-019	160	0.00	17.31845	U-Metal	Cuboid	None	None	93.15
Heumf-007-001	161	0.00	17.21598	U-Metal	Cuboid	None	None	93.15

Table 2 Experimental and Calculation Results								
Case ID	**Case Number**	**Kexp**	**Sigexp**	**K5calc**	**Sig5calc**	**K6calc**	**Sig6calc**	**ALCF, eV**
Heust-032-001	1	1.0000	0.0004	0.9994	0.0008	0.9979	0.0009	2.91E-02
Heust-002-009	2	1.0000	0.0004	1.0081	0.0017	1.0077	0.0018	3.05E-02
Heust-012-001	3	1.0000	0.0004	1.0047	0.0009	1.0018	0.0010	3.08E-02
Heust-037-005	4	1.0000	0.0004	1.0092	0.0012	1.0046	0.0011	3.16E-02
Heust-028-001	5	1.0000	0.0004	1.0019	0.0017	1.0014	0.0021	3.28E-02
Heust-014-002	6	1.0000	0.0004	1.0149	0.0014	1.0157	0.0014	3.31E-02
Heust-035-005	7	1.0000	0.0004	1.0066	0.0013	1.0096	0.0012	3.45E-02
Heust-035-001	8	1.0000	0.0004	1.0045	0.0013	1.0014	0.0011	3.52E-02
Heust-007-009	9	1.0000	0.0004	1.0085	0.0013	1.0080	0.0013	3.61E-02
Heust-037-002	10	1.0000	0.0004	1.0061	0.0011	1.0044	0.0013	3.71E-02
Heust-011-001	11	1.0000	0.0004	1.0075	0.0012	1.0049	0.0013	3.79E-02
Heumt-006-012	12	1.0000	0.0004	1.0054	0.0016	1.0049	0.0014	4.00E-02
Heust-025-006	13	1.0000	0.0004	1.0107	0.0009	1.0120	0.0009	4.07E-02
Heust-008-007	14	1.0000	0.0004	1.0003	0.0014	0.9986	0.0014	4.13E-02

Table 2 Experimental and Calculation Results								
Case ID	**Case Number**	**Kexp**	**Sigexp**	**K5calc**	**Sig5calc**	**K6calc**	**Sig6calc**	**ALCF, eV**
Heust-002-010	15	1.0000	0.0004	1.0079	0.0013	1.0089	0.0014	4.19E-02
Heust-003-001	16	1.0000	0.0004	1.0070	0.0014	1.0008	0.0014	4.19E-02
Heumt-006-005	17	1.0000	0.0004	1.0023	0.0015	1.0048	0.0016	4.34E-02
Heust-028-008	18	1.0000	0.0004	1.0010	0.0014	0.9992	0.0015	4.56E-02
Heumt-006-016	19	1.0000	0.0004	1.0030	0.0014	1.0008	0.0017	4.73E-02
Heust-007-010	20	1.0000	0.0004	1.0142	0.0013	1.0162	0.0011	5.06E-02
Heust-037-009	21	1.0000	0.0004	1.0057	0.0013	1.0057	0.0015	5.20E-02
Heust-010-003	22	1.0000	0.0004	1.0023	0.0016	1.0012	0.0015	5.33E-02
Heust-036-002	23	1.0000	0.0004	1.0006	0.0015	0.9966	0.0015	5.56E-02
Heumt-006-018	24	1.0000	0.0004	1.0036	0.0018	1.0031	0.0016	6.04E-02
Heust-015-003	25	1.0000	0.0004	1.0124	0.0013	1.0128	0.0013	6.04E-02
Heumt-006-010	26	1.0000	0.0004	1.0040	0.0015	1.0040	0.0016	6.28E-02
Heust-027-001	27	1.0000	0.0004	0.9983	0.0019	0.9999	0.0016	7.18E-02
Heust-027-005	28	1.0000	0.0004	0.9946	0.0014	0.9989	0.0014	7.33E-02
Heust-002-012	29	1.0000	0.0004	1.0113	0.0014	1.0082	0.0013	7.52E-02

Table 2 Experimental and Calculation Results								
Case ID	**Case Number**	**Kexp**	**Sigexp**	**K5calc**	**Sig5calc**	**K6calc**	**Sig6calc**	**ALCF, eV**
Heust-002-011	30	1.0000	0.0004	1.0041	0.0015	1.0034	0.0015	7.69E-02
Heuct-010-021	31	1.0000	0.0004	1.0059	0.0012	1.0040	0.0013	9.09E-02
Heuct-010-010	32	1.0000	0.0004	1.0009	0.0011	1.0019	0.0011	9.57E-02
Heuct-014-002	33	1.0000	0.0004	1.0028	0.0013	1.0000	0.0013	9.61E-02
Heuct-010-017	34	1.0000	0.0004	1.0056	0.0013	1.0042	0.0012	9.69E-02
Heuct-010-015	35	1.0000	0.0004	1.0027	0.0011	1.0031	0.0012	9.96E-02
Heuct-010-008	36	1.0000	0.0004	1.0025	0.0012	1.0029	0.0012	1.09E-01
Heuct-014-001	37	1.0000	0.0004	1.0001	0.0013	1.0036	0.0012	1.16E-01
Heust-020-003	38	1.0000	0.0004	1.0098	0.0016	1.0083	0.0017	1.32E-01
Heuct-010-005	39	1.0000	0.0004	0.9968	0.0011	0.9963	0.0012	1.37E-01
Heuct-010-006	40	1.0000	0.0004	0.9947	0.0013	0.9965	0.0012	1.38E-01
Heust-030-004	41	1.0000	0.0004	1.0028	0.0015	1.0016	0.0015	1.56E-01
Heust-025-017	42	1.0000	0.0004	1.0057	0.0010	1.0062	0.0010	1.67E-01
Heust-025-016	43	1.0000	0.0004	1.0148	0.0010	1.0134	0.0010	1.79E-01
Heuct-010-004	44	1.0000	0.0004	0.9964	0.0013	0.9958	0.0014	1.90E-01

