Bias and Uncertainty of Critical Experiment Models with CSAS25 from SCALE4.4a for Criticality Safety Analyses On the HP J-5600 (CMODB) Workstation

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Abstract

This report documents establishment of bias, bias trends and uncertainty for validation of the CSAS25 control module from the SCALE 4.4a computer code system for use in evaluating criticality safety of uranium systems. The 27-group ENDF/B-IV, 44-group ENDF/B-V, and 238-group ENDF/B-V cross-section libraries were used. The criticality validation calculations were performed using over 500 benchmark cases from Volumes II and IV of the "International Handbook of Evaluated Criticality Safety Benchmark Experiments," published by the Nuclear Energy Agency Organization for Economic Cooperation and Development (NEA/OECD). Based on statistical analysis of the calculation results, the bias, bias trends and uncertainty of the benchmark calculations have been established for these benchmark experiments. Numerical methods for applying margins are briefly described, but the determination of appropriate correlating parameter and values for additional margin, applicable to a particular analysis, must be determined as part of process analysis. As such, this document does not specify upper subcritical limits as has been done in the past. A follow-on report will be written to assess the methods for determination of an upper safety limit in more detail, provide comparisons, and recommend a preferred method. Analysts using these results are responsible for exercising sound engineering judgment using strong technical arguments to develop a margin in k_{eff} or other correlating parameter that is sufficiently large to ensure that conditions (calculated by this method to be subcritical by this margin) will actually be subcritical.[1]
Documentation of determination and justification of the appropriate margin in the analyst's evaluation, in conjunction with this report, will constitute the complete Validation Report in accordance with ANSI/ANS-8.1-1998, Section 4.3.6(4).

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Table of Contents

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Acknowledgements

1   Introduction

In nuclear criticality safety engineering, extensive use is made of computational methods for analyzing the calculation models of physical systems. The successful application of computational methods requires verification, certification and validation (V&V) of the analytic tool. Software verification, the first element of V&V, reveals the closeness in agreement between calculation results obtained using a particular computational method and calculation results obtained using other methods. Software certification provides a user assurance that the code will <u>consistently</u> produce numerical results that agree with analytic solutions for the problems the code is designed to analyze. Software validation "calibrates" the calculation results obtained using certified software (computational method) for agreement with the physical universe.

The refinement of a validation or extension of it by the addition of cases does not require re-certification of the software. Therefore, the verification and certification of the SCALE 4.4a modular code system are separate issues, and will be published separately. This document addresses the establishment of bias, bias trends and uncertainty for validation of the CSAS25 control module from the Standardized Computer Analyses for Licensing Evaluation (SCALE) Version 4.4a package with the 27-group ENDF/B-IV, 44-group ENDF/B-V, or 238-group ENDF/B-V SCALE 4.4a cross-section libraries.

Section 1.1 identifies source documents and rationale for the validation activities, and it summarizes the scope of the validation performed on the Nuclear Criticality Safety Division (NCSD) Hewlett Packard Series 9000/J-5600 (HP J-5600) unclassified workstation (referred to as CMODB) at Y-12.

1.1   Validation of CSAS25 in SCALE 4.4a for Criticality Safety Analyses

In nuclear criticality safety engineering, calculation methods are one of the methods used to establish the subcritical limits for operations involving fissile material. The American National Standards Institute (ANSI) gives fundamental guidance for establishing these limits in ANSI/ANS-8.1-1998, "Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors." [1] In paragraph 4.2.5, the standard states:

> In the absence of directly applicable experimental measurements, the limits may be
> derived from calculations made by a method shown by comparison with experimental
> data to be valid in accordance with 4.3.

Section 4.3 of the Standard provides additional guidance on the general procedure for establishing validity. This includes establishment of bias (4.3.1), bias trend (4.3.2), uncertainty (4.3.3), computer dependence (4.3.4), consistency with measurement (4.3.5), and preparing a written validation report (4.3.6).

This criticality validation is limited to enriched uranium systems consisting of fissile and fissionable material in metallic, solution and other physical forms, as described in summary in this report, and in more detail in the OECD Handbook. The emphasis of this criticality validation is on comparison of calculated neutron multiplication factors (k_{eff}) with experimental results and on establishment of bias, bias trends, and uncertainty as a final step. Compiled data for 503 critical experiments is used as the basis for the calculation models. The calculated results from SCALE 4.4a using the 27-group ENDF/B-IV, 44-group ENDF/B-V, and 238-group ENDF/B-V SCALE 4.4a cross-section libraries have been compared with reported results for the benchmark experiments. Comparison of results demonstrates that SCALE 4.4a run on CMODB produces the same results (within the statistical uncertainty of the Monte Carlo calculations) as reported by the experiments, for those libraries that were used in both. Subcritical limits can be determined through an analysis of the criticality calculation results. Determination of these limits will be addressed in a separate report. Extension of the validation to other computer platforms will be addressed separately.

1.2   Terminology

The term "model" is used in two different ways in this report. In the main body of the report, "model" generally refers to the calculation model, or the collection of input parameters for the numerical simulation in SCALE/KENO of the physical critical experiment. In the statistical analysis in Appendix B, the term "model" generally refers to a statistical model, or an equation describing the relationship between parameters considered in the statistical analysis.

2   Description of SCALE 4.4a Code Package

The U. S. Nuclear Regulatory Commission (NRC) originally sponsored the Standardized Computer Analyses for Licensing Evaluation (SCALE) code system. The original concept of SCALE was to provide "standardized" sequences where the user had very few analyses options in addition to the geometry model and materials. Input for the control modules has been designed to be free form with extensive use of keyword and engineering-type input requirements. The stand-alone functional modules are more flexible, but they have a more difficult input logic and require the user to manually interface the data sets necessary to run the modules in a stand-alone fashion. As the system has grown in popularity over the years and additional options have been requested, the control modules have been improved to allow sophisticated users additional access to the numerous capabilities within the functional modules. However, the most important feature of the SCALE system remains the capability to simplify the user knowledge and effort required to prepare material mixtures and to perform adequate problem-dependent cross-section processing.

The modules available in Version 0 of SCALE were for Criticality Safety Analysis Sequences (CSAS) that provided automated material and cross-section processing prior to a one-dimensional (1-D) or multidimensional criticality analysis. Since that time the capabilities of the system have been

significantly expanded to provide additional CSAS capabilities as well as Shielding Analysis Sequences (SAS) and a Heat Transfer Analysis Sequence (HTAS). At the center of the CSAS and SAS sequences is the library of subroutines referred to as the Material Information Processor or MIPLIB. The purpose of MIPLIB is to allow users to specify problem materials using easily remembered and easily recognizable keyword that are associated with mixtures, elements, and nuclides provided in the Standard Composition Library. MIPLIB also uses other keyword and simple geometry input specifications to prepare input for the modules that perform the problem-dependent cross-section processing: BONAMI, NITAWL-II, and XSDRNPM. A keyword supplied by the user selects the cross-section library from a standard set provided in SCALE or designates the reference to a user-supplied library. Several utility modules from AMPX have been included to provide users with the capability to edit the cross-section data and reformat user-supplied libraries for use in SCALE.

Table 2.1 provides a summary of the major applications of each of the control modules and functional modules currently in the SCALE code system and relevant to criticality safety calculations that are covered in this report. The control modules were designed to provide the system analysis capability originally requested by the NRC staff. The CSAS module (sometimes denoted as the CSAS4 module) is the primary control module designed for the calculation of the neutron multiplication factor of a system. Eight sequences enable general analysis of a 1-D system model or a multidimensional system model, capabilities to search on geometry spacing, and problem-dependent cross-section processing for use in executing stand-alone functional modules. CSAS6 is a new criticality control module to provide automated problem-dependent cross-section processing and criticality calculations via the new KENO-VI functional module. Neither XSDRNPM nor KENO-VI is covered in this report.

Table 2.1. Analysis capabilities summary of the SCALE control and functional modules covered in this report

Control Module	Analysis function(s)	Functional modules executed
CSAS	3-D Monte Carlo calculation of k-eff; Problem-dependent cross-section processing; Multiplication search or spacing	BONAMI NITAWL-II KENO V.a ICE

Functional module	Function
BONAMI	Resonance self-shielding of cross sections with Bondarenko factors
NITAWL-II	Resonance self-shielding of cross sections with resolved resonance data
ICE	Cross-section utility module for mixing cross-sections
KENO V.a	Monte Carlo code for calculation of neutron multiplication factors

A 238-energy-group neutron cross-section library based on ENDF/B-V has recently been prepared for the SCALE system. All the nuclides that are available in ENDF/B-V are in the library. A 44-group library has been collapsed from this 238-group library. These libraries are available in versions 4.3 and later of SCALE. The 44-group and 238-group libraries are used in this validation study. It has been found useful in the past to compare a fine-group calculation against a broad-group calculation when bias is observed.

The 27-group ENDF/B-IV library is the broad-group companion library to the 218-group ENDF/B-IV library. The library has 14 fast groups and 13 thermal groups (below 3 eV). The group structure was chosen to match the 16-group Hansen-Roach structure with two additional fast groups and seven additional thermal groups. The library has been extensively validated against critical experiments, and has been the standard library of choice for the Y-12 NCSD in the past few years. The 27-group library was also used in this validation study, primarily as a reference point for cases of prior usage where the analyst wants to understand a relative difference in results of prior studies compared to current work using the newer libraries.

A recent ORNL report assessed the performance of the available libraries[2]. The recommendation supports using the 238-group library, but the endorsement are not unqualified. The following discussion highlights several points from the report.

Regarding the 218-group library, from which the 27-group library is collapsed, the summary stated, "The graphite thermal kernel is deficient, with unknown results." This issue could be of concern for some Y-12 applications. The report also says, "Intermediate-energy systems, such as the Palmer problems, can be wrong by large amounts." On the positive side, the summary stated "Fast,

small metal units, highly enriched thermal systems, and very thermal low-enriched systems are generally well predicted." The body of the report includes several cautions and warnings of apparent trends or biases related to the 27-group and 218-group libraries. In summarizing where the 27-group library performs well, it states "Generally the same as the 218-group library. Some trends and biases may be slightly more pronounced in the broad-group library, but most results are fairly equivalent." The report provides several reasons to consider moving away from using the 27-group or 218-group libraries.

In summarizing the performance of the 238-group library, the report states "This library is recommended as the best library in SCALE for general-purpose criticality-safety analyses." The endorsement is not unqualified, however. The report also states "Although any intermediate-energy problems are suspect because of the scarcity of critical experiments, this library performs better than any other library in SCALE." Regarding the weaknesses of the 44-group library, the report states "Because of the 1/E weighting in the 238-group library, this library is not a good general-purpose library." In addition, it states "The 44-group library has all the shortcomings of the 238-group library, as well as not being able to calculate homogeneous thermal, epithermal, and intermediate-energy systems as accurately as the 238-group library." On the strengths of the 44-group library, the report says "LWR and mixed-oxide lattices are the library's strong point, and it is the recommended SCALE library for these applications."

The report suggests that the 238-group library should be considered the general library of choice except perhaps for applications where the 44-group library may perform slightly better, such as ^{235}U LWR (low enriched) and MOX lattices, and for ^{233}U. The 218-group and 27-group libraries also perform reasonably well for selected applications, but they have the disadvantage of having several deficiencies that must be avoided. Finally, the report anticipates development of an improved 238-group library based on ENDF/B-VI, a "refined library with additional groups (partially to facilitate analysis of problems with a dominant intermediate-energy spectrum)," and predicts that "The next version of SCALE will include a continuous-energy cross-section library."   The recommendations and future directions suggest a preference for the 238-group library.

3   Discussion of Criticality Benchmark Database for Validation of CSAS25 from SCALE 4.4a

The United States Department of Energy initiated the Criticality Safety Benchmark Evaluation Project (CSBEP) in October of 1992. The project quickly grew into an international effort, as scientists from other interested countries became involved. The International Criticality Safety Benchmark Evaluation Project (ICSBEP) is now an official activity of the Organization for Economic Cooperation and Development - Nuclear Energy Agency (OECD-NEA). The wide scale evaluation effort has concluded with the publication of the "International Handbook of Criticality Safety Benchmark Experiments"[3] (OECD Handbook). The seven-volume set of handbooks contains criticality safety benchmark specifications derived from experiments that were performed at various nuclear critical facilities around the world. The benchmark specifications are intended for use by criticality safety engineers to validate the application of calculation techniques, such as SCALE 4.4a, for criticality safety analyses. Example calculations presented in the handbook do not constitute a validation of the codes or cross section data sets by themselves, but use of the information contained

in the Handbook can be and has been used to validate SCALE 4.4a by competent nuclear criticality safety persons. The evaluated criticality safety benchmark data are published in the seven-volume OECD Handbook in hard copy form and on compact disk (CD). Acrobat® Reader is used to access the CD for extraction of the input files.

For this criticality validation of SCALE 4.4a, fissile material forms are restricted to uranium systems. The validation comprises a substantial subset of the database used to prepare Volume II, "Highly Enriched Uranium Systems," [4] and Volume IV, "Low Enriched Uranium Systems" [5] of the OECD Handbook. Table 3.1 summarizes the 503 evaluated benchmark experiments listed in Volumes II and IV, which are analyzed in this validation. The data from the benchmark experiments involving uranium represents a sufficiently wide range of enrichments and physical and chemical forms to cover many existing or presently planned activities for the Y-12 site. These include enriched uranium with ^{235}U only, natural and depleted uranium, as well as highly enriched uranium (HEU). Data analyzed from critical experiments in this validation includes systems having fast, intermediate and thermal neutron energy spectra, and they include materials in various physical and chemical forms such as uranium metals, solutions, and oxide compounds.

For most benchmark experiments, critical conditions are tabulated in the OECD Handbook for a number of parametric variables (height, concentration, shape, etc.) Although calculation results for all of these cases are reported, SCALE 4.4a input details for only some of these cases are actually provided in the OECD Handbook. Input data for the CSAS25 cases are based on information contained in the OECD distribution CD, which is accessed using Acrobat® Reader software. The CD contains the text of the Handbook in the form of Portable Document Format (PDF) files in the directory /Handbook/CD1998. It also contains a section of input file listings under the directories: /Handbook/inputs/keno27, /Handbook/inputs/keno44, /Handbook/inputs/keno238 and /Handbook/inputs/kenohr (among others irrelevant to this report). The listings in the two sections do not always correspond, so input files were taken from both parts of the CD, where they differed. In addition, where it was practical, inputs present for only one cross-section set were modified and copied to use with other cross-section sets. The models were prepared for the 27-group, 44-group, and 238-group cross-section sets. No calculations were done with Hansen-Roach data sets. Most cases were first prepared using the 1998 edition of the CD, and several additional cases were taken from the 1999 edition. Each subsequent revision provides additional experiments and input data. The organization and categorization of the experiments and data on the CD also changes. Reviews were performed of the input preparation, which assumed the models were adequate unless reasons were found to think otherwise, based on the 1999 edition. A 2000 edition is now available, but it has not been referenced.

After deletion of duplicate cases, for which the same input appeared in more than one experiment description, a total of 756 cases was extracted from the CD or created from CD cases.

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Table 3.1 shows the number of cases in various categories that were obtained. Only 503 high enrichment and low enrichment ^{235}U cases are used in this report. The plutonium and ^{233}U cases were not included in this validation, but are shown in the table to document the number of input decks that are available for broader benchmarking if desired. A copy of the input data for the validation cases is contained in a compact disk that is provided with the report.

Table 3.1 Number of Input Cases Extracted from the OECD Compact Disk

Material / Energy	High enrich ^{235}U	Low enrich ^{235}U	Total ^{235}U	Mixed U and Pu	Pu	^{233}U	Total
Metal / Fast	85		85	4	8	10	107
Metal / Mixed	3		3				3
Metal / Thermal	30		30				30
Compound / Mixed	7		7				7
Compound / Thermal	15	87	102				102
Solution / Thermal	267	9	276	32	199		507
Total	407	96	503	36	207	10	756

Tables 3.2 and 3.3 give more detailed summary information about each of the experiments and the material and energy categories from the OECD Handbook. Table 3.2 gives data on the high enrichment ^{235}U cases and Table 3.3 gives the corresponding data on the low enrichment ^{235}U cases. Appendix A gives a comparison of available experiments, which could have been modeled, versus experiments that were modeled and included in this validation. This list will be useful for determining what models to create for future inclusion in the validation. The information in Tables 3.2 and 3.3 and Appendix A could also potentially be used as regression variables in the statistical evaluation.

The OECD report contains the following admonishment: "Sample input listings are not intended to be used directly for validation efforts and should be verified by the user. Since it is not practical to describe in detail the code input used to model each benchmark critical experiment, computer input listings are given for typical reported calculations of accepted benchmark configurations. From these listings, a user can identify which options were used to obtain the reported results. This is the sole purpose for inclusion of the input listings. It is the responsibility of the user to ensure that use of these listings for any other purpose is consistent with proper criticality safety practices." In performing this validation effort, the "universe" of experiments selected for inclusion was the experiments with SCALE inputs, involving uranium, available on the CD. No additional,

independent selection of applicable experiments or preparation of input models was performed. Reviews were performed of the input preparation; however, the reviews generally did not include thorough checking of the details of the model except for a few cases that appeared to have questionable results. In this way, a few minor errors were discovered. In addition, a review of the applicability of the included experiments was performed. It is recognized that there were experiments that would be very applicable for Y-12, but they were not included because input models were not readily available. Also, some experiments were included that are probably not currently very applicable to Y-12 work. This is not a concern as long as these experiments do not have a large difference in bias compared with the other experiments in the category. The additional experiments provide confidence in the code's ability to calculate over a broader area of applicability than the minimum necessary for currently planned Y-12 applications.

Table 3.2   *INTERNATIONAL HANDBOOK OF EVALUATED CRITICALITY SAFETY BENCHMARK EXPERIMENTS Volume II: Highly Enriched Uranium-235 Systems, [NEA/NCS/DOC(95)03/II]*

OECD Experiment/ SCALE 4.4 case name(s)	No. of Casesl / Stat. Group #	% Wt. ^{235}U	Temp. (K)	Shape/Geometry		Moderator	Reflector	Notes
HIGHLY ENRICHED URANIUM-235 METAL SYSTEMS								
heu-met-fast-001 (heumf.001/ hmf001a)	1 / 1	93.5	300	sphere	homogeneous	none	bare	godiva, shell model
heu-met-fast-002 (heumf.002/ hmf002b-e,g)	5 / 2	93.5 99.3	300	pseudocylinder, pseudosphere, parallelepiped,	homogeneous	none	tuballoy	topsy, assemblies
heu-met-fast-003 (heumf.003/ hmf003a-e,g-l)	11 / 3	93.5 99.3	300	sphere	homogeneous	none	tuballoy, tungsten-carbide, nickel	elsie, assemblies, topsy
heu-met-fast-004 (heumf.004/ hmf004d)	1 / 4	97.7	300	sphere	homogeneous	none	water	
heu-met-fast-007 (heumf.007/ case_1-43)	43 / 5	93.2	293	slab	heterogeneous	plexiglas, polyethylene, teflon	polyethylene	
heu-met-fast-018 (heumf.018/ hmf018a)	1 / 6	90.0	293	hemi-sphere, sphere	heterogeneous	none	none	assembly
heu-met-fast-019 (heumf.019/ hmf019a)	1 / 7	90.0	293	sphere	homogeneous	none	graphite	assembly
heu-met-fast-020								

OECD Experiment/ SCALE 4.4 case name(s)	No. of Casesl / Stat. Group #	% Wt. ^{235}U	Temp. (K)	Shape/Geometry		Moderator	Reflector	Notes
(heumf.020/ hmf020a)	1 / 8	90.0	293	sphere	homogeneous	none	graphite	assembly
heu-met-fast-021 (heumf.021/ hmf021a)	1 / 9	90.0	293	sphere	homogeneous	none	graphite	assembly
heu-met-fast-022 (heumf.022/ hmf022a)	1 / 10	90.0	293	sphere	homogeneous	none	graphite	assembly
heu-met-fast-023 (heumf.023/ hmf023e,g)	2 / 11	93.2	293	cylinder		none	paraffin	array
heu-met-fast-026 (heumf.026/ hmf026b,g,h,j,l)	5 / 12	93.0	293	cylinders	homogeneous	none	paraffin	array
heu-met-fast-027 (heumf.027/ hmf027a)	1 / 60	90.0	293	sphere	homogeneous	none	lead	
heu-met-fast-028 (heumf.028/ hmf028b)	1 / 61	93.0	293	hemispheres	homogeneous	none	natural uranium	
heu-met-fast-029 (heumf.029/ hmf029a)	1 / 62	90.0	293	sphere	homogeneous	none	depleted uranium	

OECD Experiment/ SCALE 4.4 case name(s)	No. of Casesl / Stat. Group #	% Wt. ^{235}U	Temp. (K)	Shape/Geometry		Moderator	Reflector	Notes
heu-met-fast-030 (heumf.030/ hmf030a)	1 / 63	90.0	293	cylinder	heterogeneous	beryllium	depleted uranium	
heu-met-fast-031 (heumf.031/ hmf031b)	1 / 64	90.0	293	sphere	heterogeneous	polyethylene	polyethylene	
heu-met-fast-032 (heumf.032/ hmf032d,e,g,h)	4 / 13	94.0	293	spheres	homogeneous	none	natural uranium	
heu-met-fast-034 (heumf.034/ hmf034a,c,e)	3 / 14	96.0	293	cylinders	heterogeneous	polyethylene and Ti, Al or steel	bare	
heu-met-mixed-001 (heumm.001/ hmm001a)	1 / 65	96.0	293	cylinder	heterogeneous	polyethylene, titanium	polyethylene	
heu-met-mixed-002 (heumm.002/ hmm002a)	1 / 15	90.0	293	sphere	heterogeneous	polyethylene	polyethylene	
heu-met-mixed-003 (heumm.003/ hmm003a)	1 / 16	90.0	293	sphere	heterogeneous	polyethylene	polyethylene	
heu-met-therm-003 (heumt.003/ hmt003a-e,g,h)	7 / 17	93.0	300	cubes			water	

OECD Experiment/ SCALE 4.4 case name(s)	No. of Casesl / Stat. Group #	% Wt. ^{235}U	Temp. (K)	Shape/Geometry		Moderator	Reflector	Notes
heu-met-therm-006 (heumt.006/ case_1-23)	23 / 18	93.0	293			water, solution	solution, water	Spert-D elements
HIGHLY ENRICHED URANIUM-235 COMPOUND SYSTEMS								
heu-comp-mixed-001 (heucm.001/ hcm001_02, 6, 13, 17, 20, 27, 28)	7 / 66	93.15	293	Arrays of cans	heterogeneous	plexiglass	polyethylene	UO_2 some with alcohol-water
Heu-comp-therm-010 (heuct.010/ hct010a-e,g)	6 / 19	62.0	293	square pitch lattice	heterogeneous	water, beryllium	water	Ebor fuel pins
heu-comp-therm-011 (heuct.011/ case_1-3)	3 / 20	80.0	293	square pitch lattice	heterogeneous	water		UO_2
heu-comp-therm-012 (heuct.012/ case_1,2)	2 / 21	80.0	293	squarel pitch lattice	heterogeneous	water		UO_2
heu-comp-therm-013 (heuct.013/ case_1,2)	2 / 22	80.0	293	square pitch lattice	heterogeneous	water		UO_2

OECD Experiment/ SCALE 4.4 case name(s)	No. of Casesl / Stat. Group #	% Wt. [235]U	Temp. (K)	Shape/Geometry		Moderator	Reflector	Notes
heu-comp-therm-014 (heuct.014/ case_1,2)	2 / 23	80.0	293	square pitch lattice	heterogeneous	water		UO$_2$
HIGHLY ENRICHED URANIUM-235 SOLUTION SYSTEMS								
heu-sol-therm-001 (heust.001/ case_1-10)	10 / 24	93.0	293	cylinder	homogeneous		bare	uranyl nitrate
heu-sol-therm-002 (heust.002/ case_1-14)	14 / 25	93.0	293	cylinder	homogeneous		concrete	uranyl nitrate
heu-sol-therm-003 (heust.003/ case_1-19)	19 / 26	93.0	293	cylinder	homogeneous		plexiglass	uranyl nitrate
heu-sol-therm-004 (heust.004/ hst004a-e,g)	6 / 27	90.0	300	sphere			heavy water	uranyl fluoride
heu-sol-therm-005 (heist.005/ hst005a-e,g-i)	8 / 28	93.0	293	cylinders	heterogeneous		water	uranyl nitrate and uranyl fluoride – Pyrex glass poison
heu-sol-therm-006 (heust.006/ hst006a-e,g,h)	7 / 29	93.0	293	cylinder	heterogeneous		Ni, water	uranyl nitrate - Boric acid poisoned

OECD Experiment/ SCALE 4.4 case name(s)	No. of Casesl / Stat. Group #	% Wt. ^{235}U	Temp. (K)	Shape/Geometry			Moderator	Reflector	Notes
heu-sol-therm-007 (heust.007/ case_1-17)	17 / 30	93.0	293	cylinder	homogeneous			concrete	uranyl nitrate, array
heu-sol-therm-008 (heust.008/ case_1-14)	14 / 31	93.0	293	cylinder	homogeneous			plexiglas	uranyl nitrate, array
heu-sol-therm-009 (heust.009/ hst009a-d)	4 / 32	93.0	300	sphere	homogeneous			water	uranyl fluoride, oxyfluoride
heu-sol-therm-010 (heist.010/ hst010e,g,h,i)	4 / 33	93.0	300	sphere	homogeneous			water	uranium oxyfluoride
heu-sol-therm-011 (heust.011/ hst011c,d)	2 / 34	93.0	300	sphere	homogeneous			water	uranyl fluoride, oxyfluoride
heu-sol-therm-012 (heust.012/ hst012b)	1 / 66	93.0	300	sphere	homogeneous			water	
heu-sol-therm-013 (heust.013/ hst013e,g,h,i)	4 / 35	93.0	300	sphere	homogeneous			bare	nitric acid, boric acid
heu-sol-therm-014 (heust.014/ case_1-3)	3 / 36	89.0	293	cylinder	homogeneous			water	uranyl nitrate, gadolinium, gadolinium nitrate, nitrate solution

OECD Experiment/ SCALE 4.4 case name(s)	No. of Casesl / Stat. Group #	% Wt. [235]U	Temp. (K)	Shape/Geometry		Moderator	Reflector	Notes
heu-sol-therm-015 (heust.015/ case_1-5)	5 / 37	89.0	293	cylinder	homogeneous		water	uranyl nitrate, gadolinium, gadolinium nitrate, nitrate solution
heu-sol-therm-016 (heust.016/ case_1-3)	3 / 38	89.0	293	cylinder	homogeneous		water	uranyl nitrate, gadolinium, gadolinium nitrate, nitrate solution
heu-sol-therm-017 (heust.017/ case_1-8)	8 / 39	89.0	293	cylinder	homogeneous		water	uranyl nitrate, gadolinium, gadolinium nitrate, nitrate solution
heu-sol-therm-018 (heust.018/ case_1-12)	12 / 40	89.0	293	cylinder	homogeneous		water	uranyl nitrate, gadolinium, gadolinium nitrate, nitrate solution
heu-sol-therm-019 (heust.019/ case_1-3)	3 / 41	89.0	293	cylinder	homogeneous		water	uranyl nitrate, gadolinium, gadolinium nitrate, nitrate solution
heu-sol-therm-020 (heust.020/ hst020g-k)	5 / 42	94.0	300	cylinder		heavy water		assembly, uranyl fluoride, deuterium
heu-sol-therm-021 (heust.021/ hst021h-m)	6 / 43	93.0	298	cylinder			bare, plexiglas, paraffin	uranyl nitrate, array
heu-sol-therm-025 (heust.025/	18 / 44	89.0	293	cylinder	homogeneous		water	uranyl nitrate, Gadolinium poison

OECD Experiment/ SCALE 4.4 case name(s)	No. of Casesl / Stat. Group #	% Wt. ^{235}U	Temp. (K)	Shape/Geometry		Moderator	Reflector	Notes
case_1-18)								
heu-sol-therm-027 (heist.027/ case_1-9)	9 / 45	89.0	293	cylinder	homogeneous	water	water	uranyl nitrate, B$_4$C or Cd poison
heu-sol-therm-028 (heust.028/ hst028a-e,g-n,p-s,u)	18 / 46	89.0	293	cylinder	homogeneous	water	water	uranyl nitrate, B$_4$C rod
heu-sol-therm-029 (heust.029/ hst029a-e,g,h)	7 / 47	89.0	293	cylinder	homogeneous	water	water	uranyl nitrate, cluster of B$_4$C rods
heu-sol-therm-030 (heust.030/ hst030a-e,g,h)	7 / 48	89.0	293	cylinder	homogeneous	water	water	uranyl nitrate, cluster of B$_4$C rods
heu-sol-therm-031 (heust.031/ hst031a-d)	4 / 49	89.0	293	cylinder	homogeneous	water	water	18 or 36 B$_4$C rods
heu-sol-therm-032 (heust.032/ hst032b)	1 / 67	93.0	293	sphere	homogeneous	water	bare	uranyl nitrate
heu-sol-therm-033 (heist.033-simple/ case_xxy where xx=02-12 and	26 / 50	93.0	293	cylinder	homogeneous	water	bare	uranyl nitrate, concrete, borated concrete, borated plaster, Cd, H$_2$O, borated H$_2$O

OECD Experiment/ SCALE 4.4 case name(s)	No. of Casesl / Stat. Group #	% Wt. ^{235}U	Temp. (K)	Shape/Geometry		Moderator	Reflector	Notes
y=a,b,c or d								
heu-sol-therm-035 (heust.035/ hst035a-e,g-j)	9 / 51	89.0	293	cylinder	homogeneous	water	water	uranyl nitrate, B_4C rods
heu-sol-therm-036 (heust.036/ hst036a-d)	4 / 52	89.0	293	cylinder	homogeneous	water	water	uranyl nitrate, square-pitch lattice of B_4C rods
heu-sol-therm-037 (heust.037/ hst037a-e,g-j)	9 / 53	89.0	293	cylinder	homogeneous	water	water	uranyl nitrate, hexagonal-pitch lattice of B_4C rods

Table 3.3 *INTERNATIONAL HANDBOOK OF EVALUATED CRITICALITY SAFETY BENCHMARK EXPERIMENTS*
Volume IV: Low Enriched Uranium-235 Systems, [NEA/NCS/DOC(95)03/II]

OECD Experiment/ SCALE 4.4 case name(s)	No. of Cases / Stat. Group #	% Wt. ^{235}U	Temp. (K)	Shape/Geometry		Moderator	Reflector	Notes
LOW ENRICHED URANIUM-235 COMPOUND SYSTEMS								
leu-comp-therm-001 (leuct.001/ case_1-8)	8 / 54	2.35	293	square pitch lattice	heterogeneous	water	water	Al-clad UO$_2$ fuel pins 2.032-cm pitch
leu-comp-therm-002 (leuct.002/ case_1-5)	5 / 55	4.31	293	square pitch lattice	heterogeneous	water	water	Al-clad UO$_2$ fuel pins 2.54-cm pitch
leu-comp-therm-003 (leuct.003/ case_1-22)	22 / 56	2.35	293	square pitch lattice	heterogeneous	water	water	Al-clad UO$_2$ fuel pins 1.684-cm pitch
leu-comp-therm-004 (leuct.004/ case_1-20)	20 / 57	4.31	293	square pitch lattice	heterogeneous	water	water	Al-clad UO$_2$ fuel pins 1.892-cm pitch
leu-comp-therm-016 (leuct.016/ case_1-32)	32 / 58	2.35	293	square pitch lattice	heterogeneous	water	water	Al-clad UO$_2$ fuel pins 2.032-cm pitch steel, Boral, Cu, Cd, Al or Zirc-4 spacers

OECD Experiment/ SCALE 4.4 case name(s)	No. of Cases / Stat. Group #	% Wt. 235U	Temp. (K)	Shape/Geometry		Moderator	Reflector	Notes
LOW ENRICHED URANIUM-235 SOLUTION SYSTEMS								
leu-sol-therm-003 (leust.003/ case_1-9)	9 / 59	10.0	293	sphere	homogeneous		bare	uranyl nitrate

4   Tabulated Results of the CSAS25 from SCALE 4.4a Criticality Calculations

Input data for the CSAS25 cases are based on information contained in the OECD distribution CD, as described in Section 3. Calculations were performed for the 27-group, 44-group, and 238-group cross-section sets.

The input cases were altered as little as possible unless there was an error, but the parameters were altered to consistently include:
Parm=size=4000000   and
gen=500 npg=2000 nsk=100 nub=yes
This results in 1,000,000 neutron histories per case, skipping the first 100 generations, and causes the run output to include values for "Average Fission Group" (AFG) and "Energy of Average Lethargy Causing Fission" (EALCF).

For each CSAS25 case, Tables 4.1, 4.2 and 4.3 list the following results: the mean of the final k_{eff} (k_cal) after 800,000 histories, and the standard deviation of that mean; the mean of the "AFG", the mean of the "EALCF", and the associated standard deviation for each of these values. In addition, the expected, or experimental, k-effective (k_exp) and associated error estimate from the OECD benchmark handbook is also provided. A group categorization ("Statistical Group Number") was also made available in Tables 3.2 and 3.3 for the possible use in the statistical analysis. Stat. Group numbers 1 through 37 designate benchmark experiments with multiple SCALE 4.4a cases while Stat. group numbers 38 through 67 designate experiments with only a single case. The values of "AFG" and "EALCF" are included as potential regression variables with the expectation that the bias between experiment and Monte Carlo calculation might be correlated with these parameters. Table 4.1 provides the 27-group results, Table 4.2 provides the 44-group results, and Table 4.3 provides the 238-group results.

Table 4.1 CSAS25 from SCALE 4.4a with the 27-group Cross-Section Set Results on the J-5600 (CMODB) Workstation

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	error estimate
keno27/heucm.001/hcm001_02	2.15E+01	5.08E-03	3.54E-01	1.29E-03	1.01114	0.00108	1.0012	0.0059
keno27/heucm.001/hcm001_06	1.16E+01	7.92E-03	1.71E+03	1.16E+01	1.00626	0.00101	0.9953	0.0056
keno27/heucm.001/hcm001_13	1.39E+01	7.81E-03	2.20E+02	1.44E-00	1.00965	0.00097	1.0032	0.0053
keno27/heucm.001/hcm001_17	1.65E+01	8.18E-03	2.39E+01	1.59E-01	1.00148	0.00116	0.9997	0.0046
keno27/heucm.001/hcm001_20	1.23E+01	7.56E-03	5.37E+02	3.25E-00	1.01777	0.00104	1.006	0.0065
keno27/heucm.001/hcm001_27	1.28E+01	7.63E-03	3.76E+02	2.30E-00	1.01311	0.00109	0.9991	0.0053
keno27/heucm.001/hcm001_28	1.25E+01	7.62E-03	4.65E+02	2.82E-00	1.01854	0.00091	1.0037	0.0053
keno27/heuct.010/hct010a	2.01E+01	4.66E-03	7.82E-01	2.35E-03	0.98992	0.00115	1	0.005
keno27/heuct.010/hct010b	2.29E+01	3.07E-03	1.22E-01	2.77E-04	0.99731	0.00115	1	0.005
keno27/heuct.010/hct010c	2.34E+01	2.57E-03	8.39E-02	1.66E-04	1.00163	0.00094	1	0.005
keno27/heuct.010/hct010d	2.34E+01	2.63E-03	8.79E-02	1.79E-04	1.00081	0.00111	1	0.005
keno27/heuct.010/hct010e	2.34E+01	2.67E-03	8.54E-02	1.77E-04	1.00327	0.00098	1.001	0.0074
keno27/heuct.010/hct010g	2.35E+01	3.80E-03	7.75E-02	2.32E-04	1.00227	0.00092	1.0007	0.0076
keno27/heuct.011/case_1	2.02E+01	4.80E-03	6.49E-01	2.02E-03	0.98737	0.00085	0.9988	0.0042
keno27/heuct.011/case_2	2.07E+01	4.57E-03	4.94E-01	1.45E-03	0.99033	0.00094	0.9988	0.0042
keno27/heuct.011/case_3	2.11E+01	4.49E-03	3.83E-01	1.12E-03	0.99153	0.00086	0.9988	0.0042
keno27/heuct.012/case_1	2.06E+01	4.68E-03	5.40E-01	1.66E-03	0.98948	0.00119	0.9987	0.0032
keno27/heuct.012/case_2	2.10E+01	4.21E-03	4.11E-01	1.12E-03	0.98818	0.00099	0.9987	0.0034
keno27/heuct.013/case_1	2.10E+01	4.49E-03	4.05E-01	1.18E-03	0.99113	0.001	0.9988	0.0042
keno27/heuct.013/case_2	2.16E+01	4.21E-03	2.79E-01	7.79E-04	0.99081	0.00106	0.9988	0.0043
keno27/heuct.014/case_1	2.31E+01	3.48E-03	9.85E-02	2.42E-04	0.99855	0.00094	0.9986	0.0048
keno27/heuct.014/case_2	2.34E+01	3.30E-03	8.09E-02	2.00E-04	0.99847	0.00098	0.9986	0.0049
keno27/heumf.001/hmf001a	4.86E-00	1.99E-03	8.96E+05	1.21E+03	1.00487	0.00096	1	0.001
keno27/heumf.002/hmf002b	4.89E-00	3.03E-03	8.20E+05	1.53E+03	1.00733	0.00089	1	0.003
keno27/heumf.002/hmf002c	4.89E-00	3.29E-03	8.14E+05	1.66E+03	1.00445	0.00109	1	0.003
keno27/heumf.002/hmf002d	4.91E-00	3.15E-03	8.05E+05	1.56E+03	1.00051	0.00099	1	0.003
keno27/heumf.002/hmf002e	4.91E-00	2.82E-03	8.03E+05	1.39E+03	1.00574	0.00111	1	0.003
keno27/heumf.002/hmf002g	4.91E-00	3.02E-03	8.07E+05	1.51E+03	1.00117	0.00112	1	0.003
keno27/heumf.003/hmf003a	4.87E-00	2.07E-03	8.65E+05	1.21E+03	0.99946	0.00107	1	0.005
keno27/heumf.003/hmf003b	4.87E-00	2.08E-03	8.58E+05	1.22E+03	0.99812	0.00091	1	0.005
keno27/heumf.003/hmf003c	4.86E-00	2.12E-03	8.51E+05	1.20E+03	1.00443	0.00103	1	0.005
keno27/heumf.003/hmf003d	4.86E-00	2.37E-03	8.47E+05	1.28E+03	1.00233	0.00098	1	0.003

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	error estimate
keno27/heumf.003/hmf003e	4.87E-00	2.66E-03	8.36E+05	1.40E+03	1.00545	0.00097	1	0.003
keno27/heumf.003/hmf003g	4.87E-00	2.74E-03	8.31E+05	1.43E+03	1.00689	0.00106	1	0.003
keno27/heumf.003/hmf003h	4.89E-00	3.17E-03	8.14E+05	1.56E+03	1.00771	0.00097	1	0.003
keno27/heumf.003/hmf003i	5.20E-00	1.89E-03	6.81E+05	9.71E+02	1.00229	0.00093	1	0.005
keno27/heumf.003/hmf003j	5.30E-00	1.84E-03	6.21E+05	8.81E+02	1.00218	0.0008	1	0.005
keno27/heumf.003/hmf003k	5.37E-00	1.92E-03	5.76E+05	8.92E+02	1.00261	0.00087	1	0.005
keno27/heumf.003/hmf003l	5.39E-00	1.79E-03	5.62E+05	8.34E+02	1.00699	0.00083	1	0.005
keno27/heumf.004/hmf004d	8.50E-00	7.16E-03	2.92E+04	1.84E+02	1.00697	0.00088	1.002	0
keno27/heumf.007/case_1	4.83E-00	1.89E-03	9.10E+05	1.17E+03	1.00057	0.00101	0.9971	0.0001
keno27/heumf.007/case_10	8.03E-00	5.25E-03	2.40E+04	1.23E+02	1.00734	0.00111	1	0.0001
keno27/heumf.007/case_11	9.46E-00	5.92E-03	5.06E+03	2.76E+01	1.00723	0.00109	0.9982	0.0001
keno27/heumf.007/case_12	9.79E-00	5.99E-03	3.69E+03	1.98E+01	1.00539	0.00096	0.9951	0.0001
keno27/heumf.007/case_13	1.06E+01	7.17E-03	2.29E+03	1.44E+01	1.00889	0.00119	1.0009	0.0001
keno27/heumf.007/case_14	9.87E-00	6.22E-03	3.42E+03	1.91E+01	1.00799	0.00097	0.9983	0.0001
keno27/heumf.007/case_15	1.05E+01	7.24E-03	2.55E+03	1.60E+01	1.0059	0.00126	0.9978	0.0001
keno27/heumf.007/case_16	1.05E+01	7.04E-03	2.53E+03	1.55E+01	1.0057	0.0011	0.9988	0.0001
keno27/heumf.007/case_17	1.26E+01	7.09E-03	3.42E+02	2.03E-00	1.00657	0.00104	0.9972	0.0001
keno27/heumf.007/case_18	1.26E+01	7.76E-03	3.29E+02	2.11E-00	1.00878	0.00103	0.9991	0.0001
keno27/heumf.007/case_19	4.85E-00	1.96E-03	9.02E+05	1.24E+03	1.00361	0.00098	0.9983	0.0001
keno27/heumf.007/case_2	5.38E-00	2.60E-03	4.75E+05	1.20E+03	1.00402	0.00096	0.9986	0.0001
keno27/heumf.007/case_20	6.13E-00	3.64E-03	1.96E+05	7.33E+02	1.00423	0.00105	0.9981	0.0001
keno27/heumf.007/case_21	6.21E-00	3.76E-03	1.81E+05	6.77E+02	1.00521	0.00102	0.9987	0.0001
keno27/heumf.007/case_22	6.28E-00	3.90E-03	1.66E+05	6.57E+02	1.00565	0.00117	0.9994	0.0001
keno27/heumf.007/case_23	7.36E-00	5.35E-03	5.64E+04	2.86E+02	1.00458	0.00116	0.9993	0.0001
keno27/heumf.007/case_24	7.44E-00	5.76E-03	5.22E+04	2.86E+02	1.00502	0.001	1.0001	0.0001
keno27/heumf.007/case_25	8.19E-00	6.04E-03	2.39E+04	1.32E+02	1.00445	0.00117	0.999	0.0001
keno27/heumf.007/case_26	8.28E-00	6.12E-03	2.20E+04	1.24E+02	1.00701	0.00116	0.9997	0.0001
keno27/heumf.007/case_27	5.44E-00	2.83E-03	4.43E+05	1.24E+03	1.00066	0.0011	0.9965	0.0002
keno27/heumf.007/case_28	5.88E-00	3.01E-03	2.59E+05	8.21E+02	1.00327	0.00086	0.9987	0.0002
keno27/heumf.007/case_29	6.34E-00	3.58E-03	1.49E+05	5.68E+02	1.00598	0.00107	0.9978	0.0002
keno27/heumf.007/case_3	5.62E-00	3.11E-03	3.55E+05	1.09E+03	1.00685	0.00114	1.0012	0.0001
keno27/heumf.007/case_30	8.47E-00	5.51E-03	1.57E+04	7.91E+01	1.00621	0.00114	0.9981	0.0002
keno27/heumf.007/case_31	1.08E+01	7.20E-03	1.48E+03	9.23E-00	1.01433	0.00116	1.0013	0.0002
keno27/heumf.007/case_32	5.01E-00	1.96E-03	7.78E+05	1.12E+03	1.00485	0.00107	0.9959	0.0001
keno27/heumf.007/case_33	5.13E-00	2.10E-03	6.95E+05	1.13E+03	1.01265	0.00106	0.9995	0.0001
keno27/heumf.007/case_34	5.23E-00	2.08E-03	6.30E+05	1.04E+03	1.01643	0.00101	0.9977	0.0001
keno27/heumf.007/case_35	1.00E+01	7.73E-03	7.01E+03	4.75E+01	1.00259	0.00098	1.0011	0.0001
keno27/heumf.007/case_36	1.06E+01	8.00E-03	3.63E+03	2.47E+01	1.01233	0.00089	0.9999	0.0001

31

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	error estimate
keno27/heumf.007/case_37	1.12E+01	8.14E-03	1.79E+03	1.23E+01	1.01117	0.00097	0.9988	0.0001
keno27/heumf.007/case_38	1.12E+01	7.37E-03	1.64E+03	1.04E+01	1.00825	0.00106	1	0.0001
keno27/heumf.007/case_39	1.13E+01	7.93E-03	1.58E+03	1.06E+01	1.01327	0.00117	1.0018	0.0001
keno27/heumf.007/case_4	5.73E-00	3.03E-03	3.12E+05	9.59E+02	1.0037	0.00105	0.997	0.0001
keno27/heumf.007/case_40	1.13E+01	7.79E-03	1.63E+03	1.08E+01	1.01727	0.00103	1.0013	0.0001
keno27/heumf.007/case_41	1.29E+01	7.39E-03	2.99E+02	1.80E-00	1.01193	0.00091	0.9994	0.0001
keno27/heumf.007/case_42	1.30E+01	8.06E-03	2.85E+02	1.87E-00	1.01465	0.00105	1.0016	0.0001
keno27/heumf.007/case_43	1.53E+01	7.27E-03	3.29E+01	1.83E-01	1.01347	0.00098	0.9998	0.0001
keno27/heumf.007/case_5	5.95E-00	3.16E-03	2.35E+05	7.67E+02	1.00537	0.00109	1	0.0001
keno27/heumf.007/case_6	6.39E-00	4.17E-03	1.49E+05	6.33E+02	1.01438	0.00107	1.0028	0.0001
keno27/heumf.007/case_7	6.16E-00	3.33E-03	1.84E+05	6.56E+02	1.00823	0.00105	0.9996	0.0001
keno27/heumf.007/case_8	6.12E-00	3.16E-03	1.90E+05	6.55E+02	1.00626	0.00122	0.9992	0.0001
keno27/heumf.007/case_9	6.26E-00	3.52E-03	1.67E+05	6.06E+02	1.00897	0.00093	1.0017	0.0008
keno27/heumf.018/hmf018a	4.88E-00	1.92E-03	8.79E+05	1.17E+03	1.00474	0.00107	1	0.0014
keno27/heumf.019/hmf019a	5.00E-00	1.94E-03	7.93E+05	1.11E+03	1.01116	0.00086	1	0.0028
keno27/heumf.020/hmf020a	5.46E-00	3.43E-03	4.63E+05	1.46E+03	1.00371	0.00094	1	0.0028
keno27/heumf.021/hmf021a	5.10E-00	1.87E-03	7.52E+05	1.03E+03	1.03493	0.0009	1	0.0024
keno27/heumf.022/hmf022a	4.94E-00	1.90E-03	8.46E+05	1.10E+03	0.9974	0.00109	1	0.0019
keno27/heumf.023/hmf023e	4.87E-00	2.13E-03	8.82E+05	1.35E+03	1.00634	0.0009	1	0.0052
keno27/heumf.023/hmf023g	1.06E+01	8.76E-03	4.83E+03	3.65E+01	1.00575	0.00087	1	0.0052
keno27/heumf.026/hmf026b	4.86E-00	2.01E-03	8.90E+05	1.27E+03	1.0069	0.00099	0.9982	0.0042
keno27/heumf.026/hmf026g	8.56E-00	7.65E-03	2.85E+04	1.91E+02	1.00982	0.00106	1	0.0038
keno27/heumf.026/hmf026h	9.83E-00	8.76E-03	1.02E+04	7.68E+01	1.00524	0.00097	1	0.0038
keno27/heumf.026/hmf026j	5.44E-00	3.61E-03	4.80E+05	1.57E+03	0.9976	0.00112	0.9982	0.0042
keno27/heumf.026/hmf026l	9.40E-00	8.34E-03	1.54E+04	1.10E+02	1.00548	0.00107	1	0.0038
keno27/heumf.027/hmf027a	4.93E-00	1.84E-03	8.48E+05	1.09E+03	1.01623	0.00099	1	0.0025
keno27/heumf.028/hmf028b	4.87E-00	2.88E-03	8.33E+05	1.51E+03	1.00871	0.00092	1	0.003
keno27/heumf.029/hmf029a	4.92E-00	2.07E-03	8.37E+05	1.21E+03	1.00983	0.001	1	0.002
keno27/heumf.030/hmf030a	6.18E-00	5.24E-03	1.85E+05	8.50E+02	1.02155	0.00106	1	0.0009
keno27/heumf.031/hmf031b	1.00E+01	7.92E-03	6.23E+03	4.38E+01	1.00855	0.00088	1	0.0059
keno27/heumf.032/hmf032d	4.87E-00	2.17E-03	8.51E+05	1.20E+03	1.00863	0.00091	1	0.0016
keno27/heumf.032/hmf032e	4.87E-00	2.14E-03	8.53E+05	1.22E+03	1.0084	0.00104	1	0.0027
keno27/heumf.032/hmf032g	4.87E-00	1.97E-03	8.66E+05	1.15E+03	1.00354	0.00102	1	0.0017
keno27/heumf.032/hmf032h	4.88E-00	1.90E-03	8.76E+05	1.13E+03	1.00826	0.00102	1	0.0017
keno27/heumf.034/hmf034a	8.62E-00	6.26E-03	1.61E+04	9.24E+01	0.99784	0.00109	0.999	0.0012
keno27/heumf.034/hmf034c	8.73E-00	6.51E-03	1.49E+04	8.80E+01	1.00285	0.00095	0.999	0.0012
keno27/heumf.034/hmf034e	8.89E-00	6.45E-03	1.39E+04	7.93E+01	1.00656	0.00122	0.999	0.0012
keno27/heumm.001/hmm001a	1.10E+01	7.74E-03	2.28E+03	1.53E+01	1.00768	0.00095	0.9995	0.0013

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	error estimate
keno27/heumm.002/hmm002a	1.19E+01	8.24E-03	1.09E+03	7.54E-00	1.01528	0.00112	1	0.0037
keno27/heumm.003/hmm003a	1.19E+01	7.74E-03	1.07E+03	7.03E-00	1.01823	0.00096	1	0.0038
keno27/heumt.003/hmt003a	9.04E-00	7.85E-03	1.74E+04	1.20E+02	1.00791	0.00106	1	0.001
keno27/heumt.003/hmt003b	9.11E-00	7.81E-03	1.64E+04	1.13E+02	0.98657	0.00088	0.991	0.003
keno27/heumt.003/hmt003c	1.35E+01	7.84E-03	2.17E+02	1.40E-00	0.97797	0.00104	0.9826	0.006
keno27/heumt.003/hmt003d	1.54E+01	8.59E-03	4.60E+01	3.12E-01	0.98501	0.00104	0.9876	0.004
keno27/heumt.003/hmt003e	1.88E+01	7.03E-03	2.67E-00	1.41E-02	0.9955	0.00102	0.993	0.003
keno27/heumt.003/hmt003g	1.72E+01	7.53E-03	8.75E-00	4.93E-02	0.97967	0.00116	0.9889	0.003
keno27/heumt.003/hmt003h	1.87E+01	7.23E-03	2.87E-00	1.57E-02	0.98531	0.00096	0.9919	0.003
keno27/heumt.006/case_1	2.35E+01	3.36E-03	6.52E-02	1.73E-04	0.9971	0.0011	1	0.004
keno27/heumt.006/case_10	2.36E+01	3.32E-03	6.30E-02	1.62E-04	1.00366	0.00135	1	0.004
keno27/heumt.006/case_11	2.40E+01	2.84E-03	4.66E-02	1.14E-04	1.00452	0.00108	1	0.004
keno27/heumt.006/case_12	2.43E+01	2.70E-03	4.02E-02	9.26E-05	1.00406	0.00096	1	0.004
keno27/heumt.006/case_13	2.36E+01	3.20E-03	6.39E-02	1.67E-04	1.02735	0.00105	1	0.004
keno27/heumt.006/case_14	2.42E+01	2.72E-03	4.25E-02	9.87E-05	0.997	0.00111	1	0.004
keno27/heumt.006/case_15	2.42E+01	2.68E-03	4.21E-02	9.46E-05	0.99245	0.00091	1	0.004
keno27/heumt.006/case_16	2.40E+01	2.94E-03	4.75E-02	1.17E-04	1.00487	0.00099	1	0.004
keno27/heumt.006/case_17	2.38E+01	3.09E-03	5.60E-02	1.39E-04	1.00523	0.001	1	0.004
keno27/heumt.006/case_18	2.36E+01	3.34E-03	6.04E-02	1.63E-04	1.00385	0.00107	1	0.004
keno27/heumt.006/case_19	2.43E+01	3.03E-03	3.81E-02	9.54E-05	0.99334	0.00123	1	0.004
keno27/heumt.006/case_2	2.38E+01	2.96E-03	5.33E-02	1.38E-04	1.0005	0.00114	1	0.004
keno27/heumt.006/case_20	2.40E+01	3.15E-03	4.80E-02	1.21E-04	0.99616	0.00102	1	0.004
keno27/heumt.006/case_21	2.38E+01	3.03E-03	5.23E-02	1.28E-04	0.99649	0.00097	1	0.004
keno27/heumt.006/case_22	2.38E+01	3.17E-03	5.61E-02	1.39E-04	1.00036	0.0011	1	0.004
keno27/heumt.006/case_23	2.37E+01	3.12E-03	5.75E-02	1.39E-04	1.00245	0.00102	1	0.004
keno27/heumt.006/case_3	2.40E+01	2.79E-03	4.74E-02	1.15E-04	1.00493	0.00128	1	0.004
keno27/heumt.006/case_4	2.40E+01	2.77E-03	4.62E-02	1.11E-04	0.99338	0.00099	1	0.004
keno27/heumt.006/case_5	2.41E+01	2.77E-03	4.34E-02	1.02E-04	1.0014	0.00091	1	0.004
keno27/heumt.006/case_6	2.42E+01	2.69E-03	4.17E-02	9.50E-05	1.00019	0.00095	1	0.004
keno27/heumt.006/case_7	2.43E+01	2.55E-03	4.03E-02	9.21E-05	0.9968	0.00101	1	0.004
keno27/heumt.006/case_8	2.43E+01	2.56E-03	3.86E-02	8.83E-05	0.99429	0.00089	1	0.004
keno27/heumt.006/case_9	2.43E+01	2.61E-03	3.84E-02	8.70E-05	0.99366	0.0008	1	0.004
keno27/heust.001/case_1	2.36E+01	1.28E-03	6.09E-02	7.17E-05	1.00634	0.00123	1	0.0025
keno27/heust.001/case_10	2.45E+01	7.07E-04	3.19E-02	2.51E-05	0.99775	0.00119	1	0.0025
keno27/heust.001/case_2	2.17E+01	2.19E-03	2.30E-01	3.85E-04	1.00826	0.00122	1	0.0025
keno27/heust.001/case_3	2.36E+01	1.19E-03	5.96E-02	6.32E-05	1.0086	0.00154	1	0.0025
keno27/heust.001/case_4	2.16E+01	2.28E-03	2.47E-01	4.32E-04	1.00989	0.00135	1	0.0025
keno27/heust.001/case_5	2.46E+01	6.58E-04	2.94E-02	2.26E-05	1.00472	0.00119	1	0.0025

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	error estimate
keno27/heust.001/case_6	2.45E+01	6.48E-04	3.07E-02	2.26E-05	1.00766	0.00121	1	0.0025
keno27/heust.001/case_7	2.37E+01	1.18E-03	5.73E-02	6.37E-05	1.0066	0.00118	1	0.0025
keno27/heust.001/case_8	2.36E+01	1.19E-03	6.10E-02	6.49E-05	1.00776	0.00123	1	0.0025
keno27/heust.001/case_9	2.16E+01	2.19E-03	2.48E-01	4.03E-04	1.00484	0.0014	1	0.0025
keno27/heust.002/case_1	2.36E+01	1.18E-03	5.95E-02	6.33E-05	1.00992	0.00131	1	0.002
keno27/heust.002/case_10	2.45E+01	6.96E-04	3.03E-02	2.40E-05	1.00926	0.00103	1	0.002
keno27/heust.002/case_11	2.36E+01	1.19E-03	5.93E-02	6.45E-05	1.009	0.00147	1	0.002
keno27/heust.002/case_12	2.37E+01	1.20E-03	5.77E-02	6.34E-05	1.01431	0.00133	1	0.002
keno27/heust.002/case_13	2.19E+01	2.02E-03	2.05E-01	3.12E-04	1.01122	0.00122	1	0.002
keno27/heust.002/case_14	2.20E+01	2.13E-03	1.90E-01	3.16E-04	1.01401	0.00175	1	0.002
keno27/heust.002/case_2	2.36E+01	1.22E-03	5.90E-02	6.62E-05	1.01284	0.00131	1	0.002
keno27/heust.002/case_3	2.19E+01	2.02E-03	2.06E-01	3.18E-04	1.00932	0.00132	1	0.002
keno27/heust.002/case_4	2.19E+01	1.98E-03	1.99E-01	3.01E-04	1.01318	0.00119	1	0.002
keno27/heust.002/case_5	2.36E+01	1.20E-03	5.91E-02	6.46E-05	1.01321	0.00156	1	0.002
keno27/heust.002/case_6	2.36E+01	1.24E-03	5.81E-02	6.53E-05	1.01429	0.00119	1	0.002
keno27/heust.002/case_7	2.19E+01	1.98E-03	2.05E-01	3.07E-04	1.00908	0.00135	1	0.002
keno27/heust.002/case_8	2.19E+01	2.01E-03	1.94E-01	3.10E-04	1.01296	0.00116	1	0.002
keno27/heust.002/case_9	2.45E+01	6.34E-04	3.05E-02	2.24E-05	1.00695	0.00113	1	0.002
keno27/heust.003/case_1	2.45E+01	6.73E-04	3.04E-02	2.32E-05	1.00756	0.00135	1	0.005
keno27/heust.003/case_10	2.18E+01	2.12E-03	2.14E-01	3.49E-04	1.00723	0.00148	1	0.005
keno27/heust.003/case_11	2.20E+01	2.17E-03	1.91E-01	3.14E-04	1.0047	0.0014	1	0.005
keno27/heust.003/case_12	2.45E+01	6.87E-04	3.06E-02	2.37E-05	1.00654	0.00145	1	0.005
keno27/heust.003/case_13	2.45E+01	6.36E-04	3.00E-02	2.19E-05	1.00836	0.00098	1	0.005
keno27/heust.003/case_14	2.45E+01	6.68E-04	3.04E-02	2.28E-05	1.00516	0.00124	1	0.005
keno27/heust.003/case_15	2.45E+01	7.27E-04	3.15E-02	2.52E-05	0.99681	0.00123	1	0.005
keno27/heust.003/case_16	2.36E+01	1.28E-03	6.01E-02	7.07E-05	1.00674	0.00133	1	0.005
keno27/heust.003/case_17	2.37E+01	1.19E-03	5.67E-02	6.40E-05	1.00667	0.00135	1	0.005
keno27/heust.003/case_18	2.18E+01	2.19E-03	2.14E-01	3.55E-04	1.00482	0.00153	1	0.005
keno27/heust.003/case_19	2.20E+01	2.17E-03	1.85E-01	3.03E-04	1.00623	0.00129	1	0.005
keno27/heust.003/case_2	2.45E+01	6.63E-04	3.06E-02	2.20E-05	1.00697	0.00102	1	0.005
keno27/heust.003/case_3	2.36E+01	1.17E-03	6.05E-02	6.44E-05	1.00874	0.00135	1	0.005
keno27/heust.003/case_4	2.36E+01	1.18E-03	5.89E-02	6.42E-05	1.0088	0.00117	1	0.005
keno27/heust.003/case_5	2.18E+01	2.30E-03	2.17E-01	3.78E-04	1.00594	0.0014	1	0.005
keno27/heust.003/case_6	2.19E+01	2.17E-03	2.02E-01	3.33E-04	1.00615	0.00133	1	0.005
keno27/heust.003/case_7	2.45E+01	7.09E-04	3.01E-02	2.42E-05	1.00464	0.00107	1	0.005
keno27/heust.003/case_8	2.36E+01	1.17E-03	6.00E-02	6.46E-05	1.00814	0.00133	1	0.005
keno27/heust.003/case_9	2.37E+01	1.24E-03	5.74E-02	6.68E-05	1.00929	0.00116	1	0.005
keno27/heust.004/hst004a	1.59E+01	6.96E-03	1.39E+01	6.54E-02	1.00514	0.00123	1	0.0065

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	error estimate
keno27/heust.004/hst004b	1.80E+01	5.62E-03	2.70E-00	9.67E-03	1.00027	0.00108	1	0.0071
keno27/heust.004/hst004c	2.08E+01	3.45E-03	3.95E-01	8.87E-04	0.99251	0.00118	1	0.0078
keno27/heust.004/hst004d	1.70E+01	6.16E-03	5.80E-00	2.35E-02	0.9976	0.00097	1	0.0091
keno27/heust.004/hst004e	1.93E+01	4.57E-03	1.06E-00	3.07E-03	0.99915	0.00108	1	0.0104
keno27/heust.004/hst004g	2.21E+01	2.54E-03	1.75E-01	3.19E-04	0.9844	0.00129	1	0.0117
keno27/heust.005/hst005a	2.18E+01	2.48E-03	2.03E-01	3.69E-04	1.00819	0.0009	1	0.0124
keno27/heust.005/hst005b	2.18E+01	2.54E-03	2.09E-01	3.88E-04	1.01561	0.00104	1	0.0124
keno27/heust.005/hst005c	2.17E+01	2.83E-03	2.17E-01	4.35E-04	1.01672	0.00101	1	0.0126
keno27/heust.005/hst005d	2.20E+01	2.46E-03	1.84E-01	3.36E-04	1.00925	0.00116	1	0.0124
keno27/heust.005/hst005e	2.14E+01	2.50E-03	2.69E-01	4.89E-04	0.99792	0.00099	1	0.0124
keno27/heust.005/hst005g	2.19E+01	2.29E-03	1.99E-01	3.38E-04	1.01197	0.00108	1	0.0125
keno27/heust.005/hst005h	2.31E+01	1.72E-03	8.51E-02	1.18E-04	1.00651	0.00095	1	0.0119
keno27/heust.005/hst005i	2.40E+01	1.14E-03	4.51E-02	4.58E-05	1.00958	0.00104	1	0.0121
keno27/heust.006/hst006a	2.21E+01	2.12E-03	1.71E-01	2.80E-04	0.99258	0.00112	0.9973	0.005
keno27/heust.006/hst006b	2.09E+01	1.91E-03	3.73E-01	5.20E-04	1.00629	0.00074	1	0.0087
keno27/heust.006/hst006c	2.18E+01	2.00E-03	2.13E-01	3.22E-04	0.99607	0.00112	0.9986	0.0054
keno27/heust.006/hst006d	2.13E+01	1.95E-03	3.03E-01	4.34E-04	1.0095	0.00098	1	0.0078
keno27/heust.006/hst006e	2.11E+01	1.92E-03	3.43E-01	4.85E-04	1.01528	0.00083	1	0.0091
keno27/heust.006/hst006g	2.15E+01	1.97E-03	2.66E-01	3.90E-04	1.00646	0.00105	1	0.0065
keno27/heust.006/hst006h	2.09E+01	1.92E-03	3.80E-01	5.34E-04	1.00737	0.00074	1	0.0088
keno27/heust.007/case_1	2.44E+01	7.48E-04	3.29E-02	2.68E-05	1.01419	0.00111	1	0.0035
keno27/heust.007/case_10	2.42E+01	8.23E-04	3.74E-02	3.26E-05	1.01601	0.00106	1	0.0035
keno27/heust.007/case_11	2.18E+01	2.22E-03	2.12E-01	3.61E-04	1.01319	0.00111	1	0.0035
keno27/heust.007/case_12	2.43E+01	8.48E-04	3.60E-02	3.15E-05	1.01778	0.0012	1	0.0035
keno27/heust.007/case_13	2.20E+01	2.27E-03	1.91E-01	3.25E-04	1.01559	0.00108	1	0.0035
keno27/heust.007/case_14	2.19E+01	2.23E-03	1.98E-01	3.30E-04	1.01579	0.00133	1	0.0035
keno27/heust.007/case_15	2.19E+01	2.20E-03	2.00E-01	3.34E-04	1.00966	0.00114	1	0.0035
keno27/heust.007/case_16	2.18E+01	2.19E-03	2.13E-01	3.56E-04	1.01299	0.00122	1	0.0035
keno27/heust.007/case_17	2.19E+01	2.25E-03	1.99E-01	3.38E-04	1.01347	0.00128	1	0.0035
keno27/heust.007/case_2	2.17E+01	2.31E-03	2.23E-01	3.83E-04	1.01725	0.00111	1	0.005
keno27/heust.007/case_3	2.45E+01	7.74E-04	3.21E-02	2.64E-05	1.0103	0.00091	1	0.0035
keno27/heust.007/case_4	2.19E+01	2.38E-03	1.97E-01	3.45E-04	1.01458	0.00108	1	0.0035
keno27/heust.007/case_5	2.43E+01	7.93E-04	3.52E-02	2.95E-05	1.00831	0.00099	1	0.0035
keno27/heust.007/case_6	2.17E+01	2.24E-03	2.28E-01	3.93E-04	1.01046	0.00115	1	0.0035
keno27/heust.007/case_7	2.43E+01	7.79E-04	3.47E-02	2.91E-05	1.00888	0.00116	1	0.0035
keno27/heust.007/case_8	2.17E+01	2.31E-03	2.24E-01	3.81E-04	1.0111	0.00131	1	0.0035
keno27/heust.007/case_9	2.43E+01	8.29E-04	3.61E-02	3.09E-05	1.00899	0.00099	1	0.0035
keno27/heust.008/case_1	2.45E+01	6.98E-04	3.07E-02	2.33E-05	1.00035	0.00091	1	0.003