Table 2 Experimental and Calculation Results								
Case ID	**Case Number**	**Kexp**	**Sigexp**	**K5calc**	**Sig5calc**	**K6calc**	**Sig6calc**	**ALCF, eV**
Heust-008-014	45	1.0000	0.0004	1.0000	0.0017	1.0005	0.0014	2.06E-01
Heust-021-006	46	1.0000	0.0004	1.0132	0.0015	1.0138	0.0014	2.15E-01
Heust-005-015	47	1.0000	0.0004	0.9984	0.0014	0.9985	0.0014	2.23E-01
Heust-003-011	48	1.0000	0.0004	1.0024	0.0017	1.0012	0.0014	2.28E-01
Heust-005-008	49	1.0000	0.0004	1.0039	0.0012	1.0031	0.0013	2.33E-01
Heust-008-008	50	1.0000	0.0004	1.0004	0.0016	0.9998	0.0015	2.40E-01
Heust-002-003	51	1.0000	0.0004	1.0020	0.0017	1.0029	0.0017	2.48E-01
Heust-003-018	52	1.0000	0.0004	0.9990	0.0016	1.0003	0.0014	2.54E-01
Heust-007-008	53	1.0000	0.0004	1.0046	0.0015	1.0040	0.0015	2.66E-01
Heust-007-006	54	1.0000	0.0004	1.0065	0.0014	1.0059	0.0016	2.70E-01
Heust-021-018	55	1.0000	0.0004	1.0030	0.0015	1.0061	0.0016	2.79E-01
Heust-033-003	56	1.0000	0.0004	1.0033	0.0013	1.0020	0.0013	2.90E-01
Heust-021-023	57	1.0000	0.0004	0.9989	0.0014	1.0014	0.0014	2.98E-01
Heust-033-008	58	1.0000	0.0004	1.0029	0.0013	1.0041	0.0014	3.07E-01
Heuct-013-002	59	1.0000	0.0004	0.9993	0.0012	1.0004	0.0011	3.12E-01

Table 2 Experimental and Calculation Results								
Case ID	**Case Number**	**Kexp**	**Sigexp**	**K5calc**	**Sig5calc**	**K6calc**	**Sig6calc**	**ALCF, eV**
Heust-006-022	60	1.0000	0.0004	1.0037	0.0012	1.0024	0.0011	3.14E-01
Heust-009-002	61	1.0000	0.0004	1.0046	0.0014	1.0045	0.0014	3.18E-01
Heuct-010-003	62	1.0000	0.0004	0.9947	0.0015	0.9912	0.0014	3.24E-01
Heucm-001-002	63	1.0000	0.0004	1.0102	0.0014	1.0111	0.0013	3.56E-01
Heust-006-014	64	1.0000	0.0004	1.0048	0.0010	1.0029	0.0012	3.58E-01
Heust-006-021	65	1.0000	0.0004	1.0040	0.0008	1.0043	0.0009	4.44E-01
Heuct-013-001	66	1.0000	0.0004	0.9995	0.0014	0.9994	0.0012	4.49E-01
Heuct-011-002	67	1.0000	0.0004	0.9976	0.0012	0.9954	0.0011	5.39E-01
Heuct-012-001	68	1.0000	0.0004	0.9957	0.0015	0.9963	0.0014	5.94E-01
Heuct-011-001	69	1.0000	0.0004	0.9972	0.0012	0.9972	0.0012	7.04E-01
Heust-004-004	70	1.0000	0.0004	1.0027	0.0017	1.0044	0.0016	1.09E+00
Heust-020-001	71	1.0000	0.0004	1.0065	0.0020	1.0037	0.0019	1.35E+00
Heust-004-003	72	1.0000	0.0004	1.0017	0.0015	1.0015	0.0016	2.68E+00
Heumt-003-005	73	1.0000	0.0004	0.9943	0.0017	0.9917	0.0015	2.73E+00
Heust-004-002	74	1.0000	0.0004	1.0000	0.0017	1.0015	0.0017	5.59E+00

Table 2 Experimental and Calculation Results								
Case ID	**Case Number**	**Kexp**	**Sigexp**	**K5calc**	**Sig5calc**	**K6calc**	**Sig6calc**	**ALCF, eV**
Heust-004-001	75	1.0000	0.0004	1.0049	0.0016	1.0013	0.0016	1.30E+01
Heucm-001-018	76	1.0000	0.0004	1.0072	0.0016	1.0079	0.0014	2.35E+01
Heucm-001-017	77	1.0000	0.0004	1.0022	0.0010	1.0019	0.0010	2.50E+01
Heucm-001-015	78	1.0000	0.0004	1.0129	0.0011	1.0129	0.0012	2.88E+01
Heucm-001-016	79	1.0000	0.0004	1.0024	0.0011	1.0051	0.0010	2.92E+01
Heumf-007-043	80	1.0000	0.0004	1.0081	0.0017	1.0073	0.0017	3.32E+01
Heucm-001-019	81	1.0000	0.0004	1.0061	0.0014	1.0075	0.0017	5.81E+01
Heuci-004-001	82	1.0000	0.0004	1.0138	0.0004	1.0141	0.0004	1.45E+02
Heucm-001-013	83	1.0000	0.0004	1.0061	0.0011	1.0081	0.0010	2.32E+02
Heucm-001-011	84	1.0000	0.0004	1.0074	0.0013	1.0085	0.0012	2.58E+02
Heucm-001-012	85	1.0000	0.0004	1.0050	0.0012	1.0011	0.0011	2.59E+02
Heumf-007-042	86	1.0000	0.0004	1.0066	0.0011	1.0037	0.0013	2.91E+02
Heumf-007-041	87	1.0000	0.0004	1.0044	0.0015	1.0035	0.0014	3.05E+02
Heucm-001-009	88	1.0000	0.0004	1.0061	0.0012	1.0042	0.0012	3.46E+02
Heumf-007-018	89	1.0000	0.0004	0.9972	0.0014	0.9959	0.0013	3.47E+02

Table 2 Experimental and Calculation Results								
Case ID	**Case Number**	**Kexp**	**Sigexp**	**K5calc**	**Sig5calc**	**K6calc**	**Sig6calc**	**ALCF, eV**
Heucm-001-010	90	1.0000	0.0004	0.9996	0.0012	1.0004	0.0012	3.50E+02
Heumf-007-017	91	1.0000	0.0004	0.9943	0.0014	0.9959	0.0013	3.72E+02
Heucm-001-027	92	1.0000	0.0004	1.0066	0.0012	1.0063	0.0012	3.83E+02
Heucm-001-026	93	1.0000	0.0004	1.0049	0.0012	1.0052	0.0012	4.01E+02
Heucm-001-025	94	1.0000	0.0004	1.0021	0.0014	1.0025	0.0012	4.42E+02
Heucm-001-023	95	1.0000	0.0004	1.0131	0.0011	1.0107	0.0013	4.54E+02
Heucm-001-024	96	1.0000	0.0004	1.0056	0.0011	1.0080	0.0013	4.54E+02
Heucm-001-029	97	1.0000	0.0004	1.0096	0.0013	1.0064	0.0012	4.64E+02
Heucm-001-028	98	1.0000	0.0004	1.0089	0.0012	1.0112	0.0012	4.82E+02
Heucm-001-022	99	1.0000	0.0004	1.0059	0.0011	1.0046	0.0011	5.28E+02
Heucm-001-021	100	1.0000	0.0004	1.0067	0.0011	1.0077	0.0010	5.35E+02
Heucm-001-020	101	1.0000	0.0004	1.0122	0.0011	1.0100	0.0012	5.39E+02
Heucm-001-008	102	1.0000	0.0004	1.0017	0.0012	1.0017	0.0013	5.54E+02
Heumm-002-001	103	1.0000	0.0004	1.0096	0.0011	1.0108	0.0012	1.18E+03
Heumm-003-001	104	1.0000	0.0004	1.0107	0.0012	1.0084	0.0012	1.18E+03