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	error estimate
keno27/heust.008/case_10	2.20E+01	2.12E-03	1.92E-01	2.99E-04	1.00082	0.00127	1	0.003
keno27/heust.008/case_11	2.46E+01	6.48E-04	2.93E-02	2.18E-05	1.0012	0.00105	1	0.003
keno27/heust.008/case_12	2.22E+01	2.33E-03	1.67E-01	2.95E-04	0.99975	0.00125	1	0.003
keno27/heust.008/case_13	2.20E+01	2.22E-03	1.91E-01	3.24E-04	1.00507	0.00127	1	0.003
keno27/heust.008/case_14	2.21E+01	2.20E-03	1.72E-01	2.93E-04	1.00453	0.00122	1	0.003
keno27/heust.008/case_2	2.19E+01	2.30E-03	1.95E-01	3.43E-04	1.00295	0.00128	1	0.003
keno27/heust.008/case_3	2.46E+01	6.59E-04	2.97E-02	2.21E-05	0.99948	0.00122	1	0.003
keno27/heust.008/case_4	2.21E+01	2.34E-03	1.72E-01	3.00E-04	1.00106	0.0011	1	0.003
keno27/heust.008/case_5	2.45E+01	6.96E-04	3.05E-02	2.45E-05	0.99957	0.00116	1	0.003
keno27/heust.008/case_6	2.18E+01	2.13E-03	2.12E-01	3.42E-04	1.00603	0.00135	1	0.003
keno27/heust.008/case_7	2.45E+01	6.73E-04	3.00E-02	2.29E-05	1.00067	0.001	1	0.003
keno27/heust.008/case_8	2.19E+01	2.32E-03	2.02E-01	3.41E-04	1.0038	0.00119	1	0.003
keno27/heust.008/case_9	2.45E+01	6.74E-04	3.05E-02	2.32E-05	1.00136	0.001	1	0.003
keno27/heust.009/hst009a	2.07E+01	3.27E-03	4.59E-01	1.04E-03	1.01411	0.00129	1	0.0057
keno27/heust.009/hst009b	2.25E+01	2.04E-03	1.30E-01	2.10E-04	1.01002	0.00118	1	0.0057
keno27/heust.009/hst009c	2.15E+01	2.71E-03	2.75E-01	5.32E-04	1.01328	0.00133	1	0.0057
keno27/heust.009/hst009d	2.34E+01	1.46E-03	7.02E-02	8.65E-05	1.00567	0.0012	1	0.0057
keno27/heust.010/hst010e	2.42E+01	8.56E-04	3.80E-02	3.31E-05	1.00598	0.00136	1	0.0018
keno27/heust.010/hst010g	2.42E+01	9.30E-04	3.85E-02	3.69E-05	1.00937	0.00126	1	0.0018
keno27/heust.010/hst010h	2.42E+01	8.98E-04	4.03E-02	3.70E-05	1.00655	0.00131	1	0.0018
keno27/heust.010/hst010i	2.41E+01	1.00E-03	4.11E-02	4.17E-05	1.00215	0.0012	1	0.0018
keno27/heust.011/hst011c	2.47E+01	5.92E-04	2.76E-02	1.94E-05	1.00893	0.00108	1	0.002
keno27/heust.011/hst011d	2.47E+01	5.86E-04	2.74E-02	1.85E-05	1.00507	0.00102	1	0.002
keno27/heust.012/hst012b	2.50E+01	3.68E-04	2.19E-02	1.09E-05	1.00094	0.00082	0.9999	0.0058
keno27/heust.013/hst013e	2.50E+01	3.35E-04	2.19E-02	9.86E-06	0.99695	0.00091	1.0012	0.0026
keno27/heust.013/hst013g	2.49E+01	3.64E-04	2.30E-02	1.12E-05	0.99781	0.00078	1.0007	0.0036
keno27/heust.013/hst013h	2.48E+01	4.06E-04	2.41E-02	1.25E-05	0.99275	0.00083	1.0009	0.0036
keno27/heust.013/hst013i	2.48E+01	4.07E-04	2.46E-02	1.27E-05	0.99493	0.00085	1.0003	0.0036
keno27/heust.014/case_1	2.45E+01	6.44E-04	3.20E-02	2.33E-05	0.99795	0.00131	1	0.0028
keno27/heust.014/case_2	2.44E+01	7.10E-04	3.31E-02	2.57E-05	1.01629	0.00102	1	0.0052
keno27/heust.014/case_3	2.44E+01	6.76E-04	3.48E-02	2.49E-05	1.02468	0.00093	1	0.0087
keno27/heust.015/case_1	2.41E+01	9.00E-04	4.12E-02	3.63E-05	1.00436	0.00126	1	0.0032
keno27/heust.015/case_2	2.42E+01	9.19E-04	3.99E-02	3.65E-05	0.99415	0.00113	1	0.0034
keno27/heust.015/case_3	2.40E+01	9.10E-04	4.54E-02	4.23E-05	1.01552	0.0012	1	0.0068
keno27/heust.015/case_4	2.40E+01	9.23E-04	4.39E-02	4.03E-05	1.02079	0.00097	1	0.0069
keno27/heust.015/case_5	2.39E+01	8.25E-04	4.78E-02	4.16E-05	1.01561	0.00088	1	0.0089
keno27/heust.016/case_1	2.36E+01	1.22E-03	5.86E-02	6.63E-05	0.99604	0.00119	1	0.0036
keno27/heust.016/case_2	2.36E+01	1.09E-03	6.19E-02	5.87E-05	1.0131	0.00128	1	0.0069

36

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	error estimate
keno27/heust.016/case_3	2.34E+01	1.16E-03	6.97E-02	7.35E-05	1.03322	0.00099	1	0.0079
keno27/heust.017/case_1	2.33E+01	1.50E-03	7.49E-02	9.93E-05	0.99774	0.00113	1	0.0028
keno27/heust.017/case_2	2.31E+01	1.45E-03	8.32E-02	1.04E-04	0.99008	0.00126	1	0.004
keno27/heust.017/case_3	2.32E+01	1.47E-03	7.81E-02	9.77E-05	0.98803	0.00126	1	0.0036
keno27/heust.017/case_4	2.32E+01	1.49E-03	8.15E-02	1.06E-04	1.0046	0.00105	1	0.0047
keno27/heust.017/case_5	2.31E+01	1.38E-03	8.66E-02	1.03E-04	1.01301	0.00112	1	0.0058
keno27/heust.017/case_6	2.29E+01	1.38E-03	1.00E-01	1.17E-04	1.01042	0.00102	1	0.0055
keno27/heust.017/case_7	2.30E+01	1.37E-03	9.29E-02	1.07E-04	1.01258	0.00115	1	0.0057
keno27/heust.017/case_8	2.28E+01	1.32E-03	1.08E-01	1.21E-04	1.00678	0.00106	1	0.0067
keno27/heust.018/case_1	2.25E+01	1.88E-03	1.29E-01	1.88E-04	0.99651	0.00124	1	0.0034
keno27/heust.018/case_10	2.17E+01	1.74E-03	2.33E-01	3.05E-04	1.0264	0.0013	1	0.0057
keno27/heust.018/case_11	2.18E+01	1.66E-03	2.07E-01	2.67E-04	1.02882	0.00101	1	0.0059
keno27/heust.018/case_12	2.17E+01	1.65E-03	2.33E-01	2.92E-04	1.01842	0.00089	1	0.0065
keno27/heust.018/case_2	2.23E+01	1.97E-03	1.52E-01	2.28E-04	0.9922	0.00113	1	0.0046
keno27/heust.018/case_3	2.24E+01	1.98E-03	1.38E-01	2.13E-04	0.997	0.0015	1	0.0042
keno27/heust.018/case_4	2.24E+01	1.87E-03	1.46E-01	2.09E-04	1.00341	0.0012	1	0.0044
keno27/heust.018/case_5	2.20E+01	1.95E-03	1.85E-01	2.73E-04	1.00165	0.00111	1	0.0046
keno27/heust.018/case_6	2.22E+01	1.87E-03	1.67E-01	2.40E-04	1.00002	0.0011	1	0.0045
keno27/heust.018/case_7	2.22E+01	1.69E-03	1.66E-01	2.16E-04	1.01149	0.0009	1	0.0058
keno27/heust.018/case_8	2.19E+01	1.82E-03	2.04E-01	2.84E-04	1.01508	0.00109	1	0.0056
keno27/heust.018/case_9	2.20E+01	1.80E-03	1.84E-01	2.48E-04	1.00991	0.00103	1	0.0056
keno27/heust.019/case_1	2.15E+01	2.40E-03	2.66E-01	4.69E-04	1.00613	0.00125	1	0.0041
keno27/heust.019/case_2	2.16E+01	2.18E-03	2.50E-01	4.08E-04	1.00749	0.00119	1	0.0041
keno27/heust.019/case_3	2.13E+01	2.20E-03	3.01E-01	4.75E-04	1.00309	0.00139	1	0.0067
keno27/heust.020/hst020g	1.89E+01	3.28E-03	1.31E-00	2.81E-03	1.00141	0.00126	0.9966	0.0116
keno27/heust.020/hst020h	2.09E+01	2.56E-03	3.62E-01	6.37E-04	1.00209	0.00132	0.9956	0.0093
keno27/heust.020/hst020i	2.27E+01	1.79E-03	1.12E-01	1.58E-04	1.00351	0.00133	0.9957	0.0079
keno27/heust.020/hst020j	2.27E+01	1.82E-03	1.12E-01	1.60E-04	1.00281	0.00132	0.9955	0.0078
keno27/heust.020/hst020k	2.40E+01	1.01E-03	4.34E-02	4.35E-05	1.00656	0.00143	0.9959	0.0077
keno27/heust.021/hst021h	2.15E+01	2.41E-03	2.69E-01	4.83E-04	1.00772	0.0012	0.9975	0.0054
keno27/heust.021/hst021i	2.21E+01	2.34E-03	1.79E-01	3.19E-04	1.01736	0.00107	0.9975	0.0054
keno27/heust.021/hst021j	2.14E+01	2.44E-03	2.78E-01	5.01E-04	1.00157	0.00138	0.9978	0.0054
keno27/heust.021/hst021k	2.17E+01	2.40E-03	2.37E-01	4.21E-04	1.02036	0.00124	0.9978	0.0054
keno27/heust.021/hst021l	2.14E+01	2.35E-03	2.75E-01	4.78E-04	1.00457	0.00121	0.9978	0.0054
keno27/heust.021/hst021m	2.17E+01	2.37E-03	2.22E-01	3.83E-04	1.00558	0.0012	0.9978	0.0054
keno27/heust.025/case_1	2.47E+01	5.75E-04	2.75E-02	1.89E-05	1.00694	0.00111	1.0002	0.0025
keno27/heust.025/case_10	2.38E+01	1.43E-03	5.18E-02	6.14E-05	1.01392	0.00108	1.0003	0.0043
keno27/heust.025/case_11	2.38E+01	1.36E-03	5.23E-02	5.76E-05	1.01204	0.00089	1.0002	0.0045

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	error estimate
keno27/heust.025/case_12	2.35E+01	1.84E-03	6.61E-02	9.49E-05	1.0103	0.00091	1.0002	0.0045
keno27/heust.025/case_13	2.34E+01	1.70E-03	6.68E-02	8.81E-05	1.01635	0.00095	1.0009	0.0047
keno27/heust.025/case_14	2.30E+01	2.78E-03	8.93E-02	1.80E-04	1.00711	0.00085	1.0008	0.0053
keno27/heust.025/case_15	2.31E+01	2.66E-03	8.43E-02	1.65E-04	1.00072	0.00104	1.0002	0.0058
keno27/heust.025/case_16	2.23E+01	3.86E-03	1.43E-01	3.87E-04	1.00995	0.00088	1	0.0049
keno27/heust.025/case_17	2.24E+01	4.02E-03	1.31E-01	3.71E-04	1.00041	0.00099	1	0.0055
keno27/heust.025/case_18	2.25E+01	3.81E-03	1.23E-01	3.24E-04	0.99782	0.00098	1	0.0061
keno27/heust.025/case_2	2.47E+01	6.23E-04	2.76E-02	1.90E-05	1.00353	0.00105	1.0007	0.0025
keno27/heust.025/case_3	2.46E+01	5.54E-04	2.92E-02	2.00E-05	1.00176	0.00108	1.0002	0.0064
keno27/heust.025/case_4	2.46E+01	6.22E-04	2.82E-02	2.05E-05	1.00695	0.00123	1.0003	0.0027
keno27/heust.025/case_5	2.44E+01	7.51E-04	3.40E-02	2.70E-05	1.01088	0.00106	1.0013	0.003
keno27/heust.025/case_6	2.46E+01	5.43E-04	2.95E-02	1.88E-05	1.01315	0.00087	1.0002	0.0067
keno27/heust.025/case_7	2.44E+01	7.06E-04	3.28E-02	2.49E-05	1.01755	0.00091	1.0009	0.0073
keno27/heust.025/case_8	2.44E+01	7.55E-04	3.39E-02	2.63E-05	1.01565	0.00094	1	0.0067
keno27/heust.025/case_9	2.42E+01	9.34E-04	3.92E-02	3.37E-05	1.009	0.00091	1.0002	0.0065
keno27/heust.027/case_1	2.37E+01	1.17E-03	5.47E-02	6.21E-05	1.00394	0.0013	1	0.0046
keno27/heust.027/case_2	2.37E+01	1.14E-03	5.53E-02	5.93E-05	1.00535	0.0014	1	0.0043
keno27/heust.027/case_3	2.37E+01	1.19E-03	5.54E-02	6.28E-05	1.00548	0.00121	1	0.0037
keno27/heust.027/case_4	2.37E+01	1.13E-03	5.57E-02	5.89E-05	1.00486	0.00135	1	0.0037
keno27/heust.027/case_5	2.37E+01	1.18E-03	5.59E-02	6.07E-05	1.00196	0.00137	1	0.0044
keno27/heust.027/case_6	2.37E+01	1.12E-03	5.51E-02	5.80E-05	0.99915	0.00109	1	0.0043
keno27/heust.027/case_7	2.37E+01	1.11E-03	5.52E-02	5.80E-05	1.00465	0.00133	1	0.0038
keno27/heust.027/case_8	2.37E+01	1.10E-03	5.51E-02	5.66E-05	1.01015	0.00135	1	0.0035
keno27/heust.027/case_9	2.37E+01	1.21E-03	5.53E-02	6.28E-05	1.00629	0.0012	1	0.0039
keno27/heust.028/hst028a	2.44E+01	7.73E-04	3.29E-02	2.76E-05	1.00355	0.00105	1	0.0023
keno27/heust.028/hst028b	2.44E+01	7.54E-04	3.32E-02	2.74E-05	1.00245	0.00132	1	0.0034
keno27/heust.028/hst028c	2.44E+01	7.30E-04	3.29E-02	2.71E-05	1.00347	0.00108	1	0.0026
keno27/heust.028/hst028d	2.44E+01	7.42E-04	3.32E-02	2.67E-05	1.00327	0.00108	1	0.0028
keno27/heust.028/hst028e	2.44E+01	7.21E-04	3.30E-02	2.51E-05	0.99972	0.00118	1	0.0031
keno27/heust.028/hst028g	2.44E+01	7.72E-04	3.33E-02	2.81E-05	1.00271	0.00109	1	0.0023
keno27/heust.028/hst028h	2.44E+01	7.47E-04	3.32E-02	2.72E-05	1.00271	0.00135	1	0.0038
keno27/heust.028/hst028i	2.44E+01	7.26E-04	3.34E-02	2.64E-05	1.0028	0.00115	1	0.0027
keno27/heust.028/hst028j	2.27E+01	1.87E-03	1.16E-01	1.71E-04	1.00256	0.00132	1	0.0049
keno27/heust.028/hst028k	2.27E+01	1.86E-03	1.17E-01	1.71E-04	1.0008	0.00113	1	0.0053
keno27/heust.028/hst028l	2.27E+01	1.87E-03	1.17E-01	1.76E-04	1.00636	0.00121	1	0.0051
keno27/heust.028/hst028m	2.27E+01	1.89E-03	1.19E-01	1.77E-04	1.00068	0.00121	1	0.0046
keno27/heust.028/hst028n	2.27E+01	1.85E-03	1.19E-01	1.74E-04	1.00434	0.00126	1	0.0058
keno27/heust.028/hst028p	2.26E+01	1.86E-03	1.21E-01	1.75E-04	1.00418	0.00136	1	0.0046

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	error estimate
keno27/heust.028/hst028q	2.26E+01	1.87E-03	1.20E-01	1.74E-04	1.01238	0.0013	1	0.0064
keno27/heust.028/hst028r	2.26E+01	1.80E-03	1.22E-01	1.77E-04	1.00911	0.0011	1	0.0052
keno27/heust.028/hst028s	2.26E+01	1.82E-03	1.22E-01	1.78E-04	1.00323	0.00145	1	0.0066
keno27/heust.028/hst028u	2.26E+01	1.84E-03	1.24E-01	1.80E-04	1.00358	0.00117	1	0.006
keno27/heust.029/hst029a	2.26E+01	1.92E-03	1.27E-01	1.94E-04	1.00658	0.00126	1	0.0066
keno27/heust.029/hst029b	2.26E+01	1.89E-03	1.26E-01	1.82E-04	1.0097	0.00118	1	0.0058
keno27/heust.029/hst029c	2.25E+01	1.93E-03	1.28E-01	1.97E-04	1.00232	0.00106	1	0.0068
keno27/heust.029/hst029d	2.25E+01	2.01E-03	1.33E-01	2.10E-04	0.99864	0.00108	1	0.0074
keno27/heust.029/hst029e	2.25E+01	1.92E-03	1.36E-01	2.06E-04	1.00389	0.00118	1	0.0067
keno27/heust.029/hst029g	2.25E+01	1.98E-03	1.36E-01	2.12E-04	1.00597	0.00112	1	0.0065
keno27/heust.029/hst029h	2.25E+01	1.90E-03	1.35E-01	2.00E-04	1.00562	0.00142	1	0.0063
keno27/heust.030/hst030a	2.44E+01	7.64E-04	3.34E-02	2.80E-05	1.00451	0.00127	1	0.0039
keno27/heust.030/hst030b	2.44E+01	7.98E-04	3.38E-02	2.79E-05	1.0035	0.0012	1	0.0032
keno27/heust.030/hst030c	2.44E+01	7.85E-04	3.40E-02	2.79E-05	1.00038	0.00128	1	0.0031
keno27/heust.030/hst030d	2.26E+01	1.80E-03	1.27E-01	1.81E-04	1.00862	0.00123	1	0.0064
keno27/heust.030/hst030e	2.25E+01	1.91E-03	1.28E-01	1.98E-04	1.00291	0.00108	1	0.0058
keno27/heust.030/hst030g	2.25E+01	1.86E-03	1.29E-01	1.89E-04	1.00322	0.00136	1	0.0059
keno27/heust.030/hst030h	2.25E+01	1.95E-03	1.33E-01	1.93E-04	1.0037	0.00103	1	0.0064
keno27/heust.031/hst031a	2.25E+01	1.95E-03	1.31E-01	2.01E-04	1.00556	0.00135	1	0.0046
keno27/heust.031/hst031b	2.24E+01	2.04E-03	1.41E-01	2.23E-04	1.00596	0.00122	1	0.0058
keno27/heust.031/hst031c	2.24E+01	1.99E-03	1.36E-01	2.13E-04	1.00416	0.00113	1	0.0058
keno27/heust.031/hst031d	2.23E+01	2.02E-03	1.52E-01	2.40E-04	1.00393	0.00115	1	0.0068
keno27/heust.032/hst032b	2.51E+01	2.79E-04	2.03E-02	7.98E-06	0.99754	0.00065	1.0015	0.0026
keno27/heust.033-simple/case_02a	2.15E+01	2.26E-03	2.58E-01	4.30E-04	1.00049	0.00111	0.9979	0.0112
keno27/heust.033-simple/case_02b	2.15E+01	2.28E-03	2.66E-01	4.42E-04	0.99953	0.00127	1	0.0109
keno27/heust.033-simple/case_02c	2.14E+01	2.24E-03	2.69E-01	4.52E-04	0.99859	0.00113	0.9979	0.0067
keno27/heust.033-simple/case_03a	2.16E+01	2.26E-03	2.46E-01	4.06E-04	1.00293	0.00124	0.9942	0.0115
keno27/heust.033-simple/case_03b	2.16E+01	2.24E-03	2.44E-01	4.07E-04	1.00546	0.00119	0.9979	0.0112
keno27/heust.033-simple/case_03c	2.17E+01	2.29E-03	2.28E-01	3.89E-04	1.00961	0.00101	0.9979	0.0072
keno27/heust.033-simple/case_04a	2.15E+01	2.41E-03	2.60E-01	4.64E-04	1.00509	0.00111	0.9942	0.0115
keno27/heust.033-simple/case_04b	2.14E+01	2.39E-03	2.66E-01	4.58E-04	1.01287	0.00118	0.9979	0.0112
keno27/heust.033-simple/case_05a	2.15E+01	2.26E-03	2.58E-01	4.27E-04	1.01153	0.00115	0.9942	0.0112
keno27/heust.033-simple/case_05b	2.15E+01	2.32E-03	2.64E-01	4.51E-04	1.00892	0.00121	1	0.0109
keno27/heust.033-simple/case_06a	2.15E+01	2.28E-03	2.59E-01	4.33E-04	1.0042	0.00112	0.9942	0.0112
keno27/heust.033-simple/case_06b	2.15E+01	2.25E-03	2.65E-01	4.40E-04	1.00923	0.00117	1	0.0109
keno27/heust.033-simple/case_07a	2.15E+01	2.28E-03	2.58E-01	4.25E-04	0.99861	0.00104	0.9942	0.0112
keno27/heust.033-simple/case_07b	2.15E+01	2.32E-03	2.61E-01	4.54E-04	1.00817	0.00129	1	0.0109
keno27/heust.033-simple/case_08a	2.15E+01	2.36E-03	2.60E-01	4.54E-04	1.00444	0.00112	0.9942	0.0112

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	error estimate
keno27/heust.033-simple/case_08b	2.15E+01	2.34E-03	2.66E-01	4.51E-04	1.00644	0.0012	1	0.0109
keno27/heust.033-simple/case_09a	2.15E+01	2.29E-03	2.58E-01	4.35E-04	0.99775	0.00117	0.9942	0.0112
keno27/heust.033-simple/case_09b	2.15E+01	2.42E-03	2.63E-01	4.75E-04	0.99887	0.00115	1	0.0109
keno27/heust.033-simple/case_09c	2.15E+01	2.27E-03	2.55E-01	4.30E-04	0.99632	0.00116	0.9979	0.0105
keno27/heust.033-simple/case_10a	2.16E+01	2.31E-03	2.46E-01	4.23E-04	1.00221	0.00123	0.9942	0.0115
keno27/heust.033-simple/case_10c	2.17E+01	2.36E-03	2.30E-01	3.94E-04	1.00191	0.00099	0.9979	0.0072
keno27/heust.033-simple/case_10d	2.16E+01	2.31E-03	2.50E-01	4.13E-04	0.99429	0.00145	0.9979	0.0106
keno27/heust.033-simple/case_11a	2.16E+01	2.35E-03	2.42E-01	4.16E-04	1.00212	0.00117	0.9942	0.0112
keno27/heust.033-simple/case_11b	2.16E+01	2.43E-03	2.38E-01	4.27E-04	1.0022	0.0011	0.9979	0.0109
keno27/heust.033-simple/case_12a	2.15E+01	2.43E-03	2.55E-01	4.54E-04	1.00042	0.00134	0.9942	0.0112
keno27/heust.033-simple/case_12b	2.15E+01	2.22E-03	2.56E-01	4.18E-04	1.00389	0.0011	1	0.0109
keno27/heust.035/hst035a	2.48E+01	4.93E-04	2.51E-02	1.48E-05	1.00288	0.00117	1	0.0031
keno27/heust.035/hst035b	2.48E+01	5.16E-04	2.53E-02	1.54E-05	1.00708	0.00111	1	0.0032
keno27/heust.035/hst035c	2.48E+01	5.04E-04	2.53E-02	1.59E-05	1.00682	0.00083	1	0.003
keno27/heust.035/hst035d	2.48E+01	4.89E-04	2.51E-02	1.50E-05	1.00768	0.00099	1	0.003
keno27/heust.035/hst035e	2.44E+01	7.46E-04	3.44E-02	2.78E-05	1.00684	0.00101	1	0.0033
keno27/heust.035/hst035g	2.43E+01	7.37E-04	3.49E-02	2.69E-05	1.00992	0.00116	1	0.0029
keno27/heust.035/hst035h	2.36E+01	1.25E-03	5.99E-02	6.95E-05	1.0087	0.00117	1	0.0035
keno27/heust.035/hst035i	2.35E+01	1.29E-03	6.26E-02	7.20E-05	1.00355	0.00127	1	0.0038
keno27/heust.035/hst035j	2.36E+01	1.24E-03	6.17E-02	6.86E-05	1.00736	0.00121	1	0.0041
keno27/heust.036/hst036a	2.42E+01	9.14E-04	3.98E-02	3.65E-05	1.00111	0.00134	0.9974	0.0045
keno27/heust.036/hst036b	2.41E+01	9.60E-04	4.14E-02	3.85E-05	1.00276	0.00102	0.9979	0.0039
keno27/heust.036/hst036c	2.40E+01	1.02E-03	4.34E-02	4.29E-05	0.99768	0.00121	0.9993	0.0044
keno27/heust.036/hst036d	2.40E+01	1.08E-03	4.50E-02	4.52E-05	1.00152	0.00116	1	0.0062
keno27/heust.037/hst037a	2.47E+01	5.14E-04	2.58E-02	1.60E-05	1.00968	0.00104	0.998	0.0034
keno27/heust.037/hst037b	2.47E+01	6.26E-04	2.65E-02	1.77E-05	1.00565	0.00107	0.999	0.0035
keno27/heust.037/hst037c	2.45E+01	6.60E-04	3.04E-02	2.26E-05	1.0091	0.00106	0.997	0.0042
keno27/heust.037/hst037d	2.45E+01	7.86E-04	3.13E-02	2.59E-05	1.01221	0.00095	0.998	0.0035
keno27/heust.037/hst037e	2.45E+01	8.44E-04	3.16E-02	2.54E-05	1.00696	0.00104	0.998	0.0042
keno27/heust.037/hst037g	2.43E+01	8.20E-04	3.60E-02	3.10E-05	1.01546	0.00121	0.996	0.0051
keno27/heust.037/hst037h	2.43E+01	8.90E-04	3.72E-02	3.38E-05	1.0158	0.00105	0.998	0.0034
keno27/heust.037/hst037i	2.42E+01	8.88E-04	3.77E-02	3.31E-05	1.00906	0.00112	0.998	0.004
keno27/heust.037/hst037j	2.42E+01	1.10E-03	3.84E-02	3.83E-05	1.00906	0.0011	0.998	0.0047
keno27/leuct.001/case_1	2.36E+01	2.38E-03	7.47E-02	1.66E-04	0.99293	0.00087	0.9998	0.0031
keno27/leuct.001/case_2	2.36E+01	2.32E-03	7.40E-02	1.59E-04	0.99317	0.00085	0.9998	0.0031
keno27/leuct.001/case_3	2.36E+01	2.28E-03	7.34E-02	1.58E-04	0.99356	0.00084	0.9998	0.0031
keno27/leuct.001/case_4	2.36E+01	2.33E-03	7.40E-02	1.68E-04	0.99265	0.0009	0.9998	0.0031
keno27/leuct.001/case_5	2.36E+01	2.34E-03	7.30E-02	1.60E-04	0.99141	0.00082	0.9998	0.0031

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	error estimate
keno27/leuct.001/case_6	2.36E+01	2.26E-03	7.40E-02	1.58E-04	0.99246	0.00074	0.9998	0.0031
keno27/leuct.001/case_7	2.36E+01	2.31E-03	7.22E-02	1.57E-04	0.9917	0.00067	0.9998	0.0031
keno27/leuct.001/case_8	2.36E+01	2.29E-03	7.33E-02	1.58E-04	0.99016	0.00087	0.9998	0.0031
keno27/leuct.002/case_1	2.33E+01	2.63E-03	9.42E-02	2.17E-04	0.99308	0.00099	0.9997	0.002
keno27/leuct.002/case_2	2.33E+01	2.71E-03	9.36E-02	2.25E-04	0.99699	0.00091	0.9997	0.002
keno27/leuct.002/case_3	2.33E+01	2.65E-03	9.34E-02	2.21E-04	0.99522	0.00092	0.9997	0.002
keno27/leuct.002/case_4	2.33E+01	2.55E-03	9.33E-02	2.12E-04	0.99548	0.00117	0.9997	0.002
keno27/leuct.002/case_5	2.33E+01	2.40E-03	9.16E-02	1.94E-04	0.99448	0.0008	0.9997	0.002
keno27/leuct.003/case_1	2.27E+01	3.05E-03	1.38E-01	3.65E-04	0.98021	0.00097	1	0.0039
keno27/leuct.003/case_10	2.28E+01	2.95E-03	1.29E-01	3.37E-04	0.97803	0.00096	1	0.0039
keno27/leuct.003/case_11	2.30E+01	2.76E-03	1.15E-01	2.71E-04	0.9777	0.00091	1	0.0039
keno27/leuct.003/case_12	2.29E+01	2.78E-03	1.20E-01	2.88E-04	0.97688	0.0007	1	0.0039
keno27/leuct.003/case_13	2.29E+01	2.78E-03	1.19E-01	2.87E-04	0.98104	0.00089	1	0.0039
keno27/leuct.003/case_14	2.29E+01	2.84E-03	1.19E-01	3.05E-04	0.97925	0.00091	1	0.0039
keno27/leuct.003/case_15	2.29E+01	2.84E-03	1.20E-01	2.90E-04	0.97985	0.00094	1	0.0039
keno27/leuct.003/case_16	2.29E+01	3.03E-03	1.21E-01	3.27E-04	0.97916	0.0009	1	0.0039
keno27/leuct.003/case_17	2.29E+01	2.82E-03	1.23E-01	3.02E-04	0.98016	0.00078	1	0.0039
keno27/leuct.003/case_18	2.29E+01	3.05E-03	1.23E-01	3.30E-04	0.97823	0.0009	1	0.0039
keno27/leuct.003/case_19	2.29E+01	3.04E-03	1.25E-01	3.28E-04	0.98013	0.001	1	0.0039
keno27/leuct.003/case_2	2.27E+01	3.01E-03	1.38E-01	3.62E-04	0.982	0.001	1	0.0039
keno27/leuct.003/case_20	2.28E+01	2.89E-03	1.33E-01	3.39E-04	0.97732	0.00105	1	0.0039
keno27/leuct.003/case_21	2.28E+01	3.01E-03	1.30E-01	3.45E-04	0.97867	0.00078	1	0.0039
keno27/leuct.003/case_22	2.29E+01	2.83E-03	1.26E-01	3.07E-04	0.98846	0.00089	1	0.0039
keno27/leuct.003/case_3	2.27E+01	2.93E-03	1.38E-01	3.53E-04	0.9815	0.00083	1	0.0039
keno27/leuct.003/case_4	2.27E+01	3.11E-03	1.38E-01	3.77E-04	0.98214	0.00085	1	0.0039
keno27/leuct.003/case_5	2.27E+01	3.11E-03	1.38E-01	3.66E-04	0.98292	0.00086	1	0.0039
keno27/leuct.003/case_6	2.29E+01	2.77E-03	1.19E-01	2.90E-04	0.98213	0.00091	1	0.0039
keno27/leuct.003/case_7	2.28E+01	3.00E-03	1.27E-01	3.35E-04	0.98583	0.00085	1	0.0039
keno27/leuct.003/case_8	2.29E+01	2.86E-03	1.21E-01	3.08E-04	0.98366	0.00083	1	0.0039
keno27/leuct.003/case_9	2.29E+01	2.99E-03	1.22E-01	3.10E-04	0.97815	0.00089	1	0.0039
keno27/leuct.004/case_1	2.19E+01	3.34E-03	2.49E-01	6.84E-04	0.98619	0.00088	0.9998	0.0033
keno27/leuct.004/case_10	2.20E+01	3.64E-03	2.34E-01	7.01E-04	0.99003	0.00087	0.9998	0.0035
keno27/leuct.004/case_11	2.24E+01	3.29E-03	1.78E-01	4.81E-04	0.98136	0.00093	0.9998	0.0035
keno27/leuct.004/case_12	2.23E+01	3.44E-03	1.93E-01	5.46E-04	0.97739	0.00091	0.9998	0.0035
keno27/leuct.004/case_13	2.22E+01	3.35E-03	2.01E-01	5.40E-04	0.98259	0.00084	0.9998	0.0035
keno27/leuct.004/case_14	2.23E+01	3.10E-03	2.00E-01	5.06E-04	0.98326	0.00105	0.9998	0.0035
keno27/leuct.004/case_15	2.23E+01	3.24E-03	1.99E-01	5.34E-04	0.98466	0.001	0.9998	0.0035
keno27/leuct.004/case_16	2.23E+01	3.39E-03	2.01E-01	5.49E-04	0.98419	0.00112	0.9998	0.0035

41

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	error estimate
keno27/leuct.004/case_17	2.22E+01	3.62E-03	2.02E-01	6.04E-04	0.98263	0.001	0.9998	0.0035
keno27/leuct.004/case_18	2.22E+01	3.30E-03	2.04E-01	5.50E-04	0.98385	0.00096	0.9998	0.0035
keno27/leuct.004/case_19	2.22E+01	3.16E-03	2.06E-01	5.31E-04	0.98534	0.00093	0.9998	0.0035
keno27/leuct.004/case_2	2.19E+01	3.54E-03	2.49E-01	7.05E-04	0.9864	0.00097	0.9998	0.0033
keno27/leuct.004/case_20	2.23E+01	3.37E-03	1.90E-01	5.22E-04	0.98034	0.00097	0.9998	0.0035
keno27/leuct.004/case_3	2.19E+01	3.44E-03	2.49E-01	6.86E-04	0.98778	0.00089	0.9998	0.0033
keno27/leuct.004/case_4	2.19E+01	3.21E-03	2.50E-01	6.45E-04	0.98678	0.00092	0.9998	0.0033
keno27/leuct.004/case_5	2.25E+01	3.09E-03	1.68E-01	4.34E-04	0.98849	0.00095	0.9998	0.0033
keno27/leuct.004/case_6	2.22E+01	3.46E-03	2.01E-01	5.65E-04	0.98642	0.00112	0.9998	0.0033
keno27/leuct.004/case_7	2.25E+01	3.18E-03	1.73E-01	4.62E-04	0.98776	0.00097	0.9998	0.0033
keno27/leuct.004/case_8	2.22E+01	3.37E-03	2.07E-01	5.51E-04	0.98507	0.00097	0.9998	0.0035
keno27/leuct.004/case_9	2.20E+01	3.38E-03	2.37E-01	6.48E-04	0.98652	0.00106	0.9998	0.0035
keno27/leuct.016/case_01	2.36E+01	2.36E-03	7.43E-02	1.60E-04	0.99125	0.00088	1	0.0031
keno27/leuct.016/case_02	2.36E+01	2.28E-03	7.36E-02	1.57E-04	0.99249	0.00081	1	0.0031
keno27/leuct.016/case_03	2.36E+01	2.39E-03	7.41E-02	1.65E-04	0.99204	0.00091	1	0.0031
keno27/leuct.016/case_04	2.36E+01	2.31E-03	7.40E-02	1.59E-04	0.99174	0.00087	1	0.0031
keno27/leuct.016/case_05	2.36E+01	2.43E-03	7.37E-02	1.68E-04	0.99157	0.00078	1	0.0031
keno27/leuct.016/case_06	2.36E+01	2.50E-03	7.48E-02	1.68E-04	0.99137	0.00077	1	0.0031
keno27/leuct.016/case_07	2.36E+01	2.50E-03	7.42E-02	1.70E-04	0.99148	0.00083	1	0.0031
keno27/leuct.016/case_08	2.35E+01	2.53E-03	7.53E-02	1.79E-04	0.99108	0.00085	1	0.0031
keno27/leuct.016/case_09	2.36E+01	2.45E-03	7.47E-02	1.70E-04	0.9935	0.00078	1	0.0031
keno27/leuct.016/case_10	2.35E+01	2.46E-03	7.53E-02	1.74E-04	0.99316	0.00078	1	0.0031
keno27/leuct.016/case_11	2.36E+01	2.46E-03	7.43E-02	1.77E-04	0.99365	0.00082	1	0.0031
keno27/leuct.016/case_12	2.35E+01	2.40E-03	7.53E-02	1.69E-04	0.99169	0.00074	1	0.0031
keno27/leuct.016/case_13	2.35E+01	2.32E-03	7.50E-02	1.66E-04	0.99431	0.00087	1	0.0031
keno27/leuct.016/case_14	2.35E+01	2.30E-03	7.54E-02	1.66E-04	0.99231	0.00081	1	0.0031
keno27/leuct.016/case_15	2.36E+01	2.41E-03	7.44E-02	1.67E-04	0.99049	0.00087	1	0.0031
keno27/leuct.016/case_16	2.36E+01	2.41E-03	7.40E-02	1.68E-04	0.98951	0.00091	1	0.0031
keno27/leuct.016/case_17	2.36E+01	2.31E-03	7.45E-02	1.56E-04	0.99072	0.0009	1	0.0031
keno27/leuct.016/case_18	2.36E+01	2.40E-03	7.40E-02	1.65E-04	0.99299	0.001	1	0.0031
keno27/leuct.016/case_19	2.36E+01	2.42E-03	7.41E-02	1.64E-04	0.99227	0.00107	1	0.0031
keno27/leuct.016/case_20	2.36E+01	2.31E-03	7.47E-02	1.61E-04	0.99302	0.00079	1	0.0031
keno27/leuct.016/case_21	2.35E+01	2.47E-03	7.52E-02	1.71E-04	0.99246	0.00089	1	0.0031
keno27/leuct.016/case_22	2.35E+01	2.38E-03	7.53E-02	1.68E-04	0.99143	0.00094	1	0.0031
keno27/leuct.016/case_23	2.36E+01	2.43E-03	7.48E-02	1.72E-04	0.99248	0.00091	1	0.0031
keno27/leuct.016/case_24	2.36E+01	2.37E-03	7.48E-02	1.63E-04	0.99277	0.00083	1	0.0031
keno27/leuct.016/case_25	2.36E+01	2.29E-03	7.46E-02	1.63E-04	0.99289	0.00097	1	0.0031
keno27/leuct.016/case_26	2.35E+01	2.56E-03	7.50E-02	1.82E-04	0.99275	0.00095	1	0.0031

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	error estimate
keno27/leuct.016/case_27	2.36E+01	2.55E-03	7.45E-02	1.76E-04	0.99189	0.00078	1	0.0031
keno27/leuct.016/case_28	2.36E+01	2.30E-03	7.38E-02	1.61E-04	0.99229	0.00076	1	0.0031
keno27/leuct.016/case_29	2.36E+01	2.44E-03	7.36E-02	1.68E-04	0.99133	0.00078	1	0.0031
keno27/leuct.016/case_30	2.36E+01	2.52E-03	7.35E-02	1.71E-04	0.99168	0.00089	1	0.0031
keno27/leuct.016/case_31	2.36E+01	2.33E-03	7.36E-02	1.61E-04	0.99201	0.00095	1	0.0031
keno27/leuct.016/case_32	2.36E+01	2.36E-03	7.37E-02	1.68E-04	0.99291	0.00096	1	0.0031
keno27/leust.003/case_1	2.47E+01	5.17E-04	2.75E-02	1.65E-05	0.99791	0.00098	1.0007	0.0039
keno27/leust.003/case_2	2.47E+01	4.97E-04	2.62E-02	1.54E-05	0.99671	0.00091	1.0003	0.0042
keno27/leust.003/case_3	2.47E+01	4.80E-04	2.59E-02	1.46E-05	1.00045	0.00084	1.0005	0.0042
keno27/leust.003/case_4	2.48E+01	4.85E-04	2.58E-02	1.43E-05	0.99423	0.00082	1.0005	0.0042
keno27/leust.003/case_5	2.49E+01	3.99E-04	2.38E-02	1.19E-05	0.9973	0.00077	1.0007	0.0048
keno27/leust.003/case_6	2.49E+01	3.95E-04	2.36E-02	1.13E-05	0.99644	0.00074	1.0009	0.0049
keno27/leust.003/case_7	2.49E+01	3.96E-04	2.34E-02	1.16E-05	0.99335	0.0008	1.0004	0.0049
keno27/leust.003/case_8	2.49E+01	3.38E-04	2.27E-02	9.42E-06	0.9986	0.0006	1.0003	0.0052
keno27/leust.003/case_9	2.49E+01	3.49E-04	2.26E-02	1.03E-05	0.99555	0.00054	1.0006	0.0052
maximum	2.51E+01	8.76E-03	9.10E+05	1.66E+03	1.03493	1.75E-03	1.006	0.0126
average	2.00E+01	2.59E-03	6.60E+04	1.20E+02	1.0022540	1.07E-03	0.999524	0.00424
minimum	4.83E-00	2.79E-04	2.03E-02	7.98E-06	0.97688	5.40E-04	0.9826	0

Table 4.2 CSAS25 from SCALE 4.4a with the 44-group Cross-Section Set Results on the J-5600 (CMODB) Workstation

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	Error Estimate
keno44/heucm.001/hcm001_02	3.29E+01	7.91E-03	3.52E-01	1.12E-03	1.0096	0.0011	1.0012	0.0059
keno44/heucm.001/hcm001_06	1.79E+01	1.17E-02	1.80E+03	1.20E+01	1.00404	0.00087	0.9953	0.0056
keno44/heucm.001/hcm001_13	2.13E+01	1.14E-02	2.31E+02	1.45E-00	1.00796	0.00104	1.0032	0.0053
keno44/heucm.001/hcm001_17	2.53E+01	1.20E-02	2.53E+01	1.56E-01	1.00088	0.00094	0.9997	0.0046
keno44/heucm.001/hcm001_20	1.88E+01	1.13E-02	5.40E+02	3.19E-00	1.0101	0.00102	1.006	0.0065
keno44/heucm.001/hcm001_27	1.96E+01	1.16E-02	3.85E+02	2.39E-00	1.0037	0.001	0.9991	0.0053
keno44/heucm.001/hcm001_28	1.91E+01	1.11E-02	4.79E+02	2.79E-00	1.00807	0.00109	1.0037	0.0053
keno44/heuct.010/hct010a	3.00E+01	7.45E-03	8.44E-01	2.33E-03	0.99032	0.00107	1	0.005
keno44/heuct.010/hct010b	3.48E+01	5.39E-03	1.38E-01	2.57E-04	0.99586	0.0011	1	0.005
keno44/heuct.010/hct010c	3.58E+01	4.80E-03	9.57E-02	1.56E-04	1.00204	0.00103	1	0.005
keno44/heuct.010/hct010d	3.57E+01	5.17E-03	9.95E-02	1.73E-04	1.00127	0.00101	1	0.005
keno44/heuct.010/hct010e	3.57E+01	5.02E-03	9.69E-02	1.64E-04	1.00427	0.00116	1.001	0.0074
keno44/heuct.010/hct010g	3.59E+01	7.31E-03	9.10E-02	2.41E-04	1.00616	0.00096	1.0007	0.0076
keno44/heuct.011/case_1	3.02E+01	8.10E-03	7.12E-01	2.02E-03	0.9976	0.0009	0.9988	0.0042
keno44/heuct.011/case_2	3.09E+01	8.25E-03	5.47E-01	1.60E-03	0.99774	0.00121	0.9988	0.0042
keno44/heuct.011/case_3	3.16E+01	7.49E-03	4.29E-01	1.12E-03	0.99862	0.001	0.9988	0.0042
keno44/heuct.012/case_1	3.07E+01	7.76E-03	5.97E-01	1.61E-03	0.99712	0.00104	0.9987	0.0032
keno44/heuct.012/case_2	3.15E+01	7.93E-03	4.55E-01	1.22E-03	0.99673	0.00093	0.9987	0.0034
keno44/heuct.013/case_1	3.15E+01	7.98E-03	4.53E-01	1.24E-03	0.99921	0.00093	0.9988	0.0042
keno44/heuct.013/case_2	3.25E+01	7.54E-03	3.14E-01	8.27E-04	0.99744	0.00092	0.9988	0.0043
keno44/heuct.014/case_1	3.52E+01	6.47E-03	1.16E-01	2.52E-04	1.00189	0.00087	0.9986	0.0048
keno44/heuct.014/case_2	3.57E+01	5.98E-03	9.63E-02	1.91E-04	1.00185	0.00096	0.9986	0.0049
keno44/heumf.001/hmf001a	8.37E-00	2.61E-03	9.04E+05	1.14E+03	1.00089	0.00087	1	0.001
keno44/heumf.002/hmf002b	8.36E-00	4.07E-03	8.27E+05	1.45E+03	0.99428	0.00096	1	0.003
keno44/heumf.002/hmf002c	8.36E-00	4.23E-03	8.21E+05	1.48E+03	0.99397	0.0011	1	0.003
keno44/heumf.002/hmf002d	8.38E-00	4.02E-03	8.11E+05	1.41E+03	0.99002	0.00107	1	0.003
keno44/heumf.002/hmf002e	8.40E-00	3.93E-03	8.05E+05	1.38E+03	0.99674	0.00102	1	0.003
keno44/heumf.002/hmf002g	8.37E-00	4.11E-03	8.13E+05	1.46E+03	0.99351	0.00107	1	0.003
keno44/heumf.003/hmf003a	8.34E-00	2.78E-03	8.84E+05	1.16E+03	0.98508	0.00086	1	0.005
keno44/heumf.003/hmf003b	8.33E-00	2.80E-03	8.79E+05	1.15E+03	0.98543	0.0011	1	0.005
keno44/heumf.003/hmf003c	8.32E-00	2.98E-03	8.70E+05	1.16E+03	0.98959	0.00093	1	0.005

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	Error Estimate
keno44/heumf.003/hmf003d	8.32E-00	3.19E-03	8.63E+05	1.23E+03	0.98944	0.00111	1	0.003
keno44/heumf.003/hmf003e	8.33E-00	3.44E-03	8.47E+05	1.27E+03	0.99622	0.00111	1	0.003
keno44/heumf.003/hmf003g	8.34E-00	3.63E-03	8.37E+05	1.33E+03	0.99673	0.00089	1	0.003
keno44/heumf.003/hmf003h	8.37E-00	3.93E-03	8.14E+05	1.37E+03	0.99955	0.00122	1	0.003
keno44/heumf.003/hmf003i	8.83E-00	2.46E-03	6.84E+05	9.14E+02	1.00549	0.00088	1	0.005
keno44/heumf.003/hmf003j	8.94E-00	2.68E-03	6.25E+05	9.61E+02	1.00551	0.00092	1	0.005
keno44/heumf.003/hmf003k	9.05E-00	2.62E-03	5.75E+05	8.87E+02	1.00989	0.00095	1	0.005
keno44/heumf.003/hmf003l	9.08E-00	2.54E-03	5.59E+05	8.38E+02	1.01438	0.00095	1	0.005
keno44/heumf.004/hmf004d	1.35E+01	1.06E-02	3.10E+04	1.95E+02	1.00023	0.00097	1.002	0
keno44/heumf.007/case_1	8.34E-00	2.82E-03	9.16E+05	1.20E+03	0.99215	0.00113	0.9971	0.0001
keno44/heumf.007/case_10	1.24E+01	7.30E-03	2.66E+04	1.37E+02	0.99551	0.00123	1	0.0001
keno44/heumf.007/case_11	1.43E+01	8.62E-03	5.49E+03	3.14E+01	0.99582	0.00102	0.9982	0.0001
keno44/heumf.007/case_12	1.48E+01	8.38E-03	3.98E+03	2.16E+01	0.99153	0.00117	0.9951	0.0001
keno44/heumf.007/case_13	1.60E+01	1.08E-02	2.56E+03	1.67E+01	0.99821	0.00104	1.0009	0.0001
keno44/heumf.007/case_14	1.49E+01	8.83E-03	3.68E+03	2.09E+01	0.99484	0.00125	0.9983	0.0001
keno44/heumf.007/case_15	1.59E+01	1.06E-02	2.84E+03	1.85E+01	0.99474	0.00122	0.9978	0.0001
keno44/heumf.007/case_16	1.59E+01	1.07E-02	2.78E+03	1.82E+01	0.9937	0.00109	0.9988	0.0001
keno44/heumf.007/case_17	1.88E+01	1.08E-02	3.66E+02	2.14E-00	0.99366	0.00111	0.9972	0.0001
keno44/heumf.007/case_18	1.89E+01	1.11E-02	3.43E+02	2.14E-00	0.99663	0.00114	0.9991	0.0001
keno44/heumf.007/case_19	8.35E-00	2.63E-03	9.11E+05	1.12E+03	0.99499	0.001	0.9983	0.0001
keno44/heumf.007/case_2	9.00E-00	3.26E-03	4.98E+05	1.20E+03	0.99579	0.0011	0.9986	0.0001
keno44/heumf.007/case_20	9.92E-00	4.91E-03	2.14E+05	7.88E+02	0.99562	0.00108	0.9981	0.0001
keno44/heumf.007/case_21	1.00E+01	4.92E-03	1.97E+05	7.28E+02	0.99584	0.00111	0.9987	0.0001
keno44/heumf.007/case_22	1.01E+01	5.08E-03	1.82E+05	7.02E+02	0.99551	0.00122	0.9994	0.0001
keno44/heumf.007/case_23	1.16E+01	7.34E-03	6.28E+04	3.15E+02	0.99597	0.00105	0.9993	0.0001
keno44/heumf.007/case_24	1.17E+01	7.94E-03	5.82E+04	3.15E+02	0.99657	0.00105	1.0001	0.0001
keno44/heumf.007/case_25	1.27E+01	8.71E-03	2.66E+04	1.50E+02	0.9953	0.00105	0.999	0.0001
keno44/heumf.007/case_26	1.28E+01	8.49E-03	2.46E+04	1.39E+02	0.99522	0.00109	0.9997	0.0001
keno44/heumf.007/case_27	9.08E-00	3.52E-03	4.65E+05	1.19E+03	0.99635	0.00105	0.9965	0.0002
keno44/heumf.007/case_28	9.62E-00	3.95E-03	2.77E+05	8.49E+02	0.99316	0.00107	0.9987	0.0002
keno44/heumf.007/case_29	1.02E+01	4.44E-03	1.62E+05	5.79E+02	0.99529	0.00111	0.9978	0.0002
keno44/heumf.007/case_3	9.30E-00	4.06E-03	3.76E+05	1.14E+03	0.99539	0.00104	1.0012	0.0001
keno44/heumf.007/case_30	1.30E+01	8.38E-03	1.74E+04	9.96E+01	0.99411	0.00092	0.9981	0.0002
keno44/heumf.007/case_31	1.62E+01	9.61E-03	1.60E+03	9.31E-00	1.00266	0.00118	1.0013	0.0002
keno44/heumf.007/case_32	8.55E-00	2.57E-03	7.96E+05	1.05E+03	1.0024	0.00093	0.9959	0.0001
keno44/heumf.007/case_33	8.69E-00	2.59E-03	7.24E+05	9.91E+02	1.00675	0.00095	0.9995	0.0001
keno44/heumf.007/case_34	8.81E-00	2.83E-03	6.59E+05	1.06E+03	1.00903	0.00097	0.9977	0.0001
keno44/heumf.007/case_35	1.57E+01	1.25E-02	7.49E+03	5.45E+01	0.99717	0.00097	1.0011	0.0001

45

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	Error Estimate
keno44/heumf.007/case_36	1.64E+01	1.09E-02	3.82E+03	2.41E+01	1.0018	0.00094	0.9999	0.0001
keno44/heumf.007/case_37	1.72E+01	1.15E-02	1.90E+03	1.27E+01	1.0038	0.00095	0.9988	0.0001
keno44/heumf.007/case_38	1.73E+01	1.05E-02	1.73E+03	1.06E+01	1.00111	0.00103	1	0.0001
keno44/heumf.007/case_39	1.73E+01	1.15E-02	1.70E+03	1.12E+01	1.00175	0.00103	1.0018	0.0001
keno44/heumf.007/case_4	9.43E-00	3.77E-03	3.31E+05	9.65E+02	0.99485	0.00097	0.997	0.0001
keno44/heumf.007/case_40	1.74E+01	1.07E-02	1.71E+03	1.06E+01	1.00629	0.00108	1.0013	0.0001
keno44/heumf.007/case_41	1.97E+01	1.20E-02	3.07E+02	2.01E-00	1.00444	0.00104	0.9994	0.0001
keno44/heumf.007/case_42	1.97E+01	1.21E-02	2.91E+02	1.92E-00	1.00524	0.00108	1.0016	0.0001
keno44/heumf.007/case_43	2.29E+01	1.06E-02	3.30E+01	1.72E-01	1.00587	0.00122	0.9998	0.0001
keno44/heumf.007/case_5	9.70E-00	3.94E-03	2.54E+05	7.77E+02	0.99552	0.00096	1	0.0001
keno44/heumf.007/case_6	1.03E+01	5.38E-03	1.61E+05	6.48E+02	1.0018	0.00111	1.0028	0.0001
keno44/heumf.007/case_7	9.97E-00	4.51E-03	1.97E+05	6.96E+02	0.99718	0.00108	0.9996	0.0001
keno44/heumf.007/case_8	9.92E-00	4.32E-03	2.05E+05	7.17E+02	0.99504	0.00115	0.9992	0.0001
keno44/heumf.007/case_9	1.01E+01	4.62E-03	1.81E+05	6.32E+02	0.99772	0.001	1.0017	0.0008
keno44/heumf.018/hmf018a	8.40E-00	2.66E-03	8.86E+05	1.13E+03	1.00169	0.00091	1	0.0014
keno44/heumf.019/hmf019a	8.55E-00	2.90E-03	8.16E+05	1.19E+03	1.00608	0.00081	1	0.0028
keno44/heumf.020/hmf020a	9.13E-00	4.53E-03	4.83E+05	1.43E+03	1.00024	0.0009	1	0.0028
keno44/heumf.021/hmf021a	8.68E-00	2.52E-03	7.67E+05	9.98E+02	1.02423	0.00086	1	0.0024
keno44/heumf.022/hmf022a	8.49E-00	2.59E-03	8.52E+05	1.05E+03	0.99454	0.00097	1	0.0019
keno44/heumf.023/hmf023e	8.39E-00	3.05E-03	8.89E+05	1.35E+03	1.00087	0.00088	1	0.0052
keno44/heumf.023/hmf023g	1.66E+01	1.28E-02	5.25E+03	3.93E+01	1.00205	0.00093	1	0.0052
keno44/heumf.026/hmf026b	8.38E-00	2.81E-03	8.98E+05	1.21E+03	1.00153	0.00104	0.9982	0.0042
keno44/heumf.026/hmf026g	1.36E+01	1.14E-02	3.10E+04	2.12E+02	1.00434	0.00102	1	0.0038
keno44/heumf.026/hmf026h	1.56E+01	1.26E-02	1.09E+04	7.94E+01	1.00159	0.00116	1	0.0038
keno44/heumf.026/hmf026j	9.14E-00	5.11E-03	4.95E+05	1.59E+03	0.9919	0.00084	0.9982	0.0042
keno44/heumf.026/hmf026l	1.50E+01	1.17E-02	1.66E+04	1.13E+02	1.00195	0.00088	1	0.0038
keno44/heumf.027/hmf027a	8.48E-00	2.34E-03	8.54E+05	1.01E+03	1.01183	0.00099	1	0.0025
keno44/heumf.028/hmf028b	8.34E-00	3.50E-03	8.43E+05	1.30E+03	0.99619	0.001	1	0.003
keno44/heumf.029/hmf029a	8.40E-00	2.68E-03	8.60E+05	1.08E+03	0.99921	0.00097	1	0.002
keno44/heumf.030/hmf030a	9.84E-00	6.12E-03	2.36E+05	9.26E+02	0.99627	0.00088	1	0.0009
keno44/heumf.031/hmf031b	1.56E+01	1.19E-02	6.77E+03	4.73E+01	1.00306	0.00095	1	0.0059
keno44/heumf.032/hmf032d	8.33E-00	3.09E-03	8.69E+05	1.21E+03	0.99433	0.00093	1	0.0016
keno44/heumf.032/hmf032e	8.33E-00	2.93E-03	8.71E+05	1.20E+03	0.99415	0.00091	1	0.0027
keno44/heumf.032/hmf032g	8.35E-00	2.84E-03	8.84E+05	1.17E+03	0.99281	0.00092	1	0.0017
keno44/heumf.032/hmf032h	8.37E-00	2.62E-03	8.93E+05	1.13E+03	0.99778	0.00106	1	0.0017
keno44/heumf.034/hmf034a	1.35E+01	9.29E-03	1.58E+04	9.75E+01	0.99823	0.00106	0.999	0.0012
keno44/heumf.034/hmf034c	1.35E+01	9.73E-03	1.62E+04	1.02E+02	0.99323	0.00107	0.999	0.0012
keno44/heumf.034/hmf034e	1.38E+01	9.63E-03	1.50E+04	9.28E+01	1.00121	0.00097	0.999	0.0012

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	Error Estimate
keno44/heumm.001/hmm001a	1.69E+01	1.11E-02	2.26E+03	1.47E+01	1.0049	0.0009	0.9995	0.0013
keno44/heumm.002/hmm002a	1.84E+01	1.13E-02	1.15E+03	7.44E-00	1.0102	0.00104	1	0.0037
keno44/heumm.003/hmm003a	1.85E+01	1.19E-02	1.12E+03	7.67E-00	1.01114	0.00093	1	0.0038
keno44/heumt.003/hmt003a	1.43E+01	1.12E-02	1.84E+04	1.26E+02	1.00116	0.00106	1	0.001
keno44/heumt.003/hmt003b	1.44E+01	1.09E-02	1.75E+04	1.12E+02	0.98219	0.00097	0.991	0.003
keno44/heumt.003/hmt003c	2.05E+01	1.18E-02	2.21E+02	1.42E-00	0.97167	0.00111	0.9826	0.006
keno44/heumt.003/hmt003d	2.34E+01	1.24E-02	4.64E+01	2.97E-01	0.98169	0.00103	0.9876	0.004
keno44/heumt.003/hmt003e	2.86E+01	1.13E-02	2.79E-00	1.43E-02	0.9906	0.00093	0.993	0.003
keno44/heumt.003/hmt003g	2.61E+01	1.10E-02	8.89E-00	4.65E-02	0.97366	0.00107	0.9889	0.003
keno44/heumt.003/hmt003h	2.84E+01	1.11E-02	2.95E-00	1.52E-02	0.98359	0.00109	0.9919	0.003
keno44/heumt.006/case_1	3.60E+01	6.27E-03	8.25E-02	1.76E-04	0.99816	0.00093	1	0.004
keno44/heumt.006/case_10	3.60E+01	6.20E-03	8.04E-02	1.71E-04	1.00919	0.0011	1	0.004
keno44/heumt.006/case_11	3.69E+01	5.48E-03	6.00E-02	1.14E-04	1.00765	0.00126	1	0.004
keno44/heumt.006/case_12	3.73E+01	5.03E-03	5.18E-02	9.06E-05	1.00725	0.00094	1	0.004
keno44/heumt.006/case_13	3.60E+01	6.19E-03	8.08E-02	1.74E-04	1.03073	0.00104	1	0.004
keno44/heumt.006/case_14	3.72E+01	5.36E-03	5.48E-02	1.03E-04	0.998	0.00115	1	0.004
keno44/heumt.006/case_15	3.72E+01	5.36E-03	5.43E-02	1.01E-04	0.99591	0.00101	1	0.004
keno44/heumt.006/case_16	3.68E+01	5.54E-03	6.09E-02	1.19E-04	1.00829	0.00094	1	0.004
keno44/heumt.006/case_17	3.64E+01	6.08E-03	7.18E-02	1.48E-04	1.00432	0.00118	1	0.004
keno44/heumt.006/case_18	3.61E+01	6.06E-03	7.75E-02	1.62E-04	1.00438	0.00117	1	0.004
keno44/heumt.006/case_19	3.74E+01	5.67E-03	5.03E-02	1.01E-04	0.99573	0.00105	1	0.004
keno44/heumt.006/case_2	3.65E+01	5.55E-03	6.81E-02	1.29E-04	1.00181	0.001	1	0.004
keno44/heumt.006/case_20	3.67E+01	5.88E-03	6.24E-02	1.26E-04	0.99864	0.00098	1	0.004
keno44/heumt.006/case_21	3.65E+01	5.71E-03	6.73E-02	1.33E-04	0.99939	0.00081	1	0.004
keno44/heumt.006/case_22	3.63E+01	5.59E-03	7.16E-02	1.39E-04	1.00296	0.00088	1	0.004
keno44/heumt.006/case_23	3.63E+01	5.87E-03	7.32E-02	1.46E-04	1.00725	0.00094	1	0.004
keno44/heumt.006/case_3	3.68E+01	5.24E-03	6.08E-02	1.08E-04	1.00588	0.00116	1	0.004
keno44/heumt.006/case_4	3.69E+01	5.34E-03	5.95E-02	1.12E-04	0.99545	0.00109	1	0.004
keno44/heumt.006/case_5	3.71E+01	5.07E-03	5.63E-02	1.01E-04	1.00362	0.00105	1	0.004
keno44/heumt.006/case_6	3.72E+01	5.27E-03	5.37E-02	9.86E-05	1.00331	0.00099	1	0.004
keno44/heumt.006/case_7	3.73E+01	5.00E-03	5.22E-02	9.17E-05	0.99865	0.00122	1	0.004
keno44/heumt.006/case_8	3.74E+01	4.74E-03	5.00E-02	8.44E-05	0.99798	0.00108	1	0.004
keno44/heumt.006/case_9	3.74E+01	4.84E-03	4.98E-02	8.77E-05	0.99604	0.00104	1	0.004
keno44/heust.001/case_1	3.60E+01	2.49E-03	7.91E-02	7.46E-05	1.00173	0.00137	1	0.0025
keno44/heust.001/case_10	3.77E+01	1.48E-03	4.38E-02	2.54E-05	0.99563	0.00114	1	0.0025
keno44/heust.001/case_2	3.26E+01	4.19E-03	2.74E-01	4.22E-04	1.0011	0.00142	1	0.0025
keno44/heust.001/case_3	3.61E+01	2.20E-03	7.76E-02	6.37E-05	1.00287	0.00126	1	0.0025
keno44/heust.001/case_4	3.24E+01	4.36E-03	2.93E-01	4.70E-04	1.0028	0.00119	1	0.0025

47

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	Error Estimate
keno44/heust.001/case_5	3.79E+01	1.34E-03	4.07E-02	2.22E-05	1.00009	0.00123	1	0.0025
keno44/heust.001/case_6	3.78E+01	1.35E-03	4.23E-02	2.37E-05	1.00498	0.00109	1	0.0025
keno44/heust.001/case_7	3.62E+01	2.30E-03	7.48E-02	6.58E-05	0.99934	0.00136	1	0.0025
keno44/heust.001/case_8	3.60E+01	2.35E-03	7.91E-02	6.93E-05	1.00147	0.00132	1	0.0025
keno44/heust.001/case_9	3.24E+01	3.94E-03	2.94E-01	4.21E-04	0.9999	0.00133	1	0.0025
keno44/heust.002/case_1	3.61E+01	2.36E-03	7.73E-02	6.91E-05	1.00586	0.00141	1	0.002
keno44/heust.002/case_10	3.78E+01	1.33E-03	4.19E-02	2.25E-05	1.00712	0.00118	1	0.002
keno44/heust.002/case_11	3.61E+01	2.29E-03	7.70E-02	6.56E-05	1.00537	0.00127	1	0.002
keno44/heust.002/case_12	3.62E+01	2.39E-03	7.52E-02	6.77E-05	1.01171	0.00132	1	0.002
keno44/heust.002/case_13	3.29E+01	3.88E-03	2.44E-01	3.46E-04	1.00359	0.00122	1	0.002
keno44/heust.002/case_14	3.31E+01	3.89E-03	2.27E-01	3.22E-04	1.0121	0.00117	1	0.002
keno44/heust.002/case_2	3.61E+01	2.37E-03	7.67E-02	6.75E-05	1.00987	0.00123	1	0.002
keno44/heust.002/case_3	3.29E+01	3.88E-03	2.46E-01	3.48E-04	1.00334	0.00117	1	0.002
keno44/heust.002/case_4	3.30E+01	3.75E-03	2.38E-01	3.25E-04	1.00719	0.0013	1	0.002
keno44/heust.002/case_5	3.61E+01	2.36E-03	7.70E-02	6.96E-05	1.00857	0.00129	1	0.002
keno44/heust.002/case_6	3.62E+01	2.40E-03	7.56E-02	6.88E-05	1.01139	0.00115	1	0.002
keno44/heust.002/case_7	3.29E+01	3.94E-03	2.46E-01	3.48E-04	1.00352	0.00127	1	0.002
keno44/heust.002/case_8	3.30E+01	4.06E-03	2.33E-01	3.43E-04	1.00896	0.00117	1	0.002
keno44/heust.002/case_9	3.78E+01	1.35E-03	4.21E-02	2.31E-05	1.00299	0.00126	1	0.002
keno44/heust.003/case_1	3.78E+01	1.33E-03	4.19E-02	2.29E-05	1.00407	0.00114	1	0.005
keno44/heust.003/case_10	3.28E+01	4.16E-03	2.55E-01	3.83E-04	1.00279	0.00123	1	0.005
keno44/heust.003/case_11	3.31E+01	3.93E-03	2.27E-01	3.17E-04	1.00314	0.0012	1	0.005
keno44/heust.003/case_12	3.78E+01	1.37E-03	4.21E-02	2.37E-05	1.00133	0.00126	1	0.005
keno44/heust.003/case_13	3.78E+01	1.41E-03	4.14E-02	2.42E-05	1.00478	0.00143	1	0.005
keno44/heust.003/case_14	3.78E+01	1.35E-03	4.19E-02	2.23E-05	1.00366	0.00114	1	0.005
keno44/heust.003/case_15	3.77E+01	1.33E-03	4.33E-02	2.26E-05	0.99554	0.00131	1	0.005
keno44/heust.003/case_16	3.61E+01	2.55E-03	7.81E-02	7.47E-05	1.00405	0.00126	1	0.005
keno44/heust.003/case_17	3.62E+01	2.55E-03	7.36E-02	6.92E-05	1.00408	0.00135	1	0.005
keno44/heust.003/case_18	3.28E+01	3.94E-03	2.55E-01	3.62E-04	0.9976	0.00143	1	0.005
keno44/heust.003/case_19	3.32E+01	4.10E-03	2.20E-01	3.23E-04	1.00205	0.00121	1	0.005
keno44/heust.003/case_2	3.78E+01	1.34E-03	4.21E-02	2.23E-05	1.00525	0.00127	1	0.005
keno44/heust.003/case_3	3.60E+01	2.51E-03	7.85E-02	7.23E-05	1.00352	0.00127	1	0.005
keno44/heust.003/case_4	3.61E+01	2.40E-03	7.65E-02	6.81E-05	1.00382	0.00122	1	0.005
keno44/heust.003/case_5	3.28E+01	4.15E-03	2.58E-01	3.87E-04	1.00327	0.00137	1	0.005
keno44/heust.003/case_6	3.30E+01	4.14E-03	2.40E-01	3.63E-04	1.0013	0.00127	1	0.005
keno44/heust.003/case_7	3.78E+01	1.27E-03	4.16E-02	2.12E-05	1.00145	0.0011	1	0.005
keno44/heust.003/case_8	3.61E+01	2.41E-03	7.79E-02	6.84E-05	1.00572	0.00142	1	0.005
keno44/heust.003/case_9	3.62E+01	2.26E-03	7.48E-02	6.34E-05	1.00466	0.00125	1	0.005