Table 2 Experimental and Calculation Results								
Case ID	**Case Number**	**Kexp**	**Sigexp**	**K5calc**	**Sig5calc**	**K6calc**	**Sig6calc**	**ALCF, eV**
Heucm-001-005	105	1.0000	0.0004	1.0084	0.0011	1.0082	0.0011	1.54E+03
Heumf-007-031	106	1.0000	0.0004	1.0002	0.0015	1.0011	0.0014	1.61E+03
Heumf-007-039	107	1.0000	0.0004	1.0041	0.0011	1.0019	0.0013	1.70E+03
Heumf-007-040	108	1.0000	0.0004	1.0066	0.0012	1.0071	0.0014	1.70E+03
Heucm-001-007	109	1.0000	0.0004	1.0092	0.0012	1.0073	0.0011	1.72E+03
Heumf-007-038	110	1.0000	0.0004	1.0016	0.0011	1.0008	0.0012	1.74E+03
Heucm-001-006	111	1.0000	0.0004	1.0035	0.0010	1.0024	0.0010	1.82E+03
Heumf-007-037	112	1.0000	0.0004	1.0032	0.0012	1.0032	0.0011	1.90E+03
Heumm-001-001	113	1.0000	0.0004	1.0053	0.0012	1.0050	0.0012	2.26E+03
Heumf-007-013	114	1.0000	0.0004	0.9972	0.0014	0.9997	0.0012	2.54E+03
Heumf-007-016	115	1.0000	0.0004	0.9947	0.0014	0.9954	0.0014	2.82E+03
Heumf-007-015	116	1.0000	0.0004	0.9949	0.0013	0.9925	0.0012	2.83E+03
Heumf-007-014	117	1.0000	0.0004	0.9974	0.0013	0.9953	0.0013	3.70E+03
Heumf-007-036	118	1.0000	0.0004	1.0049	0.0011	1.0046	0.0013	3.90E+03
Heumf-023-020	119	1.0000	0.0004	1.0036	0.0013	1.0020	0.0012	5.14E+03

Table 2 Experimental and Calculation Results								
Case ID	**Case Number**	**Kexp**	**Sigexp**	**K5calc**	**Sig5calc**	**K6calc**	**Sig6calc**	**ALCF, eV**
Heumf-007-011	120	1.0000	0.0004	0.9931	0.0012	0.9955	0.0015	5.53E+03
Heumf-031	121	1.0000	0.0004	1.0018	0.0012	1.0045	0.0012	6.81E+03
Heumf-007-035	122	1.0000	0.0004	0.9971	0.0012	0.9964	0.0012	7.53E+03
Heumf-026-004	123	1.0000	0.0004	1.0013	0.0012	1.0033	0.0011	1.08E+04
Heumf-034-003	124	1.0000	0.0004	1.0006	0.0011	1.0003	0.0013	1.51E+04
Heumf-034-001	125	1.0000	0.0004	0.9963	0.0012	0.9966	0.0012	1.58E+04
Heumf-034-002	126	1.0000	0.0004	0.9937	0.0012	0.9940	0.0013	1.62E+04
Heumf-026-006	127	1.0000	0.0004	0.9999	0.0011	1.0029	0.0011	1.65E+04
Heumf-007-030	128	1.0000	0.0004	0.9942	0.0013	0.9946	0.0013	1.75E+04
Heumt-003-001	129	1.0000	0.0004	1.0009	0.0013	1.0013	0.0012	1.83E+04
Heumf-007-026	130	1.0000	0.0004	0.9943	0.0014	0.9934	0.0013	2.50E+04
Heumf-007-010	131	1.0000	0.0004	0.9970	0.0012	0.9934	0.0013	2.64E+04
Heumf-007-025	132	1.0000	0.0004	0.9940	0.0012	0.9970	0.0013	2.66E+04
Heumf-026-003	133	1.0000	0.0004	1.0036	0.0012	1.0037	0.0011	3.06E+04
Heumf-004-002	134	1.0000	0.0004	0.9972	0.0013	1.0002	0.0011	3.10E+04

Table 2 Experimental and Calculation Results								
Case ID	**Case Number**	**Kexp**	**Sigexp**	**K5calc**	**Sig5calc**	**K6calc**	**Sig6calc**	**ALCF, eV**
Heumf-004-001	135	1.0000	0.0004	0.9988	0.0011	0.9954	0.0011	3.12E+04
Heumf-007-024	136	1.0000	0.0004	0.9975	0.0011	0.9959	0.0012	5.84E+04
Heumf-007-023	137	1.0000	0.0004	0.9975	0.0014	0.9969	0.0013	6.25E+04
Heumf-007-006	138	1.0000	0.0004	1.0011	0.0015	1.0035	0.0012	1.61E+05
Heumf-007-022	139	1.0000	0.0004	0.9979	0.0012	0.9961	0.0013	1.80E+05
Heumf-007-009	140	1.0000	0.0004	0.9965	0.0013	1.0004	0.0013	1.82E+05
Heumf-007-008	141	1.0000	0.0004	0.9960	0.0012	0.9946	0.0012	2.06E+05
Heumf-007-005	142	1.0000	0.0004	0.9965	0.0013	0.9949	0.0012	2.54E+05
Heumf-007-003	143	1.0000	0.0004	0.9964	0.0014	0.9994	0.0012	3.76E+05
Heumf-020	144	1.0000	0.0004	1.0016	0.0013	1.0001	0.0013	4.82E+05
Heumf-007-002	145	1.0000	0.0004	0.9962	0.0012	0.9969	0.0010	4.98E+05
Heumf-003-004	146	1.0000	0.0004	1.0135	0.0011	1.0143	0.0012	5.60E+05
Heumf-041	147	1.0000	0.0004	1.0066	0.0012	1.0065	0.0011	5.65E+05
Heumf-003-003	148	1.0000	0.0004	1.0088	0.0010	1.0083	0.0011	5.75E+05
Heumf-003-002	149	1.0000	0.0004	1.0045	0.0011	1.0048	0.0011	6.23E+05