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	Error Estimate
keno44/heust.004/hst004a	2.37E+01	1.14E-02	1.31E+01	6.06E-02	1.00497	0.00096	1	0.0065
keno44/heust.004/hst004b	2.67E+01	9.78E-03	2.66E-00	9.49E-03	1.00491	0.00108	1	0.0071
keno44/heust.004/hst004c	3.12E+01	6.44E-03	4.22E-01	9.07E-04	1.0006	0.001	1	0.0078
keno44/heust.004/hst004d	2.52E+01	1.02E-02	5.59E-00	2.20E-02	0.99917	0.00101	1	0.0091
keno44/heust.004/hst004e	2.88E+01	8.11E-03	1.09E-00	3.06E-03	1.00282	0.00113	1	0.0104
keno44/heust.004/hst004g	3.33E+01	4.85E-03	1.98E-01	3.28E-04	0.99202	0.00119	1	0.0117
keno44/heust.005/hst005a	3.29E+01	4.57E-03	2.44E-01	3.97E-04	1.00282	0.001	1	0.0124
keno44/heust.005/hst005b	3.28E+01	5.00E-03	2.52E-01	4.52E-04	1.01027	0.00126	1	0.0124
keno44/heust.005/hst005c	3.27E+01	4.78E-03	2.61E-01	4.41E-04	1.01072	0.00094	1	0.0126
keno44/heust.005/hst005d	3.32E+01	4.23E-03	2.23E-01	3.37E-04	1.00588	0.00128	1	0.0124
keno44/heust.005/hst005e	3.21E+01	4.48E-03	3.23E-01	5.22E-04	0.98995	0.001	1	0.0124
keno44/heust.005/hst005g	3.30E+01	4.71E-03	2.40E-01	4.01E-04	1.00688	0.00114	1	0.0125
keno44/heust.005/hst005h	3.51E+01	3.31E-03	1.08E-01	1.30E-04	1.00231	0.00112	1	0.0119
keno44/heust.005/hst005i	3.68E+01	2.25E-03	6.02E-02	5.09E-05	1.00609	0.00096	1	0.0121
keno44/heust.006/hst006a	3.34E+01	3.72E-03	2.07E-01	2.83E-04	0.9883	0.00136	0.9973	0.005
keno44/heust.006/hst006b	3.12E+01	3.64E-03	4.35E-01	5.61E-04	1.00276	0.00073	1	0.0087
keno44/heust.006/hst006c	3.28E+01	3.69E-03	2.54E-01	3.32E-04	0.98953	0.00106	0.9986	0.0054
keno44/heust.006/hst006d	3.18E+01	3.51E-03	3.58E-01	4.37E-04	1.00275	0.00086	1	0.0078
keno44/heust.006/hst006e	3.14E+01	3.57E-03	4.02E-01	5.01E-04	1.01165	0.00076	1	0.0091
keno44/heust.006/hst006g	3.21E+01	3.53E-03	3.14E-01	3.90E-04	1.00254	0.00092	1	0.0065
keno44/heust.006/hst006h	3.12E+01	3.51E-03	4.41E-01	5.47E-04	1.00519	0.00079	1	0.0088
keno44/heust.007/case_1	3.76E+01	1.49E-03	4.50E-02	2.63E-05	1.01389	0.00095	1	0.0035
keno44/heust.007/case_10	3.73E+01	1.68E-03	5.05E-02	3.26E-05	1.01612	0.00108	1	0.0035
keno44/heust.007/case_11	3.28E+01	4.35E-03	2.52E-01	3.95E-04	1.01071	0.00108	1	0.0035
keno44/heust.007/case_12	3.74E+01	1.70E-03	4.88E-02	3.28E-05	1.01667	0.00115	1	0.0035
keno44/heust.007/case_13	3.31E+01	4.06E-03	2.28E-01	3.38E-04	1.01528	0.00119	1	0.0035
keno44/heust.007/case_14	3.30E+01	4.13E-03	2.36E-01	3.51E-04	1.01281	0.00162	1	0.0035
keno44/heust.007/case_15	3.30E+01	4.33E-03	2.37E-01	3.64E-04	1.01249	0.00133	1	0.0035
keno44/heust.007/case_16	3.28E+01	4.26E-03	2.52E-01	3.83E-04	1.01041	0.00117	1	0.0035
keno44/heust.007/case_17	3.30E+01	4.09E-03	2.36E-01	3.39E-04	1.01242	0.00125	1	0.0035
keno44/heust.007/case_2	3.27E+01	4.30E-03	2.64E-01	4.00E-04	1.01804	0.00127	1	0.005
keno44/heust.007/case_3	3.77E+01	1.44E-03	4.39E-02	2.51E-05	1.01189	0.00099	1	0.0035
keno44/heust.007/case_4	3.30E+01	4.28E-03	2.34E-01	3.54E-04	1.01745	0.00129	1	0.0035
keno44/heust.007/case_5	3.74E+01	1.50E-03	4.80E-02	2.87E-05	1.00749	0.00101	1	0.0035
keno44/heust.007/case_6	3.26E+01	4.30E-03	2.70E-01	4.19E-04	1.00474	0.0014	1	0.0035
keno44/heust.007/case_7	3.75E+01	1.55E-03	4.73E-02	2.94E-05	1.00642	0.00116	1	0.0035
keno44/heust.007/case_8	3.27E+01	4.23E-03	2.66E-01	4.10E-04	1.00526	0.00118	1	0.0035
keno44/heust.007/case_9	3.74E+01	1.54E-03	4.89E-02	2.94E-05	1.00773	0.00112	1	0.0035

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	Error Estimate
keno44/heust.008/case_1	3.78E+01	1.31E-03	4.23E-02	2.20E-05	0.99936	0.00119	1	0.003
keno44/heust.008/case_10	3.31E+01	4.08E-03	2.29E-01	3.23E-04	0.99928	0.00115	1	0.003
keno44/heust.008/case_11	3.79E+01	1.36E-03	4.04E-02	2.20E-05	1.00107	0.00102	1	0.003
keno44/heust.008/case_12	3.35E+01	4.02E-03	2.00E-01	2.80E-04	0.99785	0.00118	1	0.003
keno44/heust.008/case_13	3.31E+01	4.39E-03	2.26E-01	3.56E-04	1.00217	0.00129	1	0.003
keno44/heust.008/case_14	3.34E+01	4.36E-03	2.06E-01	3.17E-04	0.99989	0.00136	1	0.003
keno44/heust.008/case_2	3.31E+01	4.19E-03	2.31E-01	3.51E-04	0.99919	0.00137	1	0.003
keno44/heust.008/case_3	3.79E+01	1.30E-03	4.10E-02	2.14E-05	0.99668	0.00124	1	0.003
keno44/heust.008/case_4	3.34E+01	4.24E-03	2.05E-01	3.13E-04	0.9992	0.00121	1	0.003
keno44/heust.008/case_5	3.78E+01	1.29E-03	4.21E-02	2.24E-05	0.99765	0.00117	1	0.003
keno44/heust.008/case_6	3.28E+01	4.37E-03	2.52E-01	3.91E-04	1.00104	0.00122	1	0.003
keno44/heust.008/case_7	3.79E+01	1.32E-03	4.13E-02	2.19E-05	0.99914	0.00115	1	0.003
keno44/heust.008/case_8	3.30E+01	4.23E-03	2.39E-01	3.67E-04	1.00101	0.00144	1	0.003
keno44/heust.008/case_9	3.78E+01	1.40E-03	4.20E-02	2.40E-05	1.00127	0.00099	1	0.003
keno44/heust.009/hst009a	3.10E+01	6.13E-03	5.18E-01	1.12E-03	1.006	0.00125	1	0.0057
keno44/heust.009/hst009b	3.42E+01	3.99E-03	1.56E-01	2.19E-04	1.00456	0.00128	1	0.0057
keno44/heust.009/hst009c	3.23E+01	5.18E-03	3.17E-01	5.78E-04	1.00547	0.0012	1	0.0057
keno44/heust.009/hst009d	3.57E+01	2.95E-03	8.85E-02	9.31E-05	0.99856	0.00119	1	0.0057
keno44/heust.010/hst010e	3.73E+01	1.83E-03	5.05E-02	3.58E-05	1.0039	0.00119	1	0.0018
keno44/heust.010/hst010g	3.73E+01	1.78E-03	5.11E-02	3.62E-05	1.00243	0.00126	1	0.0018
keno44/heust.010/hst010h	3.72E+01	1.83E-03	5.32E-02	3.73E-05	1.00261	0.00127	1	0.0018
keno44/heust.010/hst010i	3.71E+01	2.00E-03	5.41E-02	4.14E-05	0.99993	0.00102	1	0.0018
keno44/heust.011/hst011c	3.81E+01	1.16E-03	3.79E-02	1.88E-05	1.0063	0.00107	1	0.002
keno44/heust.011/hst011d	3.81E+01	1.17E-03	3.76E-02	1.80E-05	1.00596	0.00111	1	0.002
keno44/heust.012/hst012b	3.87E+01	6.92E-04	3.07E-02	9.46E-06	1.00132	0.00094	0.9999	0.0058
keno44/heust.013/hst013e	3.87E+01	7.14E-04	3.07E-02	9.89E-06	0.99897	0.00074	1.0012	0.0026
keno44/heust.013/hst013g	3.86E+01	7.81E-04	3.21E-02	1.10E-05	0.99902	0.00091	1.0007	0.0036
keno44/heust.013/hst013h	3.84E+01	8.30E-04	3.35E-02	1.21E-05	0.99617	0.00071	1.0009	0.0036
keno44/heust.013/hst013i	3.84E+01	8.77E-04	3.42E-02	1.28E-05	0.99693	0.00075	1.0003	0.0036
keno44/heust.014/case_1	3.77E+01	1.44E-03	4.38E-02	2.49E-05	0.99826	0.00114	1	0.0028
keno44/heust.014/case_2	3.76E+01	1.34E-03	4.53E-02	2.46E-05	1.01319	0.00108	1	0.0052
keno44/heust.014/case_3	3.75E+01	1.39E-03	4.73E-02	2.61E-05	1.02427	0.00094	1	0.0087
keno44/heust.015/case_1	3.70E+01	1.78E-03	5.53E-02	3.82E-05	1.00112	0.00129	1	0.0032
keno44/heust.015/case_2	3.71E+01	1.92E-03	5.36E-02	3.94E-05	0.9921	0.00106	1	0.0034
keno44/heust.015/case_3	3.68E+01	1.86E-03	6.05E-02	4.24E-05	1.01221	0.00108	1	0.0068
keno44/heust.015/case_4	3.69E+01	1.72E-03	5.83E-02	3.81E-05	1.01977	0.00113	1	0.0069
keno44/heust.015/case_5	3.66E+01	1.63E-03	6.31E-02	3.91E-05	1.01435	0.00086	1	0.0089
keno44/heust.016/case_1	3.61E+01	2.50E-03	7.60E-02	6.99E-05	0.99102	0.00117	1	0.0036

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	Error Estimate
keno44/heust.016/case_2	3.60E+01	2.29E-03	8.00E-02	6.83E-05	1.0094	0.00104	1	0.0069
keno44/heust.016/case_3	3.57E+01	2.21E-03	8.92E-02	7.20E-05	1.03097	0.00102	1	0.0079
keno44/heust.017/case_1	3.55E+01	2.69E-03	9.53E-02	9.45E-05	0.99406	0.0013	1	0.0028
keno44/heust.017/case_2	3.52E+01	2.76E-03	1.06E-01	1.08E-04	0.98508	0.00129	1	0.004
keno44/heust.017/case_3	3.54E+01	2.87E-03	9.93E-02	1.03E-04	0.98123	0.00117	1	0.0036
keno44/heust.017/case_4	3.53E+01	2.65E-03	1.03E-01	9.92E-05	1.00258	0.00105	1	0.0047
keno44/heust.017/case_5	3.51E+01	2.68E-03	1.09E-01	1.02E-04	1.0092	0.00097	1	0.0058
keno44/heust.017/case_6	3.47E+01	2.61E-03	1.25E-01	1.17E-04	1.00596	0.00105	1	0.0055
keno44/heust.017/case_7	3.49E+01	2.46E-03	1.16E-01	1.04E-04	1.0116	0.00097	1	0.0057
keno44/heust.017/case_8	3.45E+01	2.66E-03	1.33E-01	1.27E-04	1.00701	0.00092	1	0.0067
keno44/heust.018/case_1	3.41E+01	3.61E-03	1.57E-01	2.02E-04	0.99344	0.00129	1	0.0034
keno44/heust.018/case_10	3.25E+01	3.06E-03	2.74E-01	3.01E-04	1.0254	0.00111	1	0.0057
keno44/heust.018/case_11	3.28E+01	3.13E-03	2.45E-01	2.66E-04	1.02696	0.00106	1	0.0059
keno44/heust.018/case_12	3.25E+01	3.01E-03	2.72E-01	2.86E-04	1.02145	0.00093	1	0.0065
keno44/heust.018/case_2	3.37E+01	3.62E-03	1.84E-01	2.44E-04	0.98793	0.00129	1	0.0046
keno44/heust.018/case_3	3.39E+01	3.63E-03	1.68E-01	2.19E-04	0.98961	0.00141	1	0.0042
keno44/heust.018/case_4	3.38E+01	3.60E-03	1.76E-01	2.23E-04	1.00164	0.00115	1	0.0044
keno44/heust.018/case_5	3.31E+01	3.58E-03	2.22E-01	2.87E-04	0.9999	0.00111	1	0.0046
keno44/heust.018/case_6	3.34E+01	3.54E-03	2.01E-01	2.53E-04	0.99711	0.00119	1	0.0045
keno44/heust.018/case_7	3.34E+01	3.22E-03	1.98E-01	2.24E-04	1.01008	0.00098	1	0.0058
keno44/heust.018/case_8	3.29E+01	3.34E-03	2.42E-01	2.86E-04	1.01394	0.00112	1	0.0056
keno44/heust.018/case_9	3.31E+01	3.33E-03	2.19E-01	2.58E-04	1.01026	0.00099	1	0.0056
keno44/heust.019/case_1	3.23E+01	4.86E-03	3.09E-01	5.26E-04	1.00194	0.00147	1	0.0041
keno44/heust.019/case_2	3.24E+01	4.26E-03	2.91E-01	4.36E-04	1.006	0.00108	1	0.0041
keno44/heust.019/case_3	3.19E+01	4.00E-03	3.47E-01	4.88E-04	1.00259	0.00128	1	0.0067
keno44/heust.020/hst020g	2.78E+01	5.76E-03	1.36E-00	2.81E-03	1.00205	0.0012	0.9966	0.0116
keno44/heust.020/hst020h	3.12E+01	4.78E-03	3.95E-01	6.54E-04	1.0046	0.00153	0.9956	0.0093
keno44/heust.020/hst020i	3.44E+01	3.46E-03	1.32E-01	1.61E-04	1.00943	0.00141	0.9957	0.0079
keno44/heust.020/hst020j	3.44E+01	3.30E-03	1.32E-01	1.53E-04	1.00887	0.00147	0.9955	0.0078
keno44/heust.020/hst020k	3.69E+01	1.86E-03	5.61E-02	4.04E-05	1.01748	0.00118	0.9959	0.0077
keno44/heust.021/hst021h	3.22E+01	4.35E-03	3.17E-01	5.00E-04	1.00336	0.00125	0.9975	0.0054
keno44/heust.021/hst021i	3.34E+01	4.55E-03	2.13E-01	3.45E-04	1.01229	0.0013	0.9975	0.0054
keno44/heust.021/hst021j	3.21E+01	4.75E-03	3.27E-01	5.55E-04	0.99608	0.00134	0.9978	0.0054
keno44/heust.021/hst021k	3.26E+01	4.38E-03	2.80E-01	4.34E-04	1.01528	0.0012	0.9978	0.0054
keno44/heust.021/hst021l	3.21E+01	4.75E-03	3.25E-01	5.63E-04	0.99844	0.00133	0.9978	0.0054
keno44/heust.021/hst021m	3.27E+01	4.50E-03	2.66E-01	4.30E-04	0.99851	0.00143	0.9978	0.0054
keno44/heust.025/case_1	3.81E+01	1.24E-03	3.83E-02	1.92E-05	1.00257	0.00124	1.0002	0.0025
keno44/heust.025/case_10	3.64E+01	2.80E-03	6.82E-02	6.77E-05	1.01288	0.001	1.0003	0.0043

51

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	Error Estimate
keno44/heust.025/case_11	3.64E+01	2.70E-03	6.84E-02	6.54E-05	1.01105	0.00101	1.0002	0.0045
keno44/heust.025/case_12	3.58E+01	3.76E-03	8.55E-02	1.14E-04	1.01109	0.00086	1.0002	0.0045
keno44/heust.025/case_13	3.57E+01	3.81E-03	8.61E-02	1.15E-04	1.01887	0.00077	1.0009	0.0047
keno44/heust.025/case_14	3.49E+01	5.33E-03	1.15E-01	2.12E-04	1.00877	0.00091	1.0008	0.0053
keno44/heust.025/case_15	3.51E+01	4.92E-03	1.09E-01	1.86E-04	1.00327	0.00103	1.0002	0.0058
keno44/heust.025/case_16	3.37E+01	6.17E-03	1.79E-01	3.88E-04	1.01441	0.00095	1	0.0049
keno44/heust.025/case_17	3.39E+01	7.22E-03	1.66E-01	4.19E-04	1.00606	0.00089	1	0.0055
keno44/heust.025/case_18	3.41E+01	6.79E-03	1.55E-01	3.68E-04	1.00343	0.00113	1	0.0061
keno44/heust.025/case_2	3.81E+01	1.20E-03	3.84E-02	1.92E-05	1.00334	0.00106	1.0007	0.0025
keno44/heust.025/case_3	3.79E+01	1.18E-03	4.04E-02	1.95E-05	0.99873	0.00096	1.0002	0.0064
keno44/heust.025/case_4	3.80E+01	1.17E-03	3.92E-02	1.87E-05	1.00387	0.00113	1.0003	0.0027
keno44/heust.025/case_5	3.75E+01	1.57E-03	4.64E-02	2.87E-05	1.00561	0.00119	1.0013	0.003
keno44/heust.025/case_6	3.79E+01	1.14E-03	4.07E-02	1.88E-05	1.01139	0.00087	1.0002	0.0067
keno44/heust.025/case_7	3.76E+01	1.44E-03	4.48E-02	2.50E-05	1.01612	0.00082	1.0009	0.0073
keno44/heust.025/case_8	3.75E+01	1.49E-03	4.62E-02	2.66E-05	1.01337	0.00088	1	0.0067
keno44/heust.025/case_9	3.71E+01	1.80E-03	5.28E-02	3.51E-05	1.00693	0.00087	1.0002	0.0065
keno44/heust.027/case_1	3.63E+01	7.32E-04	7.17E-02	2.00E-05	0.99903	0.00048	1	0.0046
keno44/heust.027/case_2	3.63E+01	7.39E-04	7.24E-02	2.02E-05	0.99829	0.00039	1	0.0043
keno44/heust.027/case_3	3.63E+01	7.46E-04	7.26E-02	2.05E-05	1.00021	0.00036	1	0.0037
keno44/heust.027/case_4	3.63E+01	7.37E-04	7.29E-02	2.09E-05	1.00119	0.00038	1	0.0037
keno44/heust.027/case_5	3.62E+01	7.11E-04	7.32E-02	1.97E-05	0.99913	0.0004	1	0.0044
keno44/heust.027/case_6	3.63E+01	7.30E-04	7.22E-02	2.04E-05	0.9949	0.00041	1	0.0043
keno44/heust.027/case_7	3.63E+01	2.21E-03	7.22E-02	5.98E-05	1.00155	0.00126	1	0.0038
keno44/heust.027/case_8	3.63E+01	2.15E-03	7.24E-02	5.93E-05	1.00268	0.00119	1	0.0035
keno44/heust.027/case_9	3.63E+01	7.33E-04	7.24E-02	2.00E-05	1.00068	0.00043	1	0.0039
keno44/heust.028/hst028a	3.76E+01	1.51E-03	4.49E-02	2.71E-05	0.99958	0.00114	1	0.0023
keno44/heust.028/hst028b	3.76E+01	1.49E-03	4.54E-02	2.68E-05	0.99818	0.00095	1	0.0034
keno44/heust.028/hst028c	3.76E+01	1.48E-03	4.49E-02	2.66E-05	1.00126	0.00104	1	0.0026
keno44/heust.028/hst028d	3.76E+01	1.49E-03	4.54E-02	2.73E-05	1.00007	0.00103	1	0.0028
keno44/heust.028/hst028e	3.76E+01	1.49E-03	4.50E-02	2.71E-05	0.99542	0.00107	1	0.0031
keno44/heust.028/hst028g	3.76E+01	1.61E-03	4.54E-02	2.88E-05	0.99874	0.00111	1	0.0023
keno44/heust.028/hst028h	3.76E+01	1.46E-03	4.52E-02	2.63E-05	0.99991	0.00134	1	0.0038
keno44/heust.028/hst028i	3.76E+01	1.49E-03	4.56E-02	2.70E-05	0.99808	0.00111	1	0.0027
keno44/heust.028/hst028j	3.44E+01	3.42E-03	1.42E-01	1.71E-04	1.0011	0.00122	1	0.0049
keno44/heust.028/hst028k	3.44E+01	3.72E-03	1.44E-01	1.93E-04	0.99675	0.0013	1	0.0053
keno44/heust.028/hst028l	3.44E+01	3.48E-03	1.44E-01	1.78E-04	1.001	0.00113	1	0.0051
keno44/heust.028/hst028m	3.43E+01	3.32E-03	1.46E-01	1.70E-04	0.99557	0.00112	1	0.0046
keno44/heust.028/hst028n	3.43E+01	3.62E-03	1.46E-01	1.87E-04	0.99987	0.0013	1	0.0058

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	Error Estimate
keno44/heust.028/hst028p	3.43E+01	3.62E-03	1.48E-01	1.89E-04	0.99948	0.0013	1	0.0046
keno44/heust.028/hst028q	3.43E+01	3.26E-03	1.47E-01	1.70E-04	1.0087	0.00113	1	0.0064
keno44/heust.028/hst028r	3.43E+01	3.60E-03	1.50E-01	1.93E-04	1.00152	0.00132	1	0.0052
keno44/heust.028/hst028s	3.43E+01	3.58E-03	1.50E-01	1.92E-04	0.99653	0.00121	1	0.0066
keno44/heust.028/hst028u	3.42E+01	3.70E-03	1.52E-01	2.01E-04	0.99677	0.00111	1	0.006
keno44/heust.029/hst029a	3.42E+01	3.46E-03	1.55E-01	1.94E-04	1.00008	0.00125	1	0.0066
keno44/heust.029/hst029b	3.42E+01	3.57E-03	1.54E-01	1.94E-04	1.00585	0.00104	1	0.0058
keno44/heust.029/hst029c	3.41E+01	3.72E-03	1.57E-01	2.09E-04	0.99721	0.00123	1	0.0068
keno44/heust.029/hst029d	3.40E+01	3.72E-03	1.63E-01	2.15E-04	0.99531	0.00111	1	0.0074
keno44/heust.029/hst029e	3.40E+01	3.76E-03	1.66E-01	2.22E-04	1.00092	0.00104	1	0.0067
keno44/heust.029/hst029g	3.40E+01	3.58E-03	1.67E-01	2.14E-04	1.00052	0.00127	1	0.0065
keno44/heust.029/hst029h	3.40E+01	3.66E-03	1.65E-01	2.16E-04	1.00199	0.00129	1	0.0063
keno44/heust.030/hst030a	3.76E+01	1.46E-03	4.55E-02	2.66E-05	0.99768	0.00144	1	0.0039
keno44/heust.030/hst030b	3.75E+01	1.52E-03	4.62E-02	2.82E-05	1.00165	0.00105	1	0.0032
keno44/heust.030/hst030c	3.75E+01	1.53E-03	4.64E-02	2.87E-05	0.9981	0.00135	1	0.0031
keno44/heust.030/hst030d	3.42E+01	3.43E-03	1.56E-01	1.89E-04	1.00305	0.00109	1	0.0064
keno44/heust.030/hst030e	3.41E+01	3.72E-03	1.57E-01	2.09E-04	1.00036	0.00131	1	0.0058
keno44/heust.030/hst030g	3.41E+01	3.68E-03	1.58E-01	2.13E-04	0.99823	0.00131	1	0.0059
keno44/heust.030/hst030h	3.40E+01	3.61E-03	1.63E-01	2.09E-04	0.99805	0.00119	1	0.0064
keno44/heust.031/hst031a	3.41E+01	3.85E-03	1.61E-01	2.21E-04	0.99991	0.00134	1	0.0046
keno44/heust.031/hst031b	3.39E+01	4.01E-03	1.72E-01	2.52E-04	0.99865	0.00112	1	0.0058
keno44/heust.031/hst031c	3.40E+01	3.79E-03	1.66E-01	2.29E-04	0.99915	0.00126	1	0.0058
keno44/heust.031/hst031d	3.37E+01	3.75E-03	1.86E-01	2.54E-04	0.99857	0.0011	1	0.0068
keno44/heust.032/hst032b	3.88E+01	5.75E-04	2.91E-02	7.80E-06	0.99882	0.00061	1.0015	0.0026
keno44/heust.033-simple/case_02a	3.22E+01	4.31E-03	3.05E-01	4.72E-04	1.00118	0.00129	0.9979	0.0112
keno44/heust.033-simple/case_02b	3.22E+01	4.13E-03	3.13E-01	4.66E-04	1.00179	0.00118	1	0.0109
keno44/heust.033-simple/case_02c	3.21E+01	4.21E-03	3.16E-01	4.78E-04	1.00116	0.00109	0.9979	0.0067
keno44/heust.033-simple/case_03a	3.24E+01	4.30E-03	2.89E-01	4.39E-04	1.00422	0.00108	0.9942	0.0115
keno44/heust.033-simple/case_03b	3.24E+01	3.78E-03	2.88E-01	3.81E-04	1.00747	0.00102	0.9979	0.0112
keno44/heust.033-simple/case_03c	3.26E+01	4.28E-03	2.69E-01	4.08E-04	1.01393	0.00115	0.9979	0.0072
keno44/heust.033-simple/case_04a	3.22E+01	4.28E-03	3.07E-01	4.69E-04	1.00409	0.00114	0.9942	0.0115
keno44/heust.033-simple/case_04b	3.21E+01	4.39E-03	3.14E-01	4.95E-04	1.01268	0.00125	0.9979	0.0112
keno44/heust.033-simple/case_05a	3.22E+01	4.11E-03	3.05E-01	4.48E-04	1.01115	0.00122	0.9942	0.0112
keno44/heust.033-simple/case_05b	3.22E+01	4.11E-03	3.12E-01	4.54E-04	1.00967	0.0011	1	0.0109
keno44/heust.033-simple/case_06a	3.22E+01	4.22E-03	3.06E-01	4.60E-04	1.00694	0.00128	0.9942	0.0112
keno44/heust.033-simple/case_06b	3.22E+01	4.56E-03	3.12E-01	4.98E-04	1.01137	0.00129	1	0.0109
keno44/heust.033-simple/case_07a	3.22E+01	4.51E-03	3.04E-01	4.91E-04	1	0.00134	0.9942	0.0112
keno44/heust.033-simple/case_07b	3.22E+01	4.34E-03	3.09E-01	4.75E-04	1.00792	0.00126	1	0.0109

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	Error Estimate
keno44/heust.033-simple/case_08a	3.22E+01	4.37E-03	3.06E-01	4.81E-04	1.00665	0.00137	0.9942	0.0112
keno44/heust.033-simple/case_08b	3.22E+01	3.99E-03	3.13E-01	4.50E-04	1.0082	0.00107	1	0.0109
keno44/heust.033-simple/case_09a	3.22E+01	4.45E-03	3.04E-01	4.88E-04	0.99888	0.0012	0.9942	0.0112
keno44/heust.033-simple/case_09b	3.22E+01	4.23E-03	3.10E-01	4.69E-04	1.00011	0.00117	1	0.0109
keno44/heust.033-simple/case_09c	3.23E+01	4.34E-03	3.02E-01	4.63E-04	0.9963	0.00107	0.9979	0.0105
keno44/heust.033-simple/case_10a	3.24E+01	4.17E-03	2.90E-01	4.39E-04	1.00403	0.00104	0.9942	0.0115
keno44/heust.033-simple/case_10c	3.26E+01	4.20E-03	2.72E-01	4.09E-04	1.00679	0.00101	0.9979	0.0072
keno44/heust.033-simple/case_10d	3.23E+01	4.16E-03	2.95E-01	4.32E-04	0.99681	0.00117	0.9979	0.0106
keno44/heust.033-simple/case_11a	3.24E+01	4.13E-03	2.87E-01	4.20E-04	1.00141	0.00104	0.9942	0.0112
keno44/heust.033-simple/case_11b	3.25E+01	4.29E-03	2.82E-01	4.19E-04	1.00181	0.00105	0.9979	0.0109
keno44/heust.033-simple/case_12a	3.23E+01	4.38E-03	3.01E-01	4.74E-04	1.00164	0.0011	0.9942	0.0112
keno44/heust.033-simple/case_12b	3.23E+01	4.16E-03	3.03E-01	4.51E-04	1.00386	0.00112	1	0.0109
keno44/heust.035/hst035a	3.83E+01	9.98E-04	3.52E-02	1.49E-05	1.0015	0.00101	1	0.0031
keno44/heust.035/hst035b	3.83E+01	1.02E-03	3.55E-02	1.51E-05	1.00704	0.00105	1	0.0032
keno44/heust.035/hst035c	3.83E+01	9.74E-04	3.55E-02	1.45E-05	1.00537	0.0009	1	0.003
keno44/heust.035/hst035d	3.83E+01	1.00E-03	3.53E-02	1.51E-05	1.00665	0.00114	1	0.003
keno44/heust.035/hst035e	3.75E+01	1.47E-03	4.70E-02	2.73E-05	1.00502	0.00114	1	0.0033
keno44/heust.035/hst035g	3.75E+01	1.57E-03	4.75E-02	2.96E-05	1.00775	0.00113	1	0.0029
keno44/heust.035/hst035h	3.61E+01	2.33E-03	7.77E-02	6.60E-05	1.00648	0.001	1	0.0035
keno44/heust.035/hst035i	3.60E+01	2.50E-03	8.09E-02	7.63E-05	1.00495	0.00123	1	0.0038
keno44/heust.035/hst035j	3.60E+01	2.51E-03	8.01E-02	7.34E-05	1.00375	0.00132	1	0.0041
keno44/heust.036/hst036a	3.71E+01	1.76E-03	5.35E-02	3.72E-05	0.99516	0.001	0.9974	0.0045
keno44/heust.036/hst036b	3.70E+01	1.81E-03	5.56E-02	3.90E-05	0.99999	0.00119	0.9979	0.0039
keno44/heust.036/hst036c	3.69E+01	1.99E-03	5.83E-02	4.49E-05	0.99759	0.00124	0.9993	0.0044
keno44/heust.036/hst036d	3.68E+01	1.97E-03	6.05E-02	4.51E-05	0.99862	0.00105	1	0.0062
keno44/heust.037/hst037a	3.82E+01	1.11E-03	3.61E-02	1.71E-05	1.01017	0.00089	0.998	0.0034
keno44/heust.037/hst037b	3.82E+01	1.11E-03	3.71E-02	1.70E-05	1.0049	0.00115	0.999	0.0035
keno44/heust.037/hst037c	3.78E+01	1.38E-03	4.19E-02	2.38E-05	1.00771	0.00119	0.997	0.0042
keno44/heust.037/hst037d	3.77E+01	1.51E-03	4.32E-02	2.56E-05	1.01169	0.00114	0.998	0.0035
keno44/heust.037/hst037e	3.77E+01	1.68E-03	4.35E-02	2.87E-05	1.0044	0.001	0.998	0.0042
keno44/heust.037/hst037g	3.74E+01	1.60E-03	4.88E-02	3.05E-05	1.01171	0.00121	0.996	0.0051
keno44/heust.037/hst037h	3.73E+01	1.70E-03	5.03E-02	3.37E-05	1.01142	0.00121	0.998	0.0034
keno44/heust.037/hst037i	3.73E+01	1.86E-03	5.10E-02	3.66E-05	1.00762	0.00126	0.998	0.004
keno44/heust.037/hst037j	3.72E+01	1.99E-03	5.20E-02	4.01E-05	1.00503	0.00106	0.998	0.0047
keno44/leuct.001/case_1	3.63E+01	4.13E-03	9.60E-02	1.84E-04	0.99638	0.00087	0.9998	0.0031
keno44/leuct.001/case_2	3.63E+01	4.20E-03	9.53E-02	1.91E-04	0.99548	0.00091	0.9998	0.0031
keno44/leuct.001/case_3	3.63E+01	4.13E-03	9.41E-02	1.81E-04	0.99517	0.00079	0.9998	0.0031
keno44/leuct.001/case_4	3.63E+01	4.19E-03	9.53E-02	1.90E-04	0.99617	0.00101	0.9998	0.0031

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	Error Estimate
keno44/leuct.001/case_5	3.63E+01	3.75E-03	9.39E-02	1.69E-04	0.99268	0.00081	0.9998	0.0031
keno44/leuct.001/case_6	3.63E+01	4.12E-03	9.47E-02	1.85E-04	0.99715	0.00091	0.9998	0.0031
keno44/leuct.001/case_7	3.63E+01	4.05E-03	9.30E-02	1.77E-04	0.99544	0.00081	0.9998	0.0031
keno44/leuct.001/case_8	3.63E+01	4.10E-03	9.43E-02	1.77E-04	0.99355	0.00099	0.9998	0.0031
keno44/leuct.002/case_1	3.57E+01	4.62E-03	1.14E-01	2.23E-04	0.99491	0.00099	0.9997	0.002
keno44/leuct.002/case_2	3.57E+01	4.66E-03	1.14E-01	2.25E-04	0.99857	0.00092	0.9997	0.002
keno44/leuct.002/case_3	3.58E+01	4.70E-03	1.13E-01	2.29E-04	0.99742	0.00095	0.9997	0.002
keno44/leuct.002/case_4	3.58E+01	4.66E-03	1.12E-01	2.23E-04	0.99812	0.00092	0.9997	0.002
keno44/leuct.002/case_5	3.58E+01	4.24E-03	1.11E-01	2.10E-04	0.99486	0.00109	0.9997	0.002
keno44/leuct.003/case_1	3.49E+01	4.55E-03	1.73E-01	3.77E-04	0.98672	0.00088	1	0.0039
keno44/leuct.003/case_10	3.50E+01	4.89E-03	1.63E-01	3.79E-04	0.98098	0.00086	1	0.0039
keno44/leuct.003/case_11	3.53E+01	4.98E-03	1.46E-01	3.47E-04	0.98173	0.00092	1	0.0039
keno44/leuct.003/case_12	3.52E+01	4.87E-03	1.51E-01	3.46E-04	0.9804	0.00107	1	0.0039
keno44/leuct.003/case_13	3.52E+01	4.62E-03	1.51E-01	3.29E-04	0.98379	0.00095	1	0.0039
keno44/leuct.003/case_14	3.52E+01	4.57E-03	1.51E-01	3.31E-04	0.98293	0.00081	1	0.0039
keno44/leuct.003/case_15	3.52E+01	4.63E-03	1.52E-01	3.35E-04	0.98507	0.00088	1	0.0039
keno44/leuct.003/case_16	3.51E+01	4.95E-03	1.54E-01	3.56E-04	0.98236	0.00098	1	0.0039
keno44/leuct.003/case_17	3.51E+01	4.66E-03	1.55E-01	3.41E-04	0.98248	0.00103	1	0.0039
keno44/leuct.003/case_18	3.51E+01	4.77E-03	1.57E-01	3.59E-04	0.98047	0.00095	1	0.0039
keno44/leuct.003/case_19	3.51E+01	4.76E-03	1.59E-01	3.58E-04	0.98238	0.00088	1	0.0039
keno44/leuct.003/case_2	3.48E+01	5.00E-03	1.75E-01	4.13E-04	0.98546	0.00096	1	0.0039
keno44/leuct.003/case_20	3.49E+01	4.99E-03	1.69E-01	4.05E-04	0.98463	0.00088	1	0.0039
keno44/leuct.003/case_21	3.50E+01	5.07E-03	1.65E-01	3.89E-04	0.98113	0.00089	1	0.0039
keno44/leuct.003/case_22	3.51E+01	4.81E-03	1.58E-01	3.57E-04	0.9936	0.00097	1	0.0039
keno44/leuct.003/case_3	3.48E+01	5.04E-03	1.74E-01	4.23E-04	0.98573	0.00097	1	0.0039
keno44/leuct.003/case_4	3.48E+01	5.07E-03	1.75E-01	4.12E-04	0.98522	0.001	1	0.0039
keno44/leuct.003/case_5	3.48E+01	4.99E-03	1.74E-01	4.09E-04	0.9862	0.00082	1	0.0039
keno44/leuct.003/case_6	3.52E+01	4.92E-03	1.51E-01	3.58E-04	0.98333	0.00094	1	0.0039
keno44/leuct.003/case_7	3.50E+01	4.72E-03	1.61E-01	3.56E-04	0.9863	0.00077	1	0.0039
keno44/leuct.003/case_8	3.51E+01	4.82E-03	1.53E-01	3.47E-04	0.98918	0.00091	1	0.0039
keno44/leuct.003/case_9	3.51E+01	4.65E-03	1.55E-01	3.41E-04	0.98102	0.00082	1	0.0039
keno44/leuct.004/case_1	3.34E+01	5.56E-03	2.97E-01	7.52E-04	0.99075	0.0011	0.9998	0.0033
keno44/leuct.004/case_10	3.36E+01	5.79E-03	2.79E-01	7.00E-04	0.99471	0.00088	0.9998	0.0035
keno44/leuct.004/case_11	3.42E+01	5.82E-03	2.14E-01	5.40E-04	0.98216	0.001	0.9998	0.0035
keno44/leuct.004/case_12	3.41E+01	5.60E-03	2.29E-01	5.45E-04	0.98075	0.00102	0.9998	0.0035
keno44/leuct.004/case_13	3.39E+01	5.73E-03	2.41E-01	5.94E-04	0.98671	0.00099	0.9998	0.0035
keno44/leuct.004/case_14	3.39E+01	5.68E-03	2.40E-01	5.99E-04	0.98753	0.00102	0.9998	0.0035
keno44/leuct.004/case_15	3.39E+01	5.55E-03	2.39E-01	5.76E-04	0.98653	0.00094	0.9998	0.0035

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	Error Estimate
keno44/leuct.004/case_16	3.39E+01	5.74E-03	2.40E-01	6.05E-04	0.98647	0.00092	0.9998	0.0035
keno44/leuct.004/case_17	3.39E+01	5.73E-03	2.43E-01	5.98E-04	0.98632	0.00092	0.9998	0.0035
keno44/leuct.004/case_18	3.39E+01	5.84E-03	2.45E-01	6.34E-04	0.98708	0.00099	0.9998	0.0035
keno44/leuct.004/case_19	3.39E+01	5.74E-03	2.46E-01	6.31E-04	0.98724	0.00109	0.9998	0.0035
keno44/leuct.004/case_2	3.34E+01	5.77E-03	2.96E-01	7.43E-04	0.99141	0.00096	0.9998	0.0033
keno44/leuct.004/case_20	3.41E+01	5.43E-03	2.26E-01	5.31E-04	0.98363	0.0009	0.9998	0.0035
keno44/leuct.004/case_3	3.34E+01	6.13E-03	2.97E-01	7.98E-04	0.99204	0.001	0.9998	0.0033
keno44/leuct.004/case_4	3.34E+01	6.00E-03	2.97E-01	7.89E-04	0.99143	0.00091	0.9998	0.0033
keno44/leuct.004/case_5	3.43E+01	5.21E-03	2.02E-01	4.60E-04	0.99067	0.00098	0.9998	0.0033
keno44/leuct.004/case_6	3.39E+01	5.45E-03	2.40E-01	5.75E-04	0.99017	0.00086	0.9998	0.0033
keno44/leuct.004/case_7	3.43E+01	5.48E-03	2.08E-01	4.95E-04	0.99155	0.00101	0.9998	0.0033
keno44/leuct.004/case_8	3.39E+01	5.97E-03	2.46E-01	6.41E-04	0.98877	0.00087	0.9998	0.0035
keno44/leuct.004/case_9	3.35E+01	6.18E-03	2.82E-01	7.47E-04	0.9904	0.00105	0.9998	0.0035
keno44/leuct.016/case_01	3.63E+01	4.10E-03	9.54E-02	1.88E-04	0.99564	0.00086	1	0.0031
keno44/leuct.016/case_02	3.63E+01	4.08E-03	9.47E-02	1.79E-04	0.99507	0.00094	1	0.0031
keno44/leuct.016/case_03	3.63E+01	4.12E-03	9.50E-02	1.83E-04	0.99411	0.00078	1	0.0031
keno44/leuct.016/case_04	3.63E+01	3.95E-03	9.51E-02	1.75E-04	0.99361	0.0009	1	0.0031
keno44/leuct.016/case_05	3.63E+01	4.13E-03	9.50E-02	1.82E-04	0.99492	0.00083	1	0.0031
keno44/leuct.016/case_06	3.63E+01	4.14E-03	9.58E-02	1.83E-04	0.99414	0.00105	1	0.0031
keno44/leuct.016/case_07	3.63E+01	4.08E-03	9.56E-02	1.83E-04	0.99416	0.00084	1	0.0031
keno44/leuct.016/case_08	3.62E+01	3.98E-03	9.66E-02	1.83E-04	0.99545	0.00086	1	0.0031
keno44/leuct.016/case_09	3.63E+01	4.19E-03	9.59E-02	1.86E-04	0.99527	0.00088	1	0.0031
keno44/leuct.016/case_10	3.62E+01	4.10E-03	9.68E-02	1.86E-04	0.99423	0.00076	1	0.0031
keno44/leuct.016/case_11	3.63E+01	4.00E-03	9.60E-02	1.85E-04	0.99414	0.00086	1	0.0031
keno44/leuct.016/case_12	3.62E+01	3.97E-03	9.74E-02	1.82E-04	0.99416	0.00074	1	0.0031
keno44/leuct.016/case_13	3.62E+01	4.13E-03	9.62E-02	1.90E-04	0.99535	0.00084	1	0.0031
keno44/leuct.016/case_14	3.62E+01	4.14E-03	9.72E-02	1.91E-04	0.99677	0.0009	1	0.0031
keno44/leuct.016/case_15	3.63E+01	4.05E-03	9.55E-02	1.83E-04	0.99352	0.00095	1	0.0031
keno44/leuct.016/case_16	3.63E+01	3.89E-03	9.54E-02	1.78E-04	0.9924	0.00081	1	0.0031
keno44/leuct.016/case_17	3.63E+01	4.01E-03	9.54E-02	1.80E-04	0.9942	0.00083	1	0.0031
keno44/leuct.016/case_18	3.63E+01	3.98E-03	9.53E-02	1.81E-04	0.99494	0.00084	1	0.0031
keno44/leuct.016/case_19	3.63E+01	4.02E-03	9.53E-02	1.83E-04	0.99588	0.00099	1	0.0031
keno44/leuct.016/case_20	3.62E+01	4.14E-03	9.62E-02	1.90E-04	0.99553	0.00091	1	0.0031
keno44/leuct.016/case_21	3.62E+01	4.25E-03	9.67E-02	1.91E-04	0.99598	0.00077	1	0.0031
keno44/leuct.016/case_22	3.62E+01	4.05E-03	9.63E-02	1.83E-04	0.99623	0.00083	1	0.0031
keno44/leuct.016/case_23	3.63E+01	4.14E-03	9.61E-02	1.87E-04	0.99479	0.0008	1	0.0031
keno44/leuct.016/case_24	3.62E+01	4.00E-03	9.65E-02	1.80E-04	0.99497	0.00092	1	0.0031
keno44/leuct.016/case_25	3.63E+01	4.12E-03	9.61E-02	1.83E-04	0.99497	0.00085	1	0.0031

56

Case	AFG	sigma	AELCF	sigma	K_calc	sigma	k_exp	Error Estimate
keno44/leuct.016/case_26	3.62E+01	4.19E-03	9.65E-02	1.93E-04	0.9971	0.00087	1	0.0031
keno44/leuct.016/case_27	3.63E+01	3.93E-03	9.59E-02	1.76E-04	0.99569	0.00091	1	0.0031
keno44/leuct.016/case_28	3.63E+01	3.97E-03	9.46E-02	1.79E-04	0.99551	0.00099	1	0.0031
keno44/leuct.016/case_29	3.63E+01	4.00E-03	9.46E-02	1.78E-04	0.99538	0.00097	1	0.0031
keno44/leuct.016/case_30	3.63E+01	4.00E-03	9.47E-02	1.79E-04	0.9935	0.00096	1	0.0031
keno44/leuct.016/case_31	3.63E+01	4.18E-03	9.41E-02	1.85E-04	0.99529	0.0009	1	0.0031
keno44/leuct.016/case_32	3.63E+01	3.84E-03	9.46E-02	1.72E-04	0.99539	0.00101	1	0.0031
keno44/leust.003/case_1	3.81E+01	1.02E-03	3.87E-02	1.66E-05	0.99815	0.00098	1.0007	0.0039
keno44/leust.003/case_2	3.82E+01	9.56E-04	3.69E-02	1.56E-05	0.99699	0.00094	1.0003	0.0042
keno44/leust.003/case_3	3.83E+01	9.39E-04	3.66E-02	1.55E-05	1.00132	0.00089	1.0005	0.0042
keno44/leust.003/case_4	3.83E+01	8.90E-04	3.64E-02	1.41E-05	0.99439	0.00108	1.0005	0.0042
keno44/leust.003/case_5	3.85E+01	8.08E-04	3.38E-02	1.22E-05	0.99732	0.00086	1.0007	0.0048
keno44/leust.003/case_6	3.85E+01	8.20E-04	3.35E-02	1.21E-05	0.99847	0.00083	1.0009	0.0049
keno44/leust.003/case_7	3.85E+01	7.53E-04	3.33E-02	1.13E-05	0.99662	0.00075	1.0004	0.0049
keno44/leust.003/case_8	3.86E+01	7.03E-04	3.23E-02	1.00E-05	0.99995	0.00068	1.0003	0.0052
keno44/leust.003/case_9	3.86E+01	6.90E-04	3.22E-02	9.98E-06	0.99607	0.00069	1.0006	0.0052
maximum	3.88E+01	1.28E-02	9.16E+05	1.59E+03	1.03097	1.62E-03	1.006	0.0126
average	3.07E+01	4.31E-03	6.75E+04	1.18E+02	1.000231	1.06E-03	0.999524	0.00424
minimum	8.32E-00	5.75E-04	2.91E-02	7.80E-06	0.97167	3.60E-04	0.9826	0

Table 4.3 CSAS25 from SCALE 4.4A with the 238-group Cross-Section Set Results on the J-5600 (CMODB) Workstation

Case	AFG	sigma	AELCF	sigma	k_calc	sigma	k_exp	sigma
keno238/heucm.001/hcm001_02	1.93E+02	4.47E-02	3.82E-01	1.26E-03	1.00853	0.00097	1.0012	0.0059
keno238/heucm.001/hcm001_06	9.23E+01	8.60E-02	1.84E+03	1.34E+01	0.9931	0.00092	0.9953	0.0056
keno238/heucm.001/hcm001_13	1.16E+02	8.27E-02	2.34E+02	1.58E-00	0.99888	0.00088	1.0032	0.0053
keno238/heucm.001/hcm001_17	1.42E+02	8.29E-02	2.54E+01	1.71E-01	0.995	0.00097	0.9997	0.0046
keno238/heucm.001/hcm001_20	9.97E+01	7.42E-02	5.61E+02	3.21E-00	1.00596	0.00106	1.006	0.0065
keno238/heucm.001/hcm001_27	1.04E+02	7.68E-02	3.97E+02	2.32E-00	0.99803	0.00095	0.9991	0.0053
keno238/heucm.001/hcm001_28	1.02E+02	7.83E-02	4.88E+02	2.93E-00	1.00403	0.00109	1.0037	0.0053
keno238/heuct.010/hct010a	1.81E+02	4.38E-02	8.51E-01	2.52E-03	0.98579	0.00105	1	0.005
keno238/heuct.010/hct010b	2.05E+02	2.62E-02	1.38E-01	2.76E-04	0.99156	0.00103	1	0.005
keno238/heuct.010/hct010c	2.10E+02	2.17E-02	9.61E-02	1.64E-04	1.00111	0.00103	1	0.005
keno238/heuct.010/hct010d	2.09E+02	2.23E-02	1.00E-01	1.72E-04	0.99926	0.00114	1	0.005
keno238/heuct.010/hct010e	2.10E+02	2.17E-02	9.73E-02	1.68E-04	1.00367	0.001	1.001	0.0074
keno238/heuct.010/hct010g	2.10E+02	2.83E-02	9.21E-02	2.19E-04	1.00566	0.00097	1.0007	0.0076
keno238/heuct.011/case_1	1.83E+02	4.48E-02	7.19E-01	2.08E-03	0.99432	0.00126	0.9988	0.0042
keno238/heuct.011/case_2	1.86E+02	4.11E-02	5.54E-01	1.53E-03	0.9946	0.00093	0.9988	0.0042
keno238/heuct.011/case_3	1.90E+02	4.00E-02	4.32E-01	1.15E-03	0.99546	0.0009	0.9988	0.0042
keno238/heuct.012/case_1	1.85E+02	4.36E-02	6.02E-01	1.69E-03	0.99229	0.00096	0.9987	0.0032
keno238/heuct.012/case_2	1.89E+02	4.21E-02	4.58E-01	1.27E-03	0.99294	0.00091	0.9987	0.0034
keno238/heuct.013/case_1	1.89E+02	4.30E-02	4.54E-01	1.32E-03	0.99565	0.00114	0.9988	0.0042
keno238/heuct.013/case_2	1.94E+02	4.06E-02	3.16E-01	8.43E-04	0.9952	0.00099	0.9988	0.0043
keno238/heuct.014/case_1	2.07E+02	3.06E-02	1.17E-01	2.60E-04	0.99989	0.00099	0.9986	0.0048
keno238/heuct.014/case_2	2.09E+02	2.92E-02	9.71E-02	2.08E-04	1.00124	0.00091	0.9986	0.0049
keno238/heumf.001/hmf001a	2.44E+01	1.35E-02	9.49E+05	1.17E+03	0.99605	0.00094	1	0.001
keno238/heumf.002/hmf002b	2.55E+01	1.82E-02	8.38E+05	1.41E+03	1.00274	0.00106	1	0.003
keno238/heumf.002/hmf002c	2.55E+01	1.91E-02	8.35E+05	1.46E+03	0.99918	0.0009	1	0.003
keno238/heumf.002/hmf002d	2.56E+01	1.92E-02	8.24E+05	1.45E+03	0.99523	0.001	1	0.003
keno238/heumf.002/hmf002e	2.57E+01	1.84E-02	8.18E+05	1.37E+03	1.00336	0.00089	1	0.003
keno238/heumf.002/hmf002g	2.56E+01	1.79E-02	8.26E+05	1.38E+03	0.99832	0.00094	1	0.003
keno238/heumf.003/hmf003a	2.48E+01	1.30E-02	9.10E+05	1.13E+03	0.99233	0.00084	1	0.005
keno238/heumf.003/hmf003b	2.49E+01	1.40E-02	8.99E+05	1.18E+03	0.99359	0.0009	1	0.005
keno238/heumf.003/hmf003c	2.50E+01	1.34E-02	8.87E+05	1.15E+03	0.99839	0.00098	1	0.005
keno238/heumf.003/hmf003d	2.51E+01	1.39E-02	8.78E+05	1.19E+03	0.99795	0.00101	1	0.003
keno238/heumf.003/hmf003e	2.53E+01	1.54E-02	8.58E+05	1.24E+03	1.00189	0.00099	1	0.003
keno238/heumf.003/hmf003g	2.53E+01	1.62E-02	8.53E+05	1.27E+03	1.00052	0.00106	1	0.003
keno238/heumf.003/hmf003h	2.55E+01	1.95E-02	8.31E+05	1.48E+03	1.0031	0.0011	1	0.003
keno238/heumf.003/hmf003i	2.72E+01	1.33E-02	7.12E+05	9.38E+02	1.00297	0.00091	1	0.005

Case	AFG	sigma	AELCF	sigma	k_calc	sigma	k_exp	sigma
keno238/heumf.003/hmf003j	2.81E+01	1.37E-02	6.41E+05	9.03E+02	1.00505	0.00082	1	0.005
keno238/heumf.003/hmf003k	2.89E+01	1.45E-02	5.83E+05	8.81E+02	1.01025	0.001	1	0.005
keno238/heumf.003/hmf003l	2.91E+01	1.36E-02	5.64E+05	8.19E+02	1.0127	0.0008	1	0.005
keno238/heumf.004/hmf004d	6.11E+01	7.45E-02	3.16E+04	2.05E+02	0.9964	0.00112	1.002	0
keno238/heumf.007/case_1	2.43E+01	1.31E-02	9.57E+05	1.18E+03	0.99113	0.00104	0.9971	0.0001
keno238/heumf.007/case_10	5.50E+01	5.08E-02	2.84E+04	1.35E+02	0.99248	0.00103	1	0.0001
keno238/heumf.007/case_11	7.01E+01	6.42E-02	5.92E+03	3.34E+01	0.99257	0.00129	0.9982	0.0001
keno238/heumf.007/case_12	7.36E+01	6.66E-02	4.33E+03	2.42E+01	0.9908	0.00112	0.9951	0.0001
keno238/heumf.007/case_13	8.21E+01	7.20E-02	2.69E+03	1.62E+01	0.99667	0.00107	1.0009	0.0001
keno238/heumf.007/case_14	7.46E+01	6.45E-02	3.97E+03	2.23E+01	0.99203	0.00115	0.9983	0.0001
keno238/heumf.007/case_15	8.07E+01	6.91E-02	3.00E+03	1.72E+01	0.99041	0.00103	0.9978	0.0001
keno238/heumf.007/case_16	8.09E+01	7.71E-02	2.95E+03	1.88E+01	0.99122	0.00116	0.9988	0.0001
keno238/heumf.007/case_17	1.03E+02	7.88E-02	3.86E+02	2.37E-00	0.99168	0.00152	0.9972	0.0001
keno238/heumf.007/case_18	1.04E+02	7.78E-02	3.68E+02	2.24E-00	0.99515	0.00117	0.9991	0.0001
keno238/heumf.007/case_19	2.43E+01	1.27E-02	9.54E+05	1.12E+03	0.99294	0.00097	0.9983	0.0001
keno238/heumf.007/case_2	2.87E+01	1.93E-02	5.29E+05	1.17E+03	0.9938	0.00106	0.9986	0.0001
keno238/heumf.007/case_20	3.57E+01	3.37E-02	2.29E+05	8.20E+02	0.99117	0.00118	0.9981	0.0001
keno238/heumf.007/case_21	3.64E+01	3.60E-02	2.12E+05	8.04E+02	0.99211	0.00093	0.9987	0.0001
keno238/heumf.007/case_22	3.72E+01	3.45E-02	1.94E+05	6.93E+02	0.99284	0.00098	0.9994	0.0001
keno238/heumf.007/case_23	4.85E+01	5.80E-02	6.60E+04	3.52E+02	0.99408	0.0009	0.9993	0.0001
keno238/heumf.007/case_24	4.92E+01	5.68E-02	6.23E+04	3.23E+02	0.99447	0.00112	1.0001	0.0001
keno238/heumf.007/case_25	5.71E+01	6.29E-02	2.80E+04	1.58E+02	0.99493	0.00109	0.999	0.0001
keno238/heumf.007/case_26	5.79E+01	6.03E-02	2.62E+04	1.43E+02	0.99366	0.00105	0.9997	0.0001
keno238/heumf.007/case_27	2.92E+01	2.08E-02	4.97E+05	1.20E+03	0.99052	0.00107	0.9965	0.0002
keno238/heumf.007/case_28	3.32E+01	2.55E-02	2.99E+05	8.79E+02	0.99132	0.00085	0.9987	0.0002
keno238/heumf.007/case_29	3.75E+01	3.28E-02	1.73E+05	6.22E+02	0.99254	0.00089	0.9978	0.0002
keno238/heumf.007/case_3	3.10E+01	2.54E-02	4.02E+05	1.14E+03	0.99399	0.00099	1.0012	0.0001
keno238/heumf.007/case_30	5.95E+01	5.75E-02	1.86E+04	9.91E+01	0.99153	0.00096	0.9981	0.0002
keno238/heumf.007/case_31	8.44E+01	6.74E-02	1.73E+03	9.64E-00	0.99799	0.00117	1.0013	0.0002
keno238/heumf.007/case_32	2.55E+01	1.31E-02	8.40E+05	1.08E+03	0.99807	0.00087	0.9959	0.0001
keno238/heumf.007/case_33	2.63E+01	1.38E-02	7.69E+05	1.05E+03	1.00516	0.00103	0.9995	0.0001
keno238/heumf.007/case_34	2.70E+01	1.49E-02	7.05E+05	1.05E+03	1.00941	0.00095	0.9977	0.0001
keno238/heumf.007/case_35	7.61E+01	7.88E-02	7.88E+03	5.42E+01	0.99206	0.00099	1.0011	0.0001
keno238/heumf.007/case_36	8.18E+01	8.40E-02	3.92E+03	2.78E+01	0.99863	0.0009	0.9999	0.0001
keno238/heumf.007/case_37	8.80E+01	7.87E-02	1.96E+03	1.25E+01	0.99808	0.00099	0.9988	0.0001
keno238/heumf.007/case_38	8.87E+01	8.13E-02	1.77E+03	1.17E+01	0.99853	0.0011	1	0.0001
keno238/heumf.007/case_39	8.88E+01	7.59E-02	1.73E+03	1.09E+01	0.99997	0.00093	1.0018	0.0001
keno238/heumf.007/case_4	3.18E+01	2.55E-02	3.54E+05	1.06E+03	0.99179	0.00103	0.997	0.0001
keno238/heumf.007/case_40	8.90E+01	7.74E-02	1.78E+03	1.12E+01	1.0031	0.00095	1.0013	0.0001
keno238/heumf.007/case_41	1.06E+02	8.13E-02	3.26E+02	2.06E-00	0.99935	0.00116	0.9994	0.0001

Case	AFG	sigma	AELCF	sigma	k_calc	sigma	k_exp	sigma
keno238/heumf.007/case_42	1.07E+02	7.80E-02	3.07E+02	1.87E-00	0.9995	0.00091	1.0016	0.0001
keno238/heumf.007/case_43	1.32E+02	7.26E-02	3.48E+01	1.88E-01	1.00107	0.0012	0.9998	0.0001
keno238/heumf.007/case_5	3.38E+01	2.66E-02	2.71E+05	8.50E+02	0.99267	0.00095	1	0.0001
keno238/heumf.007/case_6	3.85E+01	3.87E-02	1.71E+05	6.92E+02	0.99982	0.00108	1.0028	0.0001
keno238/heumf.007/case_7	3.58E+01	3.11E-02	2.13E+05	7.59E+02	0.99619	0.00116	0.9996	0.0001
keno238/heumf.007/case_8	3.54E+01	3.00E-02	2.18E+05	7.69E+02	0.99183	0.00103	0.9992	0.0001
keno238/heumf.007/case_9	3.70E+01	3.50E-02	1.93E+05	7.29E+02	0.9959	0.0011	1.0017	0.0008
keno238/heumf.018/hmf018a	2.46E+01	1.27E-02	9.29E+05	1.11E+03	0.99769	0.00102	1	0.0014
keno238/heumf.019/hmf019a	2.54E+01	1.29E-02	8.58E+05	1.06E+03	1.00212	0.00085	1	0.0028
keno238/heumf.020/hmf020a	3.00E+01	3.05E-02	5.09E+05	1.51E+03	0.99438	0.00098	1	0.0028
keno238/heumf.021/hmf021a	2.59E+01	1.28E-02	8.21E+05	1.01E+03	1.01458	0.00095	1	0.0024
keno238/heumf.022/hmf022a	2.51E+01	1.29E-02	8.91E+05	1.09E+03	0.99116	0.00103	1	0.0019
keno238/heumf.023/hmf023e	2.46E+01	1.53E-02	9.31E+05	1.32E+03	0.99692	0.00095	1	0.0052
keno238/heumf.023/hmf023g	8.22E+01	8.64E-02	5.30E+03	3.92E+01	0.99997	0.00101	1	0.0052
keno238/heumf.026/hmf026b	2.45E+01	1.38E-02	9.42E+05	1.21E+03	0.9979	0.00096	0.9982	0.0042
keno238/heumf.026/hmf026g	6.14E+01	8.14E-02	3.18E+04	2.26E+02	1.00018	0.00089	1	0.0038
keno238/heumf.026/hmf026h	7.42E+01	8.34E-02	1.12E+04	7.95E+01	0.99858	0.00096	1	0.0038
keno238/heumf.026/hmf026j	3.00E+01	3.35E-02	5.25E+05	1.64E+03	0.98957	0.00084	0.9982	0.0042
keno238/heumf.026/hmf026l	6.97E+01	7.77E-02	1.71E+04	1.14E+02	0.99961	0.00098	1	0.0038
keno238/heumf.027/hmf027a	2.50E+01	1.24E-02	8.99E+05	1.07E+03	1.00872	0.00087	1	0.0025
keno238/heumf.028/hmf028b	2.53E+01	1.60E-02	8.57E+05	1.28E+03	1.00469	0.00102	1	0.003
keno238/heumf.029/hmf029a	2.51E+01	1.30E-02	8.86E+05	1.11E+03	1.00319	0.00103	1	0.002
keno238/heumf.030/hmf030a	3.51E+01	3.53E-02	2.33E+05	9.34E+02	1.00397	0.00105	1	0.0009
keno238/heumf.031/hmf031b	7.66E+01	7.82E-02	6.87E+03	4.62E+01	1.00099	0.00093	1	0.0059
keno238/heumf.032/hmf032d	2.50E+01	1.42E-02	8.87E+05	1.21E+03	1.00413	0.00092	1	0.0016
keno238/heumf.032/hmf032e	2.50E+01	1.30E-02	8.91E+05	1.12E+03	1.00038	0.00095	1	0.0027
keno238/heumf.032/hmf032g	2.48E+01	1.27E-02	9.13E+05	1.11E+03	0.99885	0.00107	1	0.0017
keno238/heumf.032/hmf032h	2.46E+01	1.27E-02	9.29E+05	1.09E+03	0.9996	0.00108	1	0.0017
keno238/heumf.034/hmf034a	6.31E+01	6.80E-02	1.67E+04	9.84E+01	0.99319	0.00112	0.999	0.0012
keno238/heumf.034/hmf034c	6.32E+01	6.68E-02	1.68E+04	9.80E+01	0.99231	0.00114	0.999	0.0012
keno238/heumf.034/hmf034e	6.47E+01	6.59E-02	1.57E+04	8.94E+01	0.99978	0.0012	0.999	0.0012
keno238/heumm.001/hmm001a	8.72E+01	8.08E-02	2.31E+03	1.56E+01	0.99972	0.00104	0.9995	0.0013
keno238/heumm.002/hmm002a	9.64E+01	7.86E-02	1.17E+03	7.59E-00	1.00571	0.00097	1	0.0037
keno238/heumm.003/hmm003a	9.63E+01	8.41E-02	1.18E+03	8.29E-00	1.00657	0.0009	1	0.0038
keno238/heumt.003/hmt003a	6.64E+01	7.73E-02	1.94E+04	1.30E+02	0.9969	0.00105	1	0.001
keno238/heumt.003/hmt003b	6.71E+01	8.06E-02	1.81E+04	1.27E+02	0.9762	0.00087	0.991	0.003
keno238/heumt.003/hmt003c	1.12E+02	8.00E-02	2.34E+02	1.47E-00	0.96808	0.00098	0.9826	0.006
keno238/heumt.003/hmt003d	1.32E+02	8.27E-02	4.90E+01	3.16E-01	0.97501	0.00127	0.9876	0.004
keno238/heumt.003/hmt003e	1.67E+02	6.67E-02	2.83E-00	1.40E-02	0.98934	0.00112	0.993	0.003
keno238/heumt.003/hmt003g	1.51E+02	7.54E-02	9.14E-00	5.16E-02	0.96856	0.00097	0.9889	0.003