Table 2 Experimental and Calculation Results								
Case ID	**Case Number**	**Kexp**	**Sigexp**	**K5calc**	**Sig5calc**	**K6calc**	**Sig6calc**	**ALCF, eV**
Heumf-007-034	150	1.0000	0.0004	1.0105	0.0013	1.0099	0.0012	6.59E+05
Heumf-003-001	151	1.0000	0.0004	1.0063	0.0011	1.0048	0.0011	6.82E+05
Heumf-007-033	152	1.0000	0.0004	1.0064	0.0013	1.0082	0.0013	7.23E+05
Heumf-007-032	153	1.0000	0.0004	1.0005	0.0012	0.9991	0.0011	7.97E+05
Heumf-019	154	1.0000	0.0004	1.0061	0.0010	1.0047	0.0012	8.16E+05
Heumf-027	155	1.0000	0.0004	1.0131	0.0012	1.0131	0.0012	8.55E+05
Heumf-023-016	156	1.0000	0.0004	1.0019	0.0012	0.9999	0.0013	8.85E+05
Heumf-018	157	1.0000	0.0004	0.9987	0.0012	1.0019	0.0011	8.89E+05
Heumf-026-001	158	1.0000	0.0004	1.0021	0.0013	1.0031	0.0011	8.99E+05
Heumf-001-001	159	1.0000	0.0004	1.0014	0.0011	0.9999	0.0011	9.05E+05
Heumf-007-019	160	1.0000	0.0004	0.9962	0.0012	0.9971	0.0013	9.08E+05
Heumf-007-001	161	1.0000	0.0004	0.9960	0.0011	0.9937	0.0012	9.14E+05

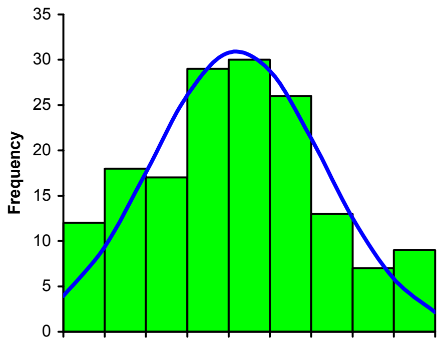
Table 3 Summary of Analysis Results

	K5Group 1 All Data	K5Group 2 ALCF ≤ 10^2 eV	K5Group 3 10^2 eV < ALCF ≤ 10^5 eV	K5Group 4 ALCF > 10^5 eV	K6Group 1 All Data	K6Group 2 ALCF ≤ 10^2 eV	K6Group 3 10^2 eV < ALCF ≤ 10^5 eV	K6Group 4 ALCF > 10^5 eV
Number of Experiments	161	81	56	24	161	81	56	24
Mean Experimental k_{eff}	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Mean Calculated k_{eff}	1.0030	1.0037	1.0024	1.0023	1.0028	1.0033	1.0022	1.0023
Experimental k_{eff} variance	1.6000E-07	1.6000E-07	1.6000E-07	1.6000E-07	1.6000E-07	1.6000E-07	1.6000E-07	1.6000E-07
Calculated k_{eff} variance	2.6907E-05	2.3170E-05	3.0155E-05	3.1154E-05	2.6907E-05	2.3170E-05	3.0155E-05	3.1154E-05
σKENO-calc mean	0.0013	0.0014	0.0012	0.0012	0.0013	0.0014	0.0012	0.0012
t-value	-2543	-1876	-1365	-879				
t-critical 1 tail (95%)	1.8610	1.9620	2.0380	2.3090				
t-critical 2 tail (95%)	1.9674	1.9750	1.9750	1.9818				
t-test 2 tail pass/fail	Fail	Fail	Fail	Fail				
Method Bias	+0.0030	+0.0037	+0.0024	+0.0023	+0.0030	+0.0037	+0.0024	+0.0023
Uncertainty (*U*) {1 tail (95%)}	0.0022	0.0024	0.0027	0.0037	0.0022	0.0024	0.0027	0.0037
Total Uncertainty *κ(σKENO-calc) + (U)*	0.0031	0.0033	0.0034	0.0042	0.0030	0.0033	0.0034	0.0042
Upper Limit k_{eff}	0.9469	0.9467	0.9466	0.9458	0.9470	0.9467	0.9466	0.9458

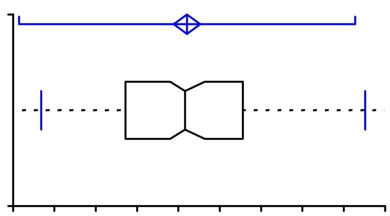
Notes; Positive biases were neglected in the determination of the k_{eff} limits and the mean KENO-calculated standard deviation (σ) was used to determine the Upper Limit.

analysed with: Analyse-it + General 1.65

Test	**Continuous summary descriptives**
	Group 1
	Kcalc
Performed by	RDMontgomery
Date	7 July 2004

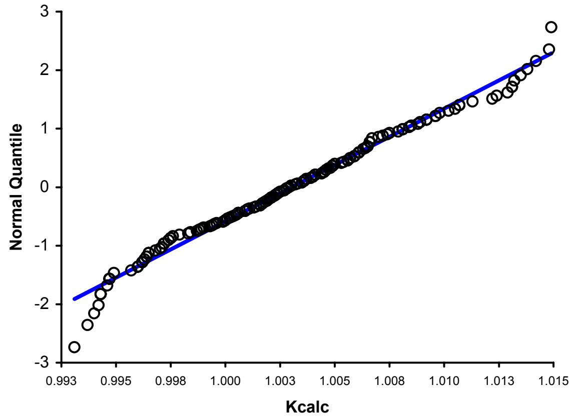


n	161
Mean	1.00302
95% CI	1.00222 to 1.00383
Variance	0.000027
SD	0.005187
SE	0.000409
CV	1%



Median	1.00290
96.0% CI	1.00200 to 1.00410
Range	0.0218
IQR	0.0071

Percentile	
2.5th	0.99421
25th	0.99930
50th	1.00290
75th	1.00640
97.5th	1.01379

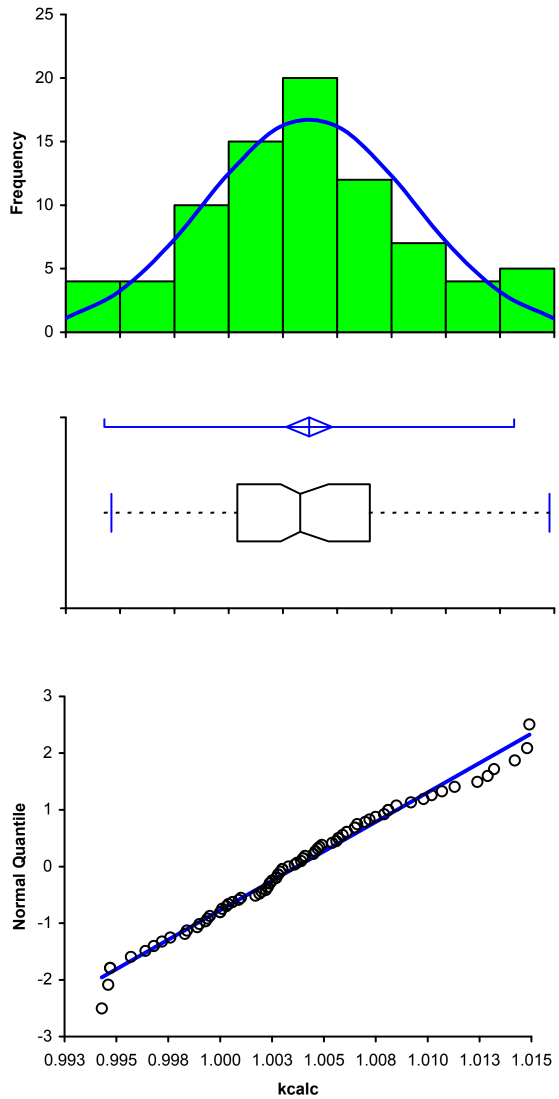


	Coefficient	p
Anderson-Darling	0.4951	0.2146
Skewness	0.1862	0.3228
Kurtosis	-0.5371	0.0741