Case	AFG	sigma	AELCF	sigma	k_calc	sigma	k_exp	sigma
keno238/heumt.003/hmt003h	1.66E+02	6.87E-02	3.01E-00	1.54E-02	0.97751	0.00106	0.9919	0.003
keno238/heumt.006/case_1	2.10E+02	2.67E-02	8.50E-02	1.70E-04	0.99769	0.00119	1	0.004
keno238/heumt.006/case_10	2.10E+02	2.81E-02	8.24E-02	1.73E-04	1.00684	0.00109	1	0.004
keno238/heumt.006/case_11	2.14E+02	2.31E-02	6.20E-02	1.18E-04	1.00598	0.0011	1	0.004
keno238/heumt.006/case_12	2.16E+02	1.96E-02	5.35E-02	8.83E-05	1.00561	0.00104	1	0.004
keno238/heumt.006/case_13	2.10E+02	2.52E-02	8.29E-02	1.62E-04	1.02842	0.00118	1	0.004
keno238/heumt.006/case_14	2.15E+02	2.04E-02	5.63E-02	9.49E-05	0.99794	0.00103	1	0.004
keno238/heumt.006/case_15	2.15E+02	2.06E-02	5.60E-02	9.80E-05	0.99419	0.00106	1	0.004
keno238/heumt.006/case_16	2.14E+02	2.23E-02	6.29E-02	1.13E-04	1.00521	0.00119	1	0.004
keno238/heumt.006/case_17	2.12E+02	2.55E-02	7.37E-02	1.46E-04	1.00387	0.00106	1	0.004
keno238/heumt.006/case_18	2.11E+02	2.73E-02	7.95E-02	1.68E-04	1.00375	0.00119	1	0.004
keno238/heumt.006/case_19	2.16E+02	2.22E-02	5.21E-02	9.89E-05	0.99379	0.00102	1	0.004
keno238/heumt.006/case_2	2.12E+02	2.56E-02	7.00E-02	1.39E-04	1.00081	0.00105	1	0.004
keno238/heumt.006/case_20	2.13E+02	2.31E-02	6.42E-02	1.21E-04	0.9968	0.00094	1	0.004
keno238/heumt.006/case_21	2.12E+02	2.48E-02	6.93E-02	1.30E-04	0.99808	0.00115	1	0.004
keno238/heumt.006/case_22	2.12E+02	2.55E-02	7.37E-02	1.45E-04	1.00322	0.001	1	0.004
keno238/heumt.006/case_23	2.11E+02	2.52E-02	7.55E-02	1.46E-04	1.00611	0.00086	1	0.004
keno238/heumt.006/case_3	2.14E+02	2.35E-02	6.26E-02	1.17E-04	1.00649	0.00098	1	0.004
keno238/heumt.006/case_4	2.14E+02	2.24E-02	6.12E-02	1.15E-04	0.99486	0.00132	1	0.004
keno238/heumt.006/case_5	2.15E+02	2.02E-02	5.77E-02	9.78E-05	1.00156	0.00098	1	0.004
keno238/heumt.006/case_6	2.15E+02	1.94E-02	5.53E-02	9.41E-05	1.00134	0.00088	1	0.004
keno238/heumt.006/case_7	2.16E+02	2.08E-02	5.35E-02	9.24E-05	0.99826	0.00097	1	0.004
keno238/heumt.006/case_8	2.16E+02	2.02E-02	5.17E-02	8.94E-05	0.99467	0.00107	1	0.004
keno238/heumt.006/case_9	2.16E+02	2.07E-02	5.12E-02	8.89E-05	0.99238	0.00108	1	0.004
keno238/heust.001/case_1	2.10E+02	9.41E-03	8.16E-02	6.96E-05	0.99982	0.00129	1	0.0025
keno238/heust.001/case_10	2.17E+02	4.62E-03	4.58E-02	2.43E-05	0.99287	0.00138	1	0.0025
keno238/heust.001/case_2	1.95E+02	1.92E-02	2.79E-01	4.29E-04	0.99784	0.00129	1	0.0025
keno238/heust.001/case_3	2.10E+02	8.66E-03	8.01E-02	6.82E-05	1.00289	0.00122	1	0.0025
keno238/heust.001/case_4	1.94E+02	1.88E-02	2.98E-01	4.56E-04	1.00024	0.00122	1	0.0025
keno238/heust.001/case_5	2.18E+02	3.88E-03	4.26E-02	1.99E-05	1.00505	0.00113	1	0.0025
keno238/heust.001/case_6	2.17E+02	4.37E-03	4.42E-02	2.20E-05	1.00384	0.0014	1	0.0025
keno238/heust.001/case_7	2.11E+02	8.75E-03	7.72E-02	6.48E-05	1.00245	0.00121	1	0.0025
keno238/heust.001/case_8	2.10E+02	9.11E-03	8.16E-02	6.83E-05	1.00286	0.00142	1	0.0025
keno238/heust.001/case_9	1.94E+02	1.95E-02	2.98E-01	4.64E-04	0.99736	0.00132	1	0.0025
keno238/heust.002/case_1	2.10E+02	8.74E-03	7.97E-02	6.76E-05	1.00567	0.00128	1	0.002
keno238/heust.002/case_10	2.17E+02	4.13E-03	4.37E-02	2.19E-05	1.0087	0.00128	1	0.002
keno238/heust.002/case_11	2.10E+02	8.69E-03	7.95E-02	6.65E-05	1.00419	0.00146	1	0.002
keno238/heust.002/case_12	2.11E+02	8.51E-03	7.76E-02	6.16E-05	1.00902	0.00126	1	0.002
keno238/heust.002/case_13	1.97E+02	1.80E-02	2.49E-01	3.48E-04	1.00353	0.00147	1	0.002
keno238/heust.002/case_14	1.97E+02	1.79E-02	2.32E-01	3.36E-04	1.00902	0.00125	1	0.002

Case	AFG	sigma	AELCF	sigma	k_calc	sigma	k_exp	sigma
keno238/heust.002/case_2	2.11E+02	8.69E-03	7.91E-02	6.57E-05	1.00948	0.00127	1	0.002
keno238/heust.002/case_3	1.96E+02	1.79E-02	2.51E-01	3.65E-04	1.00012	0.00121	1	0.002
keno238/heust.002/case_4	1.97E+02	1.64E-02	2.43E-01	3.33E-04	1.00742	0.00139	1	0.002
keno238/heust.002/case_5	2.10E+02	8.86E-03	7.95E-02	6.57E-05	1.00632	0.00131	1	0.002
keno238/heust.002/case_6	2.11E+02	8.70E-03	7.80E-02	6.54E-05	1.01045	0.00142	1	0.002
keno238/heust.002/case_7	1.97E+02	1.73E-02	2.49E-01	3.49E-04	1.00468	0.00142	1	0.002
keno238/heust.002/case_8	1.97E+02	1.71E-02	2.37E-01	3.25E-04	1.00501	0.00134	1	0.002
keno238/heust.002/case_9	2.17E+02	4.21E-03	4.40E-02	2.27E-05	1.00313	0.00135	1	0.002
keno238/heust.003/case_1	2.17E+02	4.10E-03	4.38E-02	2.11E-05	1.0049	0.00129	1	0.005
keno238/heust.003/case_10	1.96E+02	1.79E-02	2.60E-01	3.69E-04	0.99993	0.00141	1	0.005
keno238/heust.003/case_11	1.97E+02	1.87E-02	2.32E-01	3.47E-04	1.00253	0.00137	1	0.005
keno238/heust.003/case_12	2.17E+02	4.15E-03	4.40E-02	2.20E-05	1.00222	0.00127	1	0.005
keno238/heust.003/case_13	2.17E+02	3.97E-03	4.32E-02	2.03E-05	1.00266	0.00113	1	0.005
keno238/heust.003/case_14	2.17E+02	4.21E-03	4.38E-02	2.22E-05	1.00212	0.00119	1	0.005
keno238/heust.003/case_15	2.17E+02	4.35E-03	4.51E-02	2.16E-05	0.99622	0.00109	1	0.005
keno238/heust.003/case_16	2.10E+02	9.18E-03	8.07E-02	6.99E-05	1.00095	0.00133	1	0.005
keno238/heust.003/case_17	2.11E+02	9.01E-03	7.63E-02	6.47E-05	1.00378	0.00142	1	0.005
keno238/heust.003/case_18	1.96E+02	1.88E-02	2.60E-01	3.75E-04	0.99867	0.00125	1	0.005
keno238/heust.003/case_19	1.98E+02	1.78E-02	2.24E-01	3.13E-04	1.0019	0.00148	1	0.005
keno238/heust.003/case_2	2.17E+02	4.19E-03	4.40E-02	2.25E-05	1.0055	0.00104	1	0.005
keno238/heust.003/case_3	2.10E+02	8.70E-03	8.09E-02	6.76E-05	1.00152	0.00151	1	0.005
keno238/heust.003/case_4	2.11E+02	8.97E-03	7.90E-02	6.61E-05	1.00463	0.00123	1	0.005
keno238/heust.003/case_5	1.96E+02	1.77E-02	2.63E-01	3.70E-04	0.99717	0.00152	1	0.005
keno238/heust.003/case_6	1.97E+02	1.77E-02	2.45E-01	3.51E-04	0.99694	0.00148	1	0.005
keno238/heust.003/case_7	2.17E+02	4.16E-03	4.34E-02	2.08E-05	1.00462	0.00138	1	0.005
keno238/heust.003/case_8	2.10E+02	8.91E-03	8.04E-02	6.55E-05	1.0033	0.00136	1	0.005
keno238/heust.003/case_9	2.11E+02	9.09E-03	7.72E-02	6.62E-05	1.00748	0.00143	1	0.005
keno238/heust.004/hst004a	1.38E+02	6.88E-02	1.34E+01	6.12E-02	1.00371	0.0012	1	0.0065
keno238/heust.004/hst004b	1.61E+02	5.05E-02	2.72E-00	8.86E-03	1.00526	0.00114	1	0.0071
keno238/heust.004/hst004c	1.89E+02	3.08E-02	4.24E-01	9.48E-04	1.00025	0.00139	1	0.0078
keno238/heust.004/hst004d	1.50E+02	6.01E-02	5.64E-00	2.23E-02	0.99861	0.00115	1	0.0091
keno238/heust.004/hst004e	1.75E+02	4.36E-02	1.09E-00	3.18E-03	1.0067	0.00108	1	0.0104
keno238/heust.004/hst004g	1.99E+02	1.94E-02	1.98E-01	2.99E-04	0.99836	0.00114	1	0.0117
keno238/heust.005/hst005a	1.96E+02	2.05E-02	2.47E-01	4.00E-04	1.00062	0.00105	1	0.0124
keno238/heust.005/hst005b	1.96E+02	2.24E-02	2.56E-01	4.38E-04	1.00778	0.00105	1	0.0124
keno238/heust.005/hst005c	1.95E+02	2.22E-02	2.67E-01	4.50E-04	1.00636	0.00105	1	0.0126
keno238/heust.005/hst005d	1.97E+02	1.96E-02	2.26E-01	3.50E-04	1.0025	0.00121	1	0.0124
keno238/heust.005/hst005e	1.92E+02	2.02E-02	3.28E-01	5.25E-04	0.98975	0.00089	1	0.0124
keno238/heust.005/hst005g	1.96E+02	2.08E-02	2.44E-01	3.94E-04	1.00525	0.001	1	0.0125
keno238/heust.005/hst005h	2.06E+02	1.26E-02	1.11E-01	1.24E-04	1.00297	0.00109	1	0.0119

Case	AFG	sigma	AELCF	sigma	k_calc	sigma	k_exp	sigma
keno238/heust.005/hst005i	2.13E+02	8.26E-03	6.23E-02	4.87E-05	1.00594	0.00119	1	0.0121
keno238/heust.006/hst006a	1.99E+02	1.61E-02	2.11E-01	2.70E-04	0.98469	0.00143	0.9973	0.005
keno238/heust.006/hst006b	1.89E+02	1.58E-02	4.38E-01	5.35E-04	1.00256	0.00085	1	0.0087
keno238/heust.006/hst006c	1.96E+02	1.68E-02	2.58E-01	3.46E-04	0.98773	0.0012	0.9986	0.0054
keno238/heust.006/hst006d	1.92E+02	1.52E-02	3.61E-01	4.34E-04	1.0008	0.00072	1	0.0078
keno238/heust.006/hst006e	1.90E+02	1.52E-02	4.06E-01	4.85E-04	1.01075	0.00104	1	0.0091
keno238/heust.006/hst006g	1.93E+02	1.61E-02	3.19E-01	4.00E-04	0.99989	0.00108	1	0.0065
keno238/heust.006/hst006h	1.89E+02	1.59E-02	4.45E-01	5.56E-04	1.00375	0.00072	1	0.0088
keno238/heust.007/case_1	2.16E+02	4.93E-03	4.70E-02	2.60E-05	1.01325	0.00113	1	0.0035
keno238/heust.007/case_10	2.15E+02	5.55E-03	5.26E-02	3.27E-05	1.01692	0.0012	1	0.0035
keno238/heust.007/case_11	1.96E+02	1.82E-02	2.58E-01	3.67E-04	1.00742	0.00144	1	0.0035
keno238/heust.007/case_12	2.16E+02	5.57E-03	5.08E-02	3.06E-05	1.01688	0.00115	1	0.0035
keno238/heust.007/case_13	1.97E+02	1.77E-02	2.33E-01	3.23E-04	1.01163	0.00119	1	0.0035
keno238/heust.007/case_14	1.97E+02	1.80E-02	2.40E-01	3.43E-04	1.0099	0.00118	1	0.0035
keno238/heust.007/case_15	1.97E+02	1.84E-02	2.42E-01	3.47E-04	1.00849	0.00117	1	0.0035
keno238/heust.007/case_16	1.96E+02	1.92E-02	2.56E-01	3.83E-04	1.0094	0.00106	1	0.0035
keno238/heust.007/case_17	1.97E+02	1.91E-02	2.41E-01	3.62E-04	1.01066	0.00123	1	0.0035
keno238/heust.007/case_2	1.96E+02	1.95E-02	2.69E-01	4.09E-04	1.01324	0.00121	1	0.005
keno238/heust.007/case_3	2.17E+02	4.36E-03	4.58E-02	2.27E-05	1.01137	0.0011	1	0.0035
keno238/heust.007/case_4	1.97E+02	1.81E-02	2.39E-01	3.42E-04	1.01219	0.00113	1	0.0035
keno238/heust.007/case_5	2.16E+02	4.98E-03	5.00E-02	2.65E-05	1.00679	0.00117	1	0.0035
keno238/heust.007/case_6	1.95E+02	1.77E-02	2.74E-01	3.91E-04	1.00436	0.00113	1	0.0035
keno238/heust.007/case_7	2.16E+02	5.03E-03	4.93E-02	2.77E-05	1.00631	0.00123	1	0.0035
keno238/heust.007/case_8	1.95E+02	1.88E-02	2.71E-01	3.99E-04	1.00375	0.00142	1	0.0035
keno238/heust.007/case_9	2.16E+02	5.38E-03	5.09E-02	3.02E-05	1.00835	0.00098	1	0.0035
keno238/heust.008/case_1	2.17E+02	4.24E-03	4.42E-02	2.19E-05	0.99836	0.00097	1	0.003
keno238/heust.008/case_10	1.97E+02	1.87E-02	2.33E-01	3.50E-04	0.9958	0.00128	1	0.003
keno238/heust.008/case_11	2.18E+02	4.20E-03	4.22E-02	2.13E-05	1.00152	0.00096	1	0.003
keno238/heust.008/case_12	1.99E+02	1.80E-02	2.04E-01	2.96E-04	0.99676	0.00113	1	0.003
keno238/heust.008/case_13	1.97E+02	1.77E-02	2.32E-01	3.26E-04	0.99927	0.00136	1	0.003
keno238/heust.008/case_14	1.99E+02	1.97E-02	2.09E-01	3.26E-04	0.99577	0.00112	1	0.003
keno238/heust.008/case_2	1.97E+02	1.87E-02	2.36E-01	3.53E-04	0.99692	0.00102	1	0.003
keno238/heust.008/case_3	2.17E+02	4.00E-03	4.29E-02	1.99E-05	0.99756	0.00094	1	0.003
keno238/heust.008/case_4	1.99E+02	1.80E-02	2.09E-01	3.01E-04	0.9986	0.00134	1	0.003
keno238/heust.008/case_5	2.17E+02	4.32E-03	4.40E-02	2.21E-05	0.9986	0.00114	1	0.003
keno238/heust.008/case_6	1.96E+02	1.81E-02	2.56E-01	3.62E-04	0.99951	0.00129	1	0.003
keno238/heust.008/case_7	2.17E+02	4.15E-03	4.32E-02	2.17E-05	0.99933	0.00106	1	0.003
keno238/heust.008/case_8	1.97E+02	1.84E-02	2.44E-01	3.57E-04	0.99738	0.00133	1	0.003
keno238/heust.008/case_9	2.17E+02	4.14E-03	4.38E-02	2.23E-05	1.00086	0.00095	1	0.003
keno238/heust.009/hst009a	1.87E+02	2.68E-02	5.28E-01	1.02E-03	1.00326	0.00124	1	0.0057

Case	AFG	sigma	AELCF	sigma	k_calc	sigma	k_exp	sigma
keno238/heust.009/hst009b	2.02E+02	1.61E-02	1.60E-01	2.14E-04	1.00054	0.00124	1	0.0057
keno238/heust.009/hst009c	1.93E+02	2.36E-02	3.23E-01	5.89E-04	1.00374	0.00121	1	0.0057
keno238/heust.009/hst009d	2.09E+02	1.17E-02	9.11E-02	9.65E-05	0.99824	0.00149	1	0.0057
keno238/heust.010/hst010e	2.15E+02	5.76E-03	5.24E-02	3.22E-05	1.00306	0.00119	1	0.0018
keno238/heust.010/hst010g	2.15E+02	6.43E-03	5.31E-02	3.59E-05	1.00121	0.00109	1	0.0018
keno238/heust.010/hst010h	2.15E+02	6.27E-03	5.52E-02	3.59E-05	1.00325	0.00118	1	0.0018
keno238/heust.010/hst010i	2.15E+02	6.68E-03	5.62E-02	3.84E-05	0.99967	0.00107	1	0.0018
keno238/heust.011/hst011c	2.18E+02	3.66E-03	3.96E-02	1.87E-05	1.00785	0.00102	1	0.002
keno238/heust.011/hst011d	2.18E+02	3.45E-03	3.94E-02	1.70E-05	1.00248	0.00101	1	0.002
keno238/heust.012/hst012b	2.21E+02	1.78E-03	3.24E-02	9.24E-06	1.00232	0.00073	0.9999	0.0058
keno238/heust.013/hst013e	2.21E+02	1.67E-03	3.23E-02	8.82E-06	1.00013	0.00081	1.0012	0.0026
keno238/heust.013/hst013g	2.20E+02	1.90E-03	3.38E-02	9.94E-06	0.9991	0.00104	1.0007	0.0036
keno238/heust.013/hst013h	2.20E+02	2.21E-03	3.52E-02	1.13E-05	0.99531	0.00082	1.0009	0.0036
keno238/heust.013/hst013i	2.19E+02	2.32E-03	3.59E-02	1.18E-05	0.99653	0.00086	1.0003	0.0036
keno238/heust.014/case_1	2.17E+02	4.71E-03	4.56E-02	2.43E-05	0.99682	0.00107	1	0.0028
keno238/heust.014/case_2	2.16E+02	4.20E-03	4.72E-02	2.33E-05	1.01494	0.00102	1	0.0052
keno238/heust.014/case_3	2.16E+02	4.15E-03	4.92E-02	2.45E-05	1.02365	0.00093	1	0.0087
keno238/heust.015/case_1	2.14E+02	6.22E-03	5.74E-02	3.65E-05	0.99875	0.00131	1	0.0032
keno238/heust.015/case_2	2.15E+02	6.25E-03	5.57E-02	3.64E-05	0.99072	0.00115	1	0.0034
keno238/heust.015/case_3	2.13E+02	5.84E-03	6.26E-02	3.72E-05	1.01173	0.00104	1	0.0068
keno238/heust.015/case_4	2.14E+02	6.05E-03	6.05E-02	3.78E-05	1.01776	0.00103	1	0.0069
keno238/heust.015/case_5	2.13E+02	5.50E-03	6.52E-02	3.75E-05	1.01442	0.00085	1	0.0089
keno238/heust.016/case_1	2.11E+02	9.34E-03	7.84E-02	6.91E-05	0.99042	0.00127	1	0.0036
keno238/heust.016/case_2	2.10E+02	7.92E-03	8.23E-02	6.12E-05	1.0094	0.00111	1	0.0069
keno238/heust.016/case_3	2.09E+02	7.83E-03	9.15E-02	6.38E-05	1.03006	0.00089	1	0.0079
keno238/heust.017/case_1	2.08E+02	1.11E-02	9.79E-02	9.51E-05	0.99199	0.00126	1	0.0028
keno238/heust.017/case_2	2.07E+02	1.11E-02	1.08E-01	1.05E-04	0.9814	0.00159	1	0.004
keno238/heust.017/case_3	2.08E+02	1.21E-02	1.02E-01	1.07E-04	0.98022	0.00126	1	0.0036
keno238/heust.017/case_4	2.07E+02	1.03E-02	1.05E-01	9.77E-05	1.00028	0.0011	1	0.0047
keno238/heust.017/case_5	2.07E+02	1.03E-02	1.11E-01	1.04E-04	1.00877	0.00107	1	0.0058
keno238/heust.017/case_6	2.05E+02	1.03E-02	1.28E-01	1.17E-04	1.00619	0.00101	1	0.0055
keno238/heust.017/case_7	2.06E+02	1.07E-02	1.19E-01	1.10E-04	1.00987	0.00102	1	0.0057
keno238/heust.017/case_8	2.04E+02	1.08E-02	1.36E-01	1.28E-04	1.0059	0.00102	1	0.0067
keno238/heust.018/case_1	2.02E+02	1.57E-02	1.61E-01	2.09E-04	0.99072	0.00123	1	0.0034
keno238/heust.018/case_10	1.96E+02	1.43E-02	2.77E-01	3.14E-04	1.02573	0.001	1	0.0057
keno238/heust.018/case_11	1.97E+02	1.32E-02	2.48E-01	2.58E-04	1.02842	0.00113	1	0.0059
keno238/heust.018/case_12	1.96E+02	1.32E-02	2.74E-01	2.86E-04	1.02249	0.0008	1	0.0065
keno238/heust.018/case_2	2.00E+02	1.66E-02	1.88E-01	2.57E-04	0.98288	0.00134	1	0.0046
keno238/heust.018/case_3	2.01E+02	1.50E-02	1.71E-01	2.15E-04	0.9902	0.00147	1	0.0042
keno238/heust.018/case_4	2.01E+02	1.42E-02	1.80E-01	2.08E-04	0.99888	0.00111	1	0.0044

Case	AFG	sigma	AELCF	sigma	k_calc	sigma	k_exp	sigma
keno238/heust.018/case_5	1.98E+02	1.44E-02	2.25E-01	2.60E-04	0.99636	0.00127	1	0.0046
keno238/heust.018/case_6	1.99E+02	1.52E-02	2.05E-01	2.53E-04	0.99399	0.00104	1	0.0045
keno238/heust.018/case_7	2.00E+02	1.35E-02	2.01E-01	2.22E-04	1.01211	0.001	1	0.0058
keno238/heust.018/case_8	1.97E+02	1.53E-02	2.46E-01	3.03E-04	1.01196	0.00093	1	0.0056
keno238/heust.018/case_9	1.98E+02	1.43E-02	2.22E-01	2.57E-04	1.01117	0.00096	1	0.0056
keno238/heust.019/case_1	1.94E+02	2.15E-02	3.15E-01	5.34E-04	0.99939	0.0011	1	0.0041
keno238/heust.019/case_2	1.95E+02	1.99E-02	2.95E-01	4.56E-04	1.00263	0.00105	1	0.0041
keno238/heust.019/case_3	1.92E+02	1.86E-02	3.51E-01	5.04E-04	0.99913	0.00105	1	0.0067
keno238/heust.020/hst020g	1.72E+02	2.85E-02	1.36E-00	2.62E-03	1.00619	0.00136	0.9966	0.0116
keno238/heust.020/hst020h	1.90E+02	2.22E-02	3.97E-01	6.37E-04	1.00957	0.0014	0.9956	0.0093
keno238/heust.020/hst020i	2.04E+02	1.39E-02	1.34E-01	1.58E-04	1.01668	0.0014	0.9957	0.0079
keno238/heust.020/hst020j	2.04E+02	1.34E-02	1.34E-01	1.50E-04	1.01671	0.00142	0.9955	0.0078
keno238/heust.020/hst020k	2.14E+02	6.86E-03	5.79E-02	4.15E-05	1.02228	0.00116	0.9959	0.0077
keno238/heust.021/hst021h	1.93E+02	2.10E-02	3.22E-01	5.25E-04	1.00349	0.00121	0.9975	0.0054
keno238/heust.021/hst021i	1.98E+02	2.00E-02	2.16E-01	3.38E-04	1.0105	0.00122	0.9975	0.0054
keno238/heust.021/hst021j	1.93E+02	1.97E-02	3.32E-01	5.05E-04	0.99427	0.00131	0.9978	0.0054
keno238/heust.021/hst021k	1.95E+02	1.77E-02	2.86E-01	4.08E-04	1.01397	0.00143	0.9978	0.0054
keno238/heust.021/hst021l	1.93E+02	1.99E-02	3.29E-01	5.16E-04	0.99489	0.00113	0.9978	0.0054
keno238/heust.021/hst021m	1.96E+02	2.04E-02	2.69E-01	4.29E-04	0.99912	0.00122	0.9978	0.0054
keno238/heust.025/case_1	2.18E+02	3.38E-03	4.01E-02	1.77E-05	1.00148	0.00096	1.0002	0.0025
keno238/heust.025/case_10	2.12E+02	9.62E-03	7.01E-02	6.28E-05	1.0135	0.00097	1.0003	0.0043
keno238/heust.025/case_11	2.12E+02	1.07E-02	7.11E-02	6.90E-05	1.01263	0.00083	1.0002	0.0045
keno238/heust.025/case_12	2.09E+02	1.28E-02	8.76E-02	1.01E-04	1.01107	0.00081	1.0002	0.0045
keno238/heust.025/case_13	2.09E+02	1.40E-02	8.88E-02	1.13E-04	1.0189	0.00087	1.0009	0.0047
keno238/heust.025/case_14	2.06E+02	1.92E-02	1.18E-01	1.91E-04	1.01054	0.0008	1.0008	0.0053
keno238/heust.025/case_15	2.06E+02	2.05E-02	1.13E-01	1.95E-04	1.0053	0.00093	1.0002	0.0058
keno238/heust.025/case_16	2.00E+02	2.55E-02	1.84E-01	3.77E-04	1.01688	0.00084	1	0.0049
keno238/heust.025/case_17	2.01E+02	2.99E-02	1.71E-01	4.19E-04	1.00844	0.00098	1	0.0055
keno238/heust.025/case_18	2.01E+02	2.90E-02	1.60E-01	3.71E-04	1.00468	0.0009	1	0.0061
keno238/heust.025/case_2	2.18E+02	3.42E-03	4.02E-02	1.71E-05	1.0028	0.00108	1.0007	0.0025
keno238/heust.025/case_3	2.18E+02	3.45E-03	4.22E-02	1.78E-05	0.99786	0.00116	1.0002	0.0064
keno238/heust.025/case_4	2.18E+02	3.48E-03	4.10E-02	1.77E-05	1.00214	0.00123	1.0003	0.0027
keno238/heust.025/case_5	2.16E+02	5.09E-03	4.84E-02	2.78E-05	1.00558	0.00122	1.0013	0.003
keno238/heust.025/case_6	2.18E+02	3.35E-03	4.25E-02	1.75E-05	1.01187	0.0008	1.0002	0.0067
keno238/heust.025/case_7	2.17E+02	4.89E-03	4.67E-02	2.54E-05	1.01496	0.00075	1.0009	0.0073
keno238/heust.025/case_8	2.16E+02	4.89E-03	4.82E-02	2.61E-05	1.01381	0.00099	1	0.0067
keno238/heust.025/case_9	2.15E+02	6.54E-03	5.49E-02	3.70E-05	1.00901	0.0009	1.0002	0.0065
keno238/heust.027/case_1	2.11E+02	2.96E-03	7.40E-02	1.99E-05	0.99904	0.00038	1	0.0046
keno238/heust.027/case_2	2.11E+02	2.82E-03	7.48E-02	2.05E-05	0.9998	0.00045	1	0.0043
keno238/heust.027/case_3	2.11E+02	2.63E-03	7.50E-02	1.87E-05	0.99996	0.00039	1	0.0037

Case	AFG	sigma	AELCF	sigma	k_calc	sigma	k_exp	sigma
keno238/heust.027/case_4	2.11E+02	2.77E-03	7.53E-02	2.00E-05	1.00134	0.00042	1	0.0037
keno238/heust.027/case_5	2.11E+02	2.93E-03	7.56E-02	2.15E-05	0.99915	0.00038	1	0.0044
keno238/heust.027/case_6	2.11E+02	2.73E-03	7.46E-02	1.88E-05	0.99406	0.00037	1	0.0043
keno238/heust.027/case_7	2.11E+02	8.21E-03	7.47E-02	5.91E-05	1.00159	0.00129	1	0.0038
keno238/heust.027/case_8	2.11E+02	8.33E-03	7.47E-02	5.91E-05	1.00216	0.00129	1	0.0035
keno238/heust.027/case_9	2.11E+02	2.79E-03	7.48E-02	2.06E-05	1.00001	0.00037	1	0.0039
keno238/heust.028/hst028a	2.17E+02	4.72E-03	4.68E-02	2.61E-05	0.99816	0.00115	1	0.0023
keno238/heust.028/hst028b	2.16E+02	5.29E-03	4.73E-02	2.69E-05	0.999	0.00113	1	0.0034
keno238/heust.028/hst028c	2.17E+02	4.88E-03	4.69E-02	2.63E-05	0.99857	0.00125	1	0.0026
keno238/heust.028/hst028d	2.16E+02	5.09E-03	4.73E-02	2.64E-05	1.00006	0.00116	1	0.0028
keno238/heust.028/hst028e	2.17E+02	4.78E-03	4.70E-02	2.57E-05	0.99521	0.00109	1	0.0031
keno238/heust.028/hst028g	2.16E+02	5.00E-03	4.74E-02	2.64E-05	0.99818	0.00117	1	0.0023
keno238/heust.028/hst028h	2.16E+02	4.47E-03	4.72E-02	2.47E-05	0.99884	0.00111	1	0.0038
keno238/heust.028/hst028i	2.16E+02	4.79E-03	4.74E-02	2.69E-05	0.99968	0.00107	1	0.0027
keno238/heust.028/hst028j	2.03E+02	1.39E-02	1.45E-01	1.71E-04	0.99678	0.0012	1	0.0049
keno238/heust.028/hst028k	2.03E+02	1.54E-02	1.47E-01	1.88E-04	0.99533	0.00116	1	0.0053
keno238/heust.028/hst028l	2.03E+02	1.41E-02	1.46E-01	1.78E-04	0.9986	0.00129	1	0.0051
keno238/heust.028/hst028m	2.03E+02	1.46E-02	1.49E-01	1.91E-04	0.99563	0.00119	1	0.0046
keno238/heust.028/hst028n	2.03E+02	1.50E-02	1.49E-01	1.83E-04	0.99822	0.00125	1	0.0058
keno238/heust.028/hst028p	2.03E+02	1.46E-02	1.52E-01	1.87E-04	0.9955	0.00113	1	0.0046
keno238/heust.028/hst028q	2.03E+02	1.37E-02	1.51E-01	1.70E-04	1.00355	0.00129	1	0.0064
keno238/heust.028/hst028r	2.03E+02	1.54E-02	1.53E-01	1.95E-04	0.99966	0.00112	1	0.0052
keno238/heust.028/hst028s	2.03E+02	1.44E-02	1.53E-01	1.83E-04	0.99623	0.00122	1	0.0066
keno238/heust.028/hst028u	2.03E+02	1.50E-02	1.55E-01	1.96E-04	0.99754	0.00142	1	0.006
keno238/heust.029/hst029a	2.02E+02	1.51E-02	1.58E-01	1.96E-04	0.99819	0.00142	1	0.0066
keno238/heust.029/hst029b	2.02E+02	1.53E-02	1.57E-01	1.97E-04	1.0052	0.00119	1	0.0058
keno238/heust.029/hst029c	2.02E+02	1.56E-02	1.60E-01	2.04E-04	0.99533	0.00114	1	0.0068
keno238/heust.029/hst029d	2.01E+02	1.71E-02	1.67E-01	2.33E-04	0.99207	0.00115	1	0.0074
keno238/heust.029/hst029e	2.01E+02	1.56E-02	1.70E-01	2.18E-04	0.99916	0.00133	1	0.0067
keno238/heust.029/hst029g	2.01E+02	1.67E-02	1.70E-01	2.33E-04	0.9992	0.00124	1	0.0065
keno238/heust.029/hst029h	2.01E+02	1.51E-02	1.68E-01	2.09E-04	1.00176	0.00133	1	0.0063
keno238/heust.030/hst030a	2.16E+02	5.05E-03	4.74E-02	2.68E-05	0.999	0.00108	1	0.0039
keno238/heust.030/hst030b	2.16E+02	5.10E-03	4.81E-02	2.71E-05	1.00047	0.00117	1	0.0032
keno238/heust.030/hst030c	2.16E+02	5.10E-03	4.84E-02	2.73E-05	0.99873	0.00115	1	0.0031
keno238/heust.030/hst030d	2.02E+02	1.56E-02	1.59E-01	2.10E-04	1.00129	0.00116	1	0.0064
keno238/heust.030/hst030e	2.02E+02	1.54E-02	1.60E-01	1.99E-04	0.99798	0.00112	1	0.0058
keno238/heust.030/hst030g	2.02E+02	1.51E-02	1.61E-01	1.99E-04	0.99864	0.00113	1	0.0059
keno238/heust.030/hst030h	2.02E+02	1.47E-02	1.66E-01	2.06E-04	0.99885	0.00118	1	0.0064
keno238/heust.031/hst031a	2.02E+02	1.60E-02	1.64E-01	2.13E-04	0.99762	0.00116	1	0.0046
keno238/heust.031/hst031b	2.01E+02	1.70E-02	1.75E-01	2.41E-04	0.99886	0.00114	1	0.0058