Figure 1, Group 1 Histogram, Skewness and Kurtosis.

analysed with: Analyse-it + General 1.65

Test	**Continuous summary descriptives**
	Group 2
	kcalc
Performed by	RDMontgomery
Date	10 September 2003



n	81
Mean	1.00371
95% CI	1.00264 to 1.00477
Variance	0.000023
SD	0.004814
SE	0.000535
CV	0%
Median	1.00330
95.5% CI	1.00240 to 1.00460
Range	0.0206
IQR	0.0061

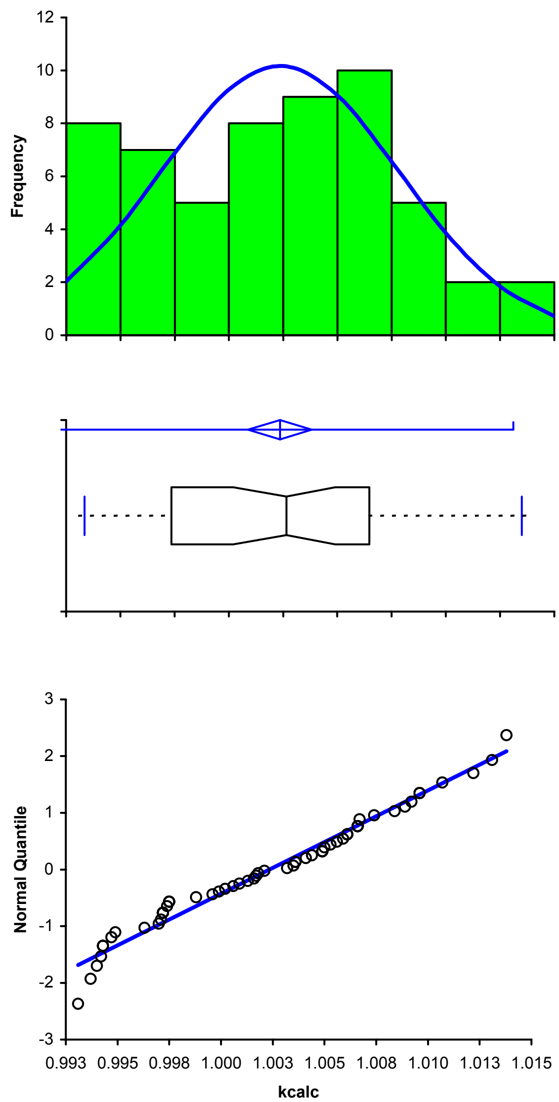
Percentile	
2.5th	0.99461
25th	1.00040
50th	1.00330
75th	1.00650
97.5th	1.01477

	Coefficient	p
Anderson-Darling	0.3513	0.4696
Skewness	0.2746	0.2927
Kurtosis	-0.0750	0.9661

Figure 2, Group 2 Histogram, Skewness and Kurtosis.

analysed with: Analyse-it + General 1.65

Test	**Continuous summary descriptives**
	Group 3
	kcalc
Performed by	RDMontgomery
Date	10 September 2003



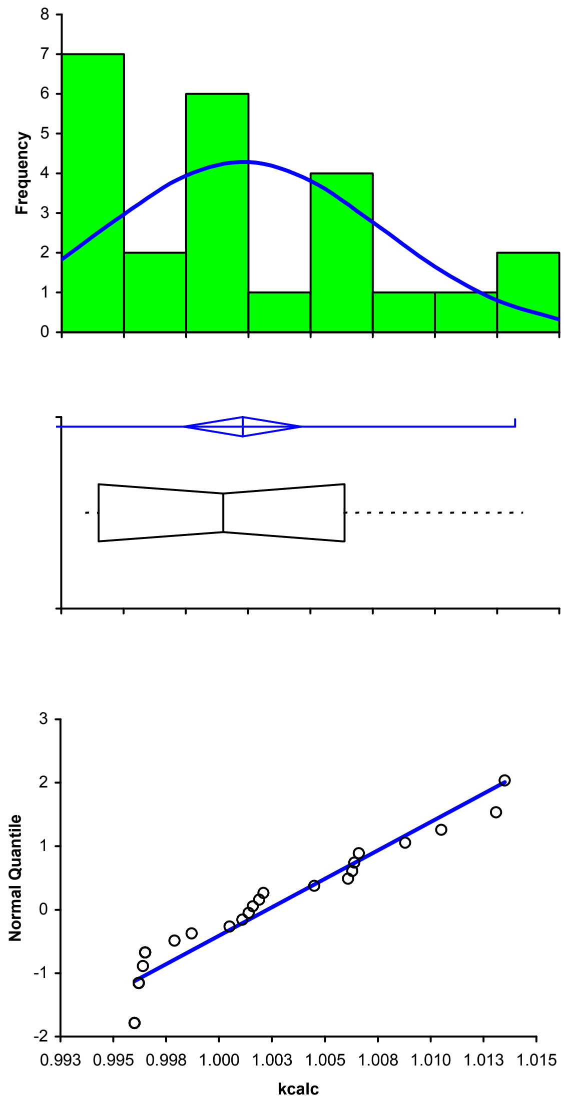
n	56
Mean	1.00235
95% CI	1.00088 to 1.00382
Variance	0.000030
SD	0.005491
SE	0.000734
CV	1%
Median	1.00265
95.6% CI	1.00020 to 1.00490
Range	0.0207
IQR	0.0091

Percentile	
2.5th	0.99336
25th	0.99735
50th	1.00265
75th	1.00648
97.5th	1.01350

	Coefficient	**p**
Anderson-Darling	0.5075	0.2000
Skewness	0.0838	0.7834
Kurtosis	-0.8797	0.0391

Figure 3, Group 3 Histogram, Skewness and Kurtosis.

Test	**Continuous summary descriptives**		
	Group 4		
	kcalc		
Performed by	RDMontgomery	**Date**	10 September 2003



n	24
Mean	1.00228
95% CI	0.99993 to 1.00464
Variance	0.000031
SD	0.005582
SE	0.001139
CV	1%
Median	1.00150
97.7% CI	0.99650 to 1.00630
Range	0.0175
IQR	0.0099

Percentile	
2.5th	-
25th	0.99650
50th	1.00150
75th	1.00638
97.5th	-

	Coefficient	**p**
Anderson-Darling	0.7342	0.0557
Skewness	0.5767	0.2084
Kurtosis	-0.7094	0.4126

Figure 4, Group 4 Histogram, Skewness and Kurtosis.

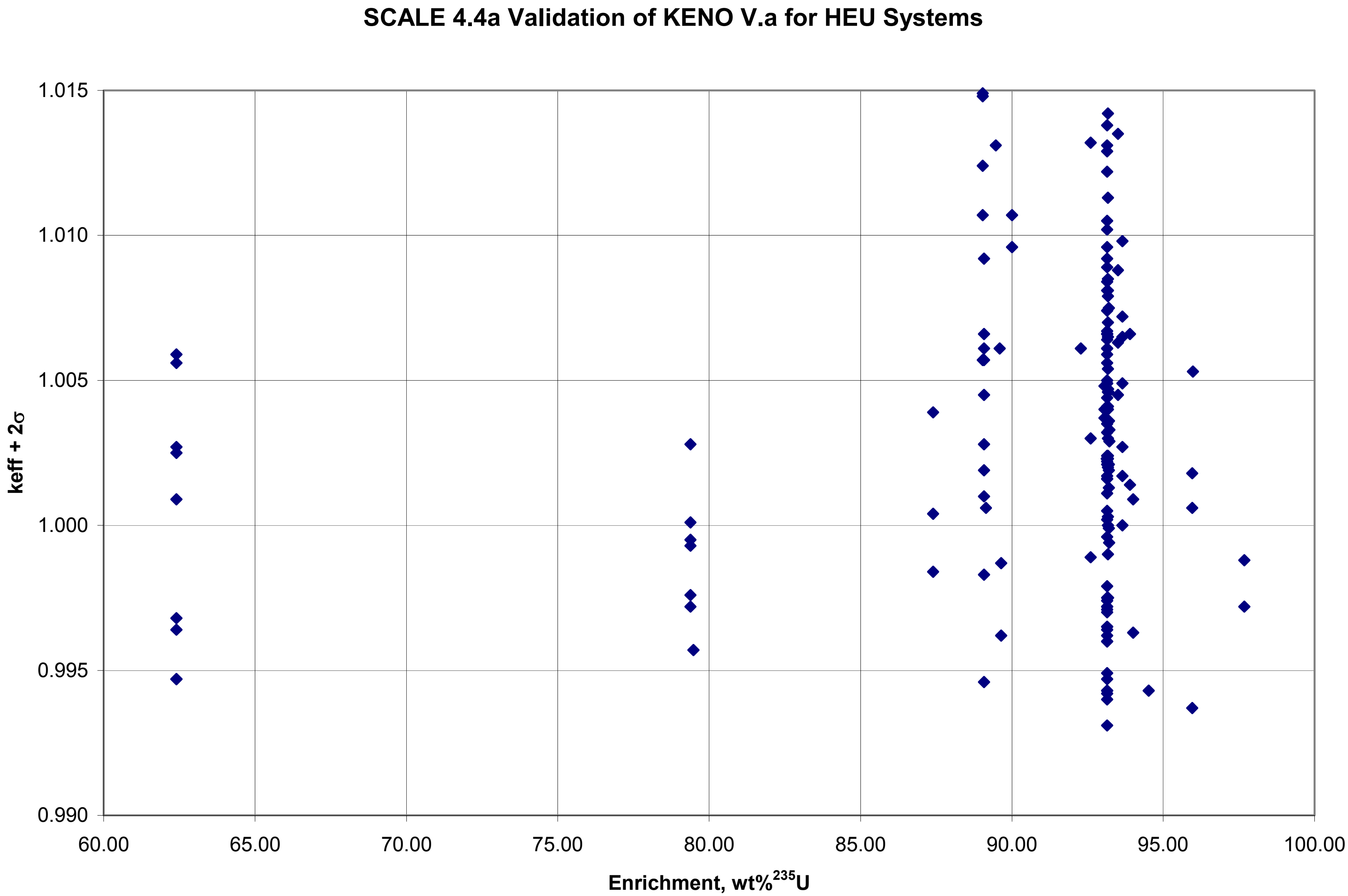


Figure 5, Plot of k_{eff} with the Enrichment (wt%^{235}U).

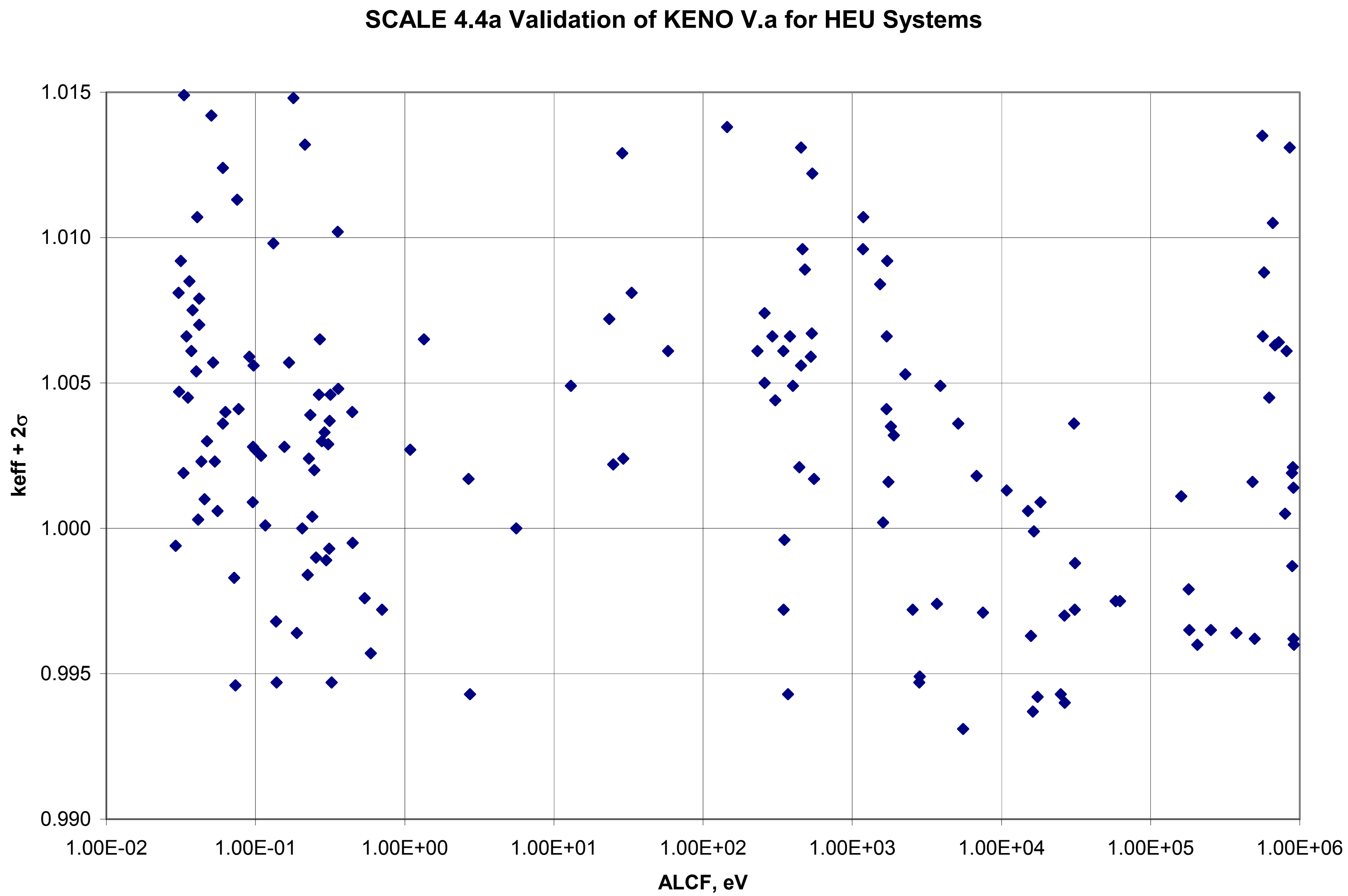


Figure 6, Plot of k_{eff} with the Energy of the Average Lethargy Causing Fission (ALCF).

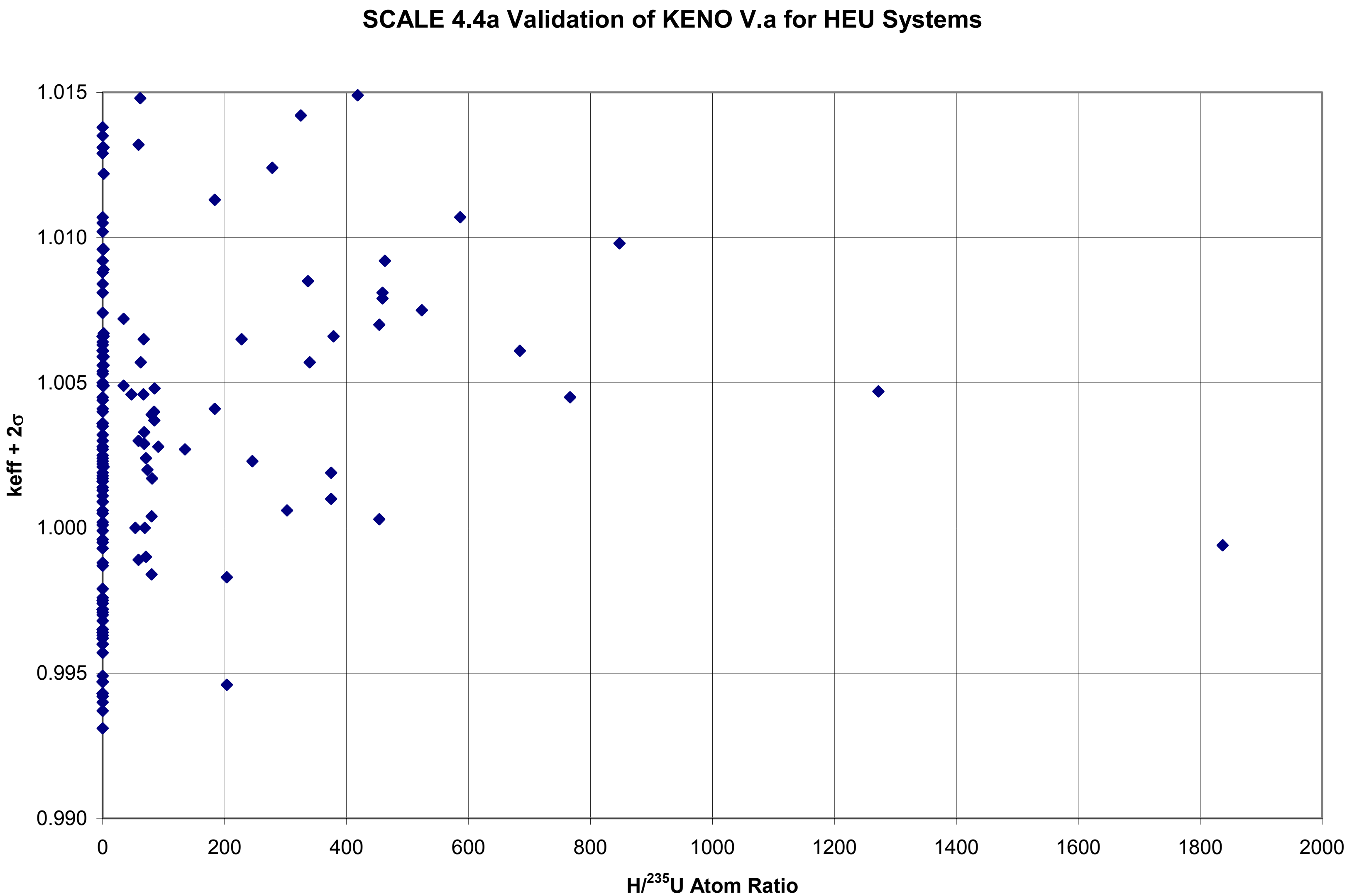


Figure 7, Plot of the k_{eff} with the Moderator-to-Fissile atom ratio (H/^{235}U).

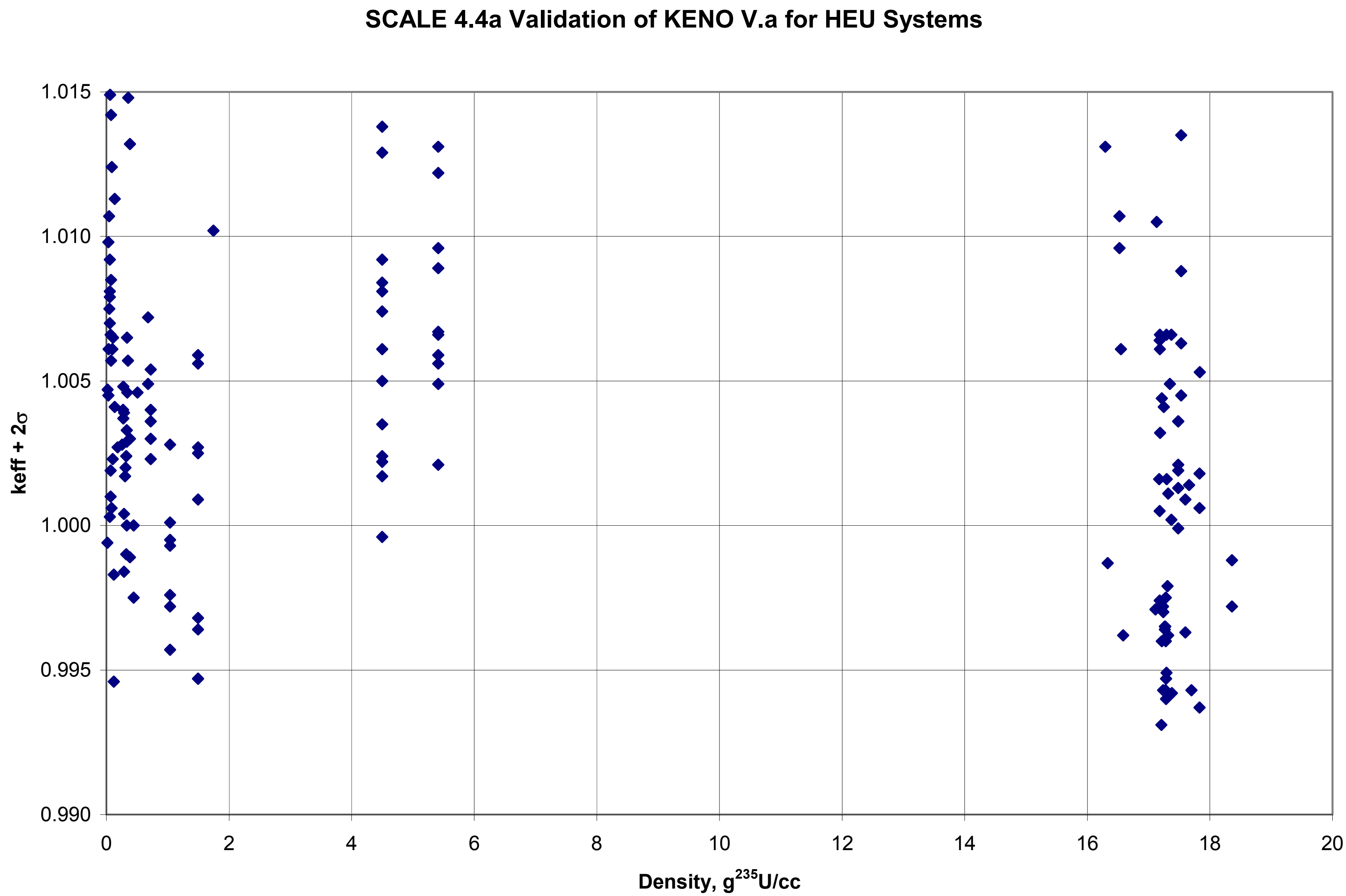


Figure 8, Plot of k_{eff} with the Fissile Denstiy (g ^{235}U/cc)

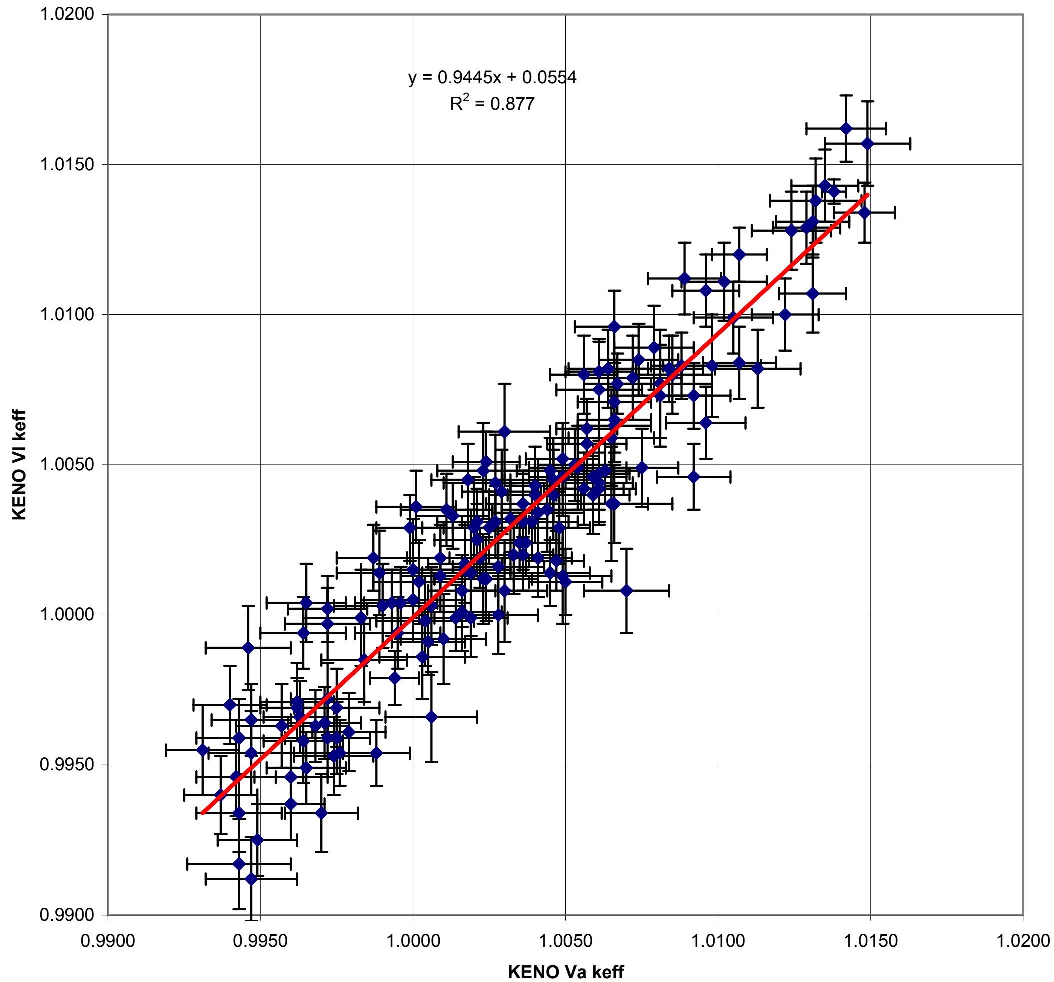


Figure 9, Plot of KENO VI k_{eff} with the KENO Va k_{eff}

APPENDIX A

SCALE INPUT CASES FOR DATA SETS 1 THROUGH 161 CRITICAL EXPERIMENTS

(This information available in electronic media only)