Case	AFG	sigma	AELCF	sigma	k_calc	sigma	k_exp	sigma
keno238/heust.031/hst031c	2.01E+02	1.64E-02	1.70E-01	2.33E-04	0.99885	0.00121	1	0.0058
keno238/heust.031/hst031d	2.00E+02	1.78E-02	1.90E-01	2.73E-04	0.99486	0.0011	1	0.0068
keno238/heust.032/hst032b	2.21E+02	1.31E-03	3.07E-02	6.94E-06	1.00101	0.00066	1.0015	0.0026
keno238/heust.033-simple/case_02a	1.94E+02	1.95E-02	3.10E-01	4.77E-04	1.00023	0.00118	0.9979	0.0112
keno238/heust.033-simple/case_02b	1.93E+02	1.96E-02	3.18E-01	4.90E-04	1	0.00128	1	0.0109
keno238/heust.033-simple/case_02c	1.93E+02	1.91E-02	3.23E-01	4.76E-04	0.99873	0.00099	0.9979	0.0067
keno238/heust.033-simple/case_03a	1.94E+02	1.81E-02	2.94E-01	4.16E-04	0.99942	0.00111	0.9942	0.0115
keno238/heust.033-simple/case_03b	1.94E+02	1.80E-02	2.93E-01	4.22E-04	1.00393	0.00111	0.9979	0.0112
keno238/heust.033-simple/case_03c	1.95E+02	1.86E-02	2.74E-01	4.00E-04	1.01165	0.00097	0.9979	0.0072
keno238/heust.033-simple/case_04a	1.94E+02	1.89E-02	3.12E-01	4.71E-04	1.00245	0.00107	0.9942	0.0115
keno238/heust.033-simple/case_04b	1.93E+02	1.91E-02	3.19E-01	4.79E-04	1.00806	0.00112	0.9979	0.0112
keno238/heust.033-simple/case_05a	1.94E+02	1.93E-02	3.10E-01	4.74E-04	1.00832	0.00112	0.9942	0.0112
keno238/heust.033-simple/case_05b	1.93E+02	1.87E-02	3.18E-01	4.66E-04	1.00748	0.00125	1	0.0109
keno238/heust.033-simple/case_06a	1.94E+02	1.85E-02	3.10E-01	4.59E-04	1.00413	0.00114	0.9942	0.0112
keno238/heust.033-simple/case_06b	1.93E+02	1.97E-02	3.17E-01	4.94E-04	1.00926	0.00121	1	0.0109
keno238/heust.033-simple/case_07a	1.94E+02	1.94E-02	3.09E-01	4.68E-04	1.00075	0.00119	0.9942	0.0112
keno238/heust.033-simple/case_07b	1.93E+02	1.81E-02	3.15E-01	4.38E-04	1.00375	0.00116	1	0.0109
keno238/heust.033-simple/case_08a	1.93E+02	1.95E-02	3.13E-01	4.73E-04	1.00001	0.00114	0.9942	0.0112
keno238/heust.033-simple/case_08b	1.93E+02	1.85E-02	3.19E-01	4.72E-04	1.00652	0.00109	1	0.0109
keno238/heust.033-simple/case_09a	1.94E+02	1.96E-02	3.09E-01	4.78E-04	0.99698	0.00122	0.9942	0.0112
keno238/heust.033-simple/case_09b	1.93E+02	1.85E-02	3.15E-01	4.58E-04	0.99746	0.00107	1	0.0109
keno238/heust.033-simple/case_09c	1.94E+02	1.93E-02	3.06E-01	4.55E-04	0.99457	0.00111	0.9979	0.0105
keno238/heust.033-simple/case_10a	1.94E+02	1.87E-02	2.95E-01	4.36E-04	1.00075	0.00118	0.9942	0.0115
keno238/heust.033-simple/case_10c	1.95E+02	1.91E-02	2.77E-01	4.05E-04	1.00272	0.00105	0.9979	0.0072
keno238/heust.033-simple/case_10d	1.94E+02	2.07E-02	3.00E-01	4.84E-04	0.99377	0.00117	0.9979	0.0106
keno238/heust.033-simple/case_11a	1.94E+02	1.86E-02	2.90E-01	4.26E-04	0.99748	0.00106	0.9942	0.0112
keno238/heust.033-simple/case_11b	1.95E+02	1.84E-02	2.87E-01	4.13E-04	0.99987	0.00124	0.9979	0.0109
keno238/heust.033-simple/case_12a	1.94E+02	1.80E-02	3.05E-01	4.30E-04	0.99929	0.0011	0.9942	0.0112
keno238/heust.033-simple/case_12b	1.94E+02	1.89E-02	3.08E-01	4.61E-04	1.00059	0.00121	1	0.0109
keno238/heust.035/hst035a	2.19E+02	2.86E-03	3.70E-02	1.49E-05	1.0043	0.00087	1	0.0031
keno238/heust.035/hst035b	2.19E+02	2.99E-03	3.72E-02	1.44E-05	1.00552	0.00092	1	0.0032
keno238/heust.035/hst035c	2.19E+02	2.97E-03	3.72E-02	1.44E-05	1.00655	0.00086	1	0.003
keno238/heust.035/hst035d	2.19E+02	2.87E-03	3.70E-02	1.39E-05	1.00663	0.00088	1	0.003
keno238/heust.035/hst035e	2.16E+02	5.33E-03	4.89E-02	2.96E-05	1.00477	0.00103	1	0.0033
keno238/heust.035/hst035g	2.16E+02	5.31E-03	4.95E-02	3.01E-05	1.0071	0.00106	1	0.0029
keno238/heust.035/hst035h	2.10E+02	8.86E-03	8.02E-02	6.61E-05	1.00413	0.00109	1	0.0035
keno238/heust.035/hst035i	2.10E+02	9.56E-03	8.35E-02	7.51E-05	1.00207	0.00132	1	0.0038
keno238/heust.035/hst035j	2.10E+02	9.83E-03	8.25E-02	7.33E-05	1.00344	0.00118	1	0.0041
keno238/heust.036/hst036a	2.15E+02	6.02E-03	5.56E-02	3.66E-05	0.99619	0.00112	0.9974	0.0045
keno238/heust.036/hst036b	2.14E+02	6.36E-03	5.78E-02	3.74E-05	1.00008	0.00124	0.9979	0.0039

Case	AFG	sigma	AELCF	sigma	k_calc	sigma	k_exp	sigma
keno238/heust.036/hst036c	2.13E+02	7.22E-03	6.05E-02	4.32E-05	0.99706	0.00126	0.9993	0.0044
keno238/heust.036/hst036d	2.13E+02	7.46E-03	6.28E-02	4.57E-05	0.99964	0.00109	1	0.0062
keno238/heust.037/hst037a	2.19E+02	3.02E-03	3.79E-02	1.47E-05	1.01151	0.00105	0.998	0.0034
keno238/heust.037/hst037b	2.19E+02	3.87E-03	3.89E-02	1.67E-05	1.00335	0.00096	0.999	0.0035
keno238/heust.037/hst037c	2.17E+02	4.04E-03	4.38E-02	2.22E-05	1.00809	0.00105	0.997	0.0042
keno238/heust.037/hst037d	2.17E+02	4.92E-03	4.50E-02	2.42E-05	1.00894	0.00104	0.998	0.0035
keno238/heust.037/hst037e	2.17E+02	5.50E-03	4.55E-02	2.63E-05	1.00635	0.00104	0.998	0.0042
keno238/heust.037/hst037g	2.16E+02	5.51E-03	5.08E-02	3.04E-05	1.01374	0.00129	0.996	0.0051
keno238/heust.037/hst037h	2.15E+02	6.29E-03	5.24E-02	3.37E-05	1.01342	0.00115	0.998	0.0034
keno238/heust.037/hst037i	2.15E+02	6.85E-03	5.31E-02	3.61E-05	1.00632	0.00126	0.998	0.004
keno238/heust.037/hst037j	2.15E+02	7.97E-03	5.40E-02	3.84E-05	1.00572	0.00127	0.998	0.0047
keno238/leuct.001/case_1	2.09E+02	2.05E-02	9.88E-02	1.86E-04	0.99462	0.0008	0.9998	0.0031
keno238/leuct.001/case_2	2.09E+02	2.02E-02	9.77E-02	1.81E-04	0.99464	0.00079	0.9998	0.0031
keno238/leuct.001/case_3	2.09E+02	2.01E-02	9.68E-02	1.76E-04	0.99251	0.00088	0.9998	0.0031
keno238/leuct.001/case_4	2.09E+02	2.12E-02	9.78E-02	1.89E-04	0.99282	0.0009	0.9998	0.0031
keno238/leuct.001/case_5	2.09E+02	1.99E-02	9.61E-02	1.72E-04	0.99198	0.0009	0.9998	0.0031
keno238/leuct.001/case_6	2.09E+02	1.96E-02	9.76E-02	1.75E-04	0.9927	0.00095	0.9998	0.0031
keno238/leuct.001/case_7	2.09E+02	1.99E-02	9.54E-02	1.74E-04	0.99302	0.00094	0.9998	0.0031
keno238/leuct.001/case_8	2.09E+02	2.05E-02	9.64E-02	1.79E-04	0.99317	0.00085	0.9998	0.0031
keno238/leuct.002/case_1	2.07E+02	2.22E-02	1.16E-01	2.26E-04	0.99313	0.00095	0.9997	0.002
keno238/leuct.002/case_2	2.07E+02	2.17E-02	1.15E-01	2.24E-04	0.99659	0.001	0.9997	0.002
keno238/leuct.002/case_3	2.07E+02	2.18E-02	1.16E-01	2.20E-04	0.99443	0.00089	0.9997	0.002
keno238/leuct.002/case_4	2.08E+02	2.14E-02	1.14E-01	2.15E-04	0.99222	0.00101	0.9997	0.002
keno238/leuct.002/case_5	2.08E+02	2.31E-02	1.13E-01	2.26E-04	0.99262	0.00115	0.9997	0.002
keno238/leuct.003/case_1	2.02E+02	2.61E-02	1.78E-01	4.02E-04	0.98246	0.00093	1	0.0039
keno238/leuct.003/case_10	2.03E+02	2.53E-02	1.67E-01	3.65E-04	0.97622	0.00091	1	0.0039
keno238/leuct.003/case_11	2.04E+02	2.59E-02	1.50E-01	3.36E-04	0.97878	0.00097	1	0.0039
keno238/leuct.003/case_12	2.04E+02	2.65E-02	1.55E-01	3.64E-04	0.97602	0.0009	1	0.0039
keno238/leuct.003/case_13	2.04E+02	2.65E-02	1.54E-01	3.58E-04	0.98346	0.00092	1	0.0039
keno238/leuct.003/case_14	2.04E+02	2.53E-02	1.54E-01	3.50E-04	0.97766	0.0009	1	0.0039
keno238/leuct.003/case_15	2.04E+02	2.50E-02	1.55E-01	3.43E-04	0.98011	0.00096	1	0.0039
keno238/leuct.003/case_16	2.03E+02	2.49E-02	1.58E-01	3.49E-04	0.98168	0.00093	1	0.0039
keno238/leuct.003/case_17	2.03E+02	2.73E-02	1.59E-01	3.82E-04	0.97774	0.00111	1	0.0039
keno238/leuct.003/case_18	2.03E+02	2.65E-02	1.61E-01	3.77E-04	0.97974	0.00093	1	0.0039
keno238/leuct.003/case_19	2.03E+02	2.62E-02	1.62E-01	3.74E-04	0.97964	0.00103	1	0.0039
keno238/leuct.003/case_2	2.02E+02	2.52E-02	1.78E-01	3.96E-04	0.98209	0.00088	1	0.0039
keno238/leuct.003/case_20	2.02E+02	2.70E-02	1.72E-01	4.05E-04	0.98077	0.00094	1	0.0039
keno238/leuct.003/case_21	2.03E+02	2.62E-02	1.68E-01	3.86E-04	0.97881	0.00092	1	0.0039
keno238/leuct.003/case_22	2.03E+02	2.57E-02	1.62E-01	3.63E-04	0.98988	0.00098	1	0.0039
keno238/leuct.003/case_3	2.02E+02	2.62E-02	1.78E-01	4.17E-04	0.98458	0.00081	1	0.0039

Case	AFG	sigma	AELCF	sigma	k_calc	sigma	k_exp	sigma
keno238/leuct.003/case_4	2.02E+02	2.67E-02	1.79E-01	4.20E-04	0.98333	0.00079	1	0.0039
keno238/leuct.003/case_5	2.02E+02	2.71E-02	1.79E-01	4.28E-04	0.98229	0.00084	1	0.0039
keno238/leuct.003/case_6	2.04E+02	2.50E-02	1.54E-01	3.45E-04	0.98089	0.00102	1	0.0039
keno238/leuct.003/case_7	2.03E+02	2.62E-02	1.65E-01	3.80E-04	0.98501	0.00086	1	0.0039
keno238/leuct.003/case_8	2.03E+02	2.62E-02	1.58E-01	3.62E-04	0.98575	0.00091	1	0.0039
keno238/leuct.003/case_9	2.03E+02	2.45E-02	1.59E-01	3.44E-04	0.97818	0.00101	1	0.0039
keno238/leuct.004/case_1	1.96E+02	3.16E-02	3.01E-01	7.80E-04	0.986	0.00105	0.9998	0.0033
keno238/leuct.004/case_10	1.97E+02	3.12E-02	2.82E-01	7.24E-04	0.98916	0.00105	0.9998	0.0035
keno238/leuct.004/case_11	2.00E+02	2.78E-02	2.16E-01	5.09E-04	0.98122	0.00097	0.9998	0.0035
keno238/leuct.004/case_12	1.99E+02	2.96E-02	2.32E-01	5.82E-04	0.97513	0.00101	0.9998	0.0035
keno238/leuct.004/case_13	1.98E+02	3.03E-02	2.43E-01	6.06E-04	0.98301	0.00107	0.9998	0.0035
keno238/leuct.004/case_14	1.98E+02	3.04E-02	2.42E-01	6.15E-04	0.98267	0.00111	0.9998	0.0035
keno238/leuct.004/case_15	1.98E+02	2.96E-02	2.41E-01	5.92E-04	0.9829	0.00103	0.9998	0.0035
keno238/leuct.004/case_16	1.98E+02	2.91E-02	2.44E-01	5.99E-04	0.98202	0.00123	0.9998	0.0035
keno238/leuct.004/case_17	1.98E+02	3.00E-02	2.46E-01	6.20E-04	0.9848	0.00085	0.9998	0.0035
keno238/leuct.004/case_18	1.98E+02	3.05E-02	2.47E-01	6.37E-04	0.9839	0.00104	0.9998	0.0035
keno238/leuct.004/case_19	1.98E+02	2.93E-02	2.51E-01	6.13E-04	0.98182	0.001	0.9998	0.0035
keno238/leuct.004/case_2	1.96E+02	2.99E-02	3.02E-01	7.56E-04	0.98517	0.00119	0.9998	0.0033
keno238/leuct.004/case_20	1.99E+02	2.96E-02	2.30E-01	5.64E-04	0.97991	0.00115	0.9998	0.0035
keno238/leuct.004/case_3	1.96E+02	3.11E-02	3.01E-01	7.76E-04	0.98662	0.00094	0.9998	0.0033
keno238/leuct.004/case_4	1.96E+02	3.19E-02	3.02E-01	8.06E-04	0.98845	0.00096	0.9998	0.0033
keno238/leuct.004/case_5	2.01E+02	2.70E-02	2.04E-01	4.60E-04	0.9867	0.001	0.9998	0.0033
keno238/leuct.004/case_6	1.98E+02	3.03E-02	2.44E-01	6.17E-04	0.98524	0.00098	0.9998	0.0033
keno238/leuct.004/case_7	2.00E+02	2.80E-02	2.10E-01	4.94E-04	0.98555	0.00111	0.9998	0.0033
keno238/leuct.004/case_8	1.98E+02	2.97E-02	2.50E-01	6.19E-04	0.98342	0.001	0.9998	0.0035
keno238/leuct.004/case_9	1.96E+02	3.20E-02	2.87E-01	7.51E-04	0.98495	0.00098	0.9998	0.0035
keno238/leuct.016/case_01	2.09E+02	2.12E-02	9.73E-02	1.87E-04	0.99214	0.00094	1	0.0031
keno238/leuct.016/case_02	2.09E+02	2.04E-02	9.72E-02	1.84E-04	0.99191	0.00095	1	0.0031
keno238/leuct.016/case_03	2.09E+02	1.99E-02	9.76E-02	1.79E-04	0.99225	0.00091	1	0.0031
keno238/leuct.016/case_04	2.09E+02	2.04E-02	9.77E-02	1.75E-04	0.99311	0.00096	1	0.0031
keno238/leuct.016/case_05	2.09E+02	1.99E-02	9.74E-02	1.77E-04	0.99348	0.00081	1	0.0031
keno238/leuct.016/case_06	2.09E+02	2.13E-02	9.82E-02	1.88E-04	0.9941	0.00092	1	0.0031
keno238/leuct.016/case_07	2.09E+02	2.15E-02	9.76E-02	1.93E-04	0.99436	0.00093	1	0.0031
keno238/leuct.016/case_08	2.09E+02	2.04E-02	9.88E-02	1.86E-04	0.99392	0.00083	1	0.0031
keno238/leuct.016/case_09	2.09E+02	2.07E-02	9.80E-02	1.82E-04	0.99357	0.00082	1	0.0031
keno238/leuct.016/case_10	2.09E+02	1.92E-02	9.91E-02	1.73E-04	0.99251	0.00092	1	0.0031
keno238/leuct.016/case_11	2.09E+02	2.16E-02	9.83E-02	1.94E-04	0.99262	0.00098	1	0.0031
keno238/leuct.016/case_12	2.09E+02	2.10E-02	9.96E-02	1.92E-04	0.99355	0.00107	1	0.0031
keno238/leuct.016/case_13	2.09E+02	2.04E-02	9.87E-02	1.79E-04	0.99146	0.00084	1	0.0031
keno238/leuct.016/case_14	2.09E+02	2.06E-02	9.97E-02	1.90E-04	0.99467	0.00092	1	0.0031

Case	AFG	sigma	AELCF	sigma	k_calc	sigma	k_exp	sigma
keno238/leuct.016/case_15	2.09E+02	2.05E-02	9.78E-02	1.81E-04	0.99424	0.00092	1	0.0031
keno238/leuct.016/case_16	2.09E+02	1.95E-02	9.76E-02	1.74E-04	0.9911	0.00082	1	0.0031
keno238/leuct.016/case_17	2.09E+02	2.03E-02	9.74E-02	1.82E-04	0.99271	0.00089	1	0.0031
keno238/leuct.016/case_18	2.09E+02	1.97E-02	9.76E-02	1.76E-04	0.99534	0.00092	1	0.0031
keno238/leuct.016/case_19	2.09E+02	2.03E-02	9.76E-02	1.81E-04	0.99452	0.00087	1	0.0031
keno238/leuct.016/case_20	2.09E+02	2.11E-02	9.86E-02	1.88E-04	0.99285	0.00095	1	0.0031
keno238/leuct.016/case_21	2.09E+02	2.07E-02	9.91E-02	1.90E-04	0.99224	0.00096	1	0.0031
keno238/leuct.016/case_22	2.09E+02	2.01E-02	9.89E-02	1.82E-04	0.99347	0.0009	1	0.0031
keno238/leuct.016/case_23	2.09E+02	2.00E-02	9.84E-02	1.78E-04	0.99439	0.00098	1	0.0031
keno238/leuct.016/case_24	2.09E+02	2.05E-02	9.90E-02	1.87E-04	0.99301	0.00086	1	0.0031
keno238/leuct.016/case_25	2.09E+02	2.07E-02	9.84E-02	1.86E-04	0.9936	0.00092	1	0.0031
keno238/leuct.016/case_26	2.09E+02	2.01E-02	9.86E-02	1.78E-04	0.99506	0.00076	1	0.0031
keno238/leuct.016/case_27	2.09E+02	2.00E-02	9.84E-02	1.81E-04	0.99266	0.00085	1	0.0031
keno238/leuct.016/case_28	2.09E+02	2.11E-02	9.68E-02	1.89E-04	0.99311	0.00097	1	0.0031
keno238/leuct.016/case_29	2.09E+02	2.11E-02	9.71E-02	1.88E-04	0.99282	0.00085	1	0.0031
keno238/leuct.016/case_30	2.09E+02	2.03E-02	9.72E-02	1.80E-04	0.99202	0.00093	1	0.0031
keno238/leuct.016/case_31	2.09E+02	2.04E-02	9.69E-02	1.77E-04	0.99347	0.00079	1	0.0031
keno238/leuct.016/case_32	2.09E+02	2.03E-02	9.67E-02	1.78E-04	0.99398	0.00099	1	0.0031
keno238/leust.003/case_1	2.18E+02	3.40E-03	4.05E-02	1.61E-05	0.9987	0.00092	1.0007	0.0039
keno238/leust.003/case_2	2.19E+02	3.20E-03	3.87E-02	1.47E-05	0.99562	0.0009	1.0003	0.0042
keno238/leust.003/case_3	2.19E+02	3.10E-03	3.84E-02	1.47E-05	1.00286	0.0009	1.0005	0.0042
keno238/leust.003/case_4	2.19E+02	3.03E-03	3.82E-02	1.46E-05	0.99412	0.001	1.0005	0.0042
keno238/leust.003/case_5	2.19E+02	2.52E-03	3.55E-02	1.16E-05	0.99768	0.0008	1.0007	0.0048
keno238/leust.003/case_6	2.20E+02	2.48E-03	3.52E-02	1.14E-05	0.99871	0.00078	1.0009	0.0049
keno238/leust.003/case_7	2.20E+02	2.25E-03	3.50E-02	1.07E-05	0.99791	0.00085	1.0004	0.0049
keno238/leust.003/case_8	2.20E+02	2.04E-03	3.40E-02	9.68E-06	0.99971	0.0007	1.0003	0.0052
keno238/leust.003/case_9	2.20E+02	2.05E-03	3.39E-02	9.70E-06	0.99749	0.00062	1.0006	0.0052
Maximum	2.21E+02	8.64E-02	9.57E+05	1.64E+03	1.03006	1.59E-03	1.006	0.0126
Average	1.76E+02	2.24E-02	7.01E+04	1.19E+02	0.998831	1.06E-03	0.999524	0.00424
Minimum	2.43E+01	1.31E-03	3.07E-02	6.94E-06	0.96808	3.70E-04	0.9826	0

5 Results of Statistical Analysis

5.1 Introduction

Using the data in Tables 3.2, 3.3, 4.1, 4.2 and 4.3; Appendix B provides a statistical discussion of the calculation results, experiment (benchmark) data, and the bias results. Regression with neutron energy causing fission was found to be not applicable.

The OECD reports provide an estimate of the actual k_{eff} for each experiment. While most experiments were estimated to be exactly critical, or k_exp = 1.0, a number of the estimates were slightly above or slightly below exactly critical. It was considered desirable to account for this difference. The following adjustment, to determine an adjusted calculation result, k', was proposed for possible use in the statistical evaluation:

k' = 1 + bias = 1 + (k_cal - k_exp)

where k_cal = code calculated k_{eff} result for the modeled experiment, and
k_exp = OECD estimate of actual k_{eff} for the experiment

The assumption inherent in making this adjustment is that the experiments were very close to critical, and if a very small adjustment could be made so that the experiment would be exactly critical, the bias of the calculation would not change. In the statistical evaluation, the bias and uncertainty was determined.

When calculation methods are employed, the subcritical limit is a quantitative value used for implementation of NCSD policy, which is established in accordance with DOE Orders, Standards, or by NRC regulations for those activities under NRC jurisdiction. Evaluation criteria are usually the calculated reactivity, k_{eff}, for the model of the problem being evaluated, uncertainty in the calculated value of reactivity, bias introduced by the code used to calculate reactivity, and bias introduced by the model. Code bias is determined by a validation performed in accordance with ANSI/ANS 8.1. The statistical results in this report determine code bias based on comparison of code calculations with experimental results. Model bias is due to uncertainties in the modeled parameters describing the problem, approximations made for the model to conform to the input requirements of the code, and any significant simplifications of the problem introduced into the model by the analyst. The acceptance criterion requires that the evaluation criteria be bounded by the subcritical limit. In the case of code calculations, the subcritical limit is often a criterion based on calculated k_{eff} and estimated bias and uncertainties.

It is recognized that it may also be possible to determine subcritical limits based on adjustment of correlating parameters other than k_{eff}, as allowed by ANSI/ANS-8.1. These parameters could include physical parameters such as mass or radius, for example, or other calculated parameters besides k_{eff}, if they can be shown to provide subcritical margin. This report does not address other potential correlating parameters, but an analyst could determine them as part of an evaluation and use them to determine subcritical limits in conjunction with the code bias results in this report.

5.2   Summary of Results

Tables 1, 2 and 3 in Appendix B provide a statistical summary of the "raw" calculation results for the critical experiments. These results do not account for the known differences between the estimated experiment actual k_{eff} (k_exp) and the ideal critical k_{eff} (1.0). The benchmark experiments are near critical experiments with neutron multiplication factors very close to unity. Some experiments were enough different from unity to justify accounting for the difference. The results in Tables 1, 2 and 3 in Appendix B are the output results from the code. There appears to be a noticeable difference in apparent bias of the results based on enrichment and physical form. In general, based on the average values the high-enriched experiments calculated slightly higher than the low enriched experiments. Also, the difference between highest and lowest result is larger for high-enriched experiments than for the low enriched experiments. There are also differences between the results for the different cross section libraries. In particular, for the high-enriched metal and solution categories, the average results for high-enriched experiments is seen to progressively decrease in going from the 27 to 44 to 238-group libraries.

Table 4 in Appendix B provides a statistical summary of the OECD estimated experiment k_{eff} values. As shown, the average values are very close to 1.0; however, the lowest values are relatively far below 1.0. For example, the lowest value overall is 0.9826 for high enriched metal. The highest value overall is 1.006 for high enriched compounds, which is comparatively less different from 1.0 (0.0174 versus 0.0060). This is consistent with what one would anticipate based on reactor physics and controlling reactors with delayed neutrons. It is considered more likely that the distribution of k_{eff} of the population of all approximately critical experiments would not be symmetric around 1.0, but would be peaked at 1.0, and the tails would be skewed towards less than 1.0. An experiment can achieve relatively high neutron multiplication while having k_{eff} around 0.98 to 0.99, but an experiment with k_{eff} of 1.01 to 1.02, which is a similar difference in k_{eff} from 1.0 (0.01 to 0.02), would be prompt critical!

Tables 5, 6 and 7 in Appendix B provide a statistical summary of the code bias results for the critical experiment calculations. These results do account for the estimated experiment actual k_{eff} (k_exp) being different from the ideal critical k_{eff} (1.0), and they summarize the code's ability to match the experiment results. The results confirm the existence of a noticeable difference in code bias based on enrichment and physical form. In general, based on the average values the high-enriched

experiments calculated slightly higher than the low enriched experiments. Also, the difference between highest and lowest result is larger for high-enriched experiments than for the low enriched experiments. There are also differences between the results for the different cross section libraries. In particular, for the high-enriched metal and solution categories, the average results for high-enriched experiments is seen to progressively decrease in going from the 27 to 44 to 238-group libraries. It is also noted that the 44-group library had the lowest average bias magnitude (closest to zero) for high-enriched metal, and the bias changes from slightly positive to essentially zero, to somewhat negative in going from the 27 to 44 to 238-group libraries.

5.3   Determination of Limits from the Bias and Uncertainty

Several methods could be used for determination of subcritical limits in terms of calculated k_{eff}. The methods will be examined in more detail, and an approach will be recommended in another report, but a summary overview is provided here. As discussed in Section 5.1, it may also be possible to determine subcritical limits based on adjustment of correlating parameters other than k_{eff}, but this approach is not addressed here.

5.3.1   Area of Applicability

Whether a particular plant application is similar to a sufficient number of experiments contained in the validation set is an important issue. This is a prerequisite before a subcritical limit may be determined from the validation results. Based on the demonstrated performance of the code for a large number of experiments, we have reasonable assurance that it performs well over a wide range of conditions. However, this does not ensure that the code performs as well over all conditions. It does not guarantee that there is not a scenario where the code would calculate unusually low due to some kind of anomaly or limitation in the code or cross section data. There are some types of experiments that are one or two of a kind. It is possible that there could be one or more of these types of experiments that would exhibit a larger bias than seen in this report, if more experiments of that type were included. The only way to assess whether the validation set contains a sufficient number of experiments that are similar to a plant application is to carefully compare the details of the experiment description with the details of the plant application. The broad categories used for the statistical analysis are not sufficient for making the determination, and even the experiment summary information included in this report (Tables 3.2 and 3.3, and Appendix A) may not provide enough information. The analyst must become familiar with the experiment descriptions provided in the OECD handbook. The minimum number of similar experiments needed cannot be determined in advance, but the analyst must consider this issue carefully as one of the factors when deciding how much margin to include in determining a subcritical limit. If there are only a few experiments similar to the application, it may be wise to take the time to select additional applicable experiments for addition to the validation set, or to perform a separate evaluation.

Appropriateness of the subcritical limit does not depend solely on the validity of the statistical analysis. Rather, the appropriateness of a subcritical limit depends on two quite different factors: (1) the range of conditions under which a generalization for its use is established, and (2) whether or not the modeled scenario is within the range of these conditions. The criticality safety analyst exercising sound engineering judgment using strong technical arguments must develop these determinations. Extrapolation beyond the range of applicability should not be done.

5.3.2 Simple Methods for Determination of Limits

The simplest and most straightforward method is to observe that for a large number of critical (or very close to critical) experiments, calculated results were relatively consistent, and none were lower than a particular minimum. Limits would be established based on the cross section library and physical form. A value of k_{eff} could be picked that is at or slightly below all the calculated results. Combined limits could be used for simplicity as long as the minimum values were used. The minimum k_{eff} value would be reduced further to provide additional margin as appropriate as determined by the analyst.

Another similar method is to choose the lowest (least positive or most negative) bias result, add it to 1.0, and reduce this value by an additional amount to allow for a margin of safety.

5.3.3 Linear Addition of Margin and Bias Based on Tolerance Bounds

In the following relationship, which has been commonly used at Y-12, the subcritical limit appears as the term on the right, while the evaluation criteria of a given problem are expressed by the term on the left. It is recognized that this approach mixes confidence intervals and tolerance limits in a semi-statistical formula or method. Acceptability is established when the term on the left is less than or equal to the term on the right:

$$\{ k_{eff} + 2\sigma + \text{model bias} \} \leq \{ 1.0 - \text{code bias} - \text{margin of safety} \}$$

Code bias is determined by a validation performed in accordance with ANSI/ANS-8.1. The statistical results in this report present code bias based on comparison of code calculations with experimental results. Some regulators require that when the mean value of calculated k_{eff} for the validation cases is greater than or equal one, then the code bias is set equal to 0.

Model bias is intended to compensate for the uncertainty in the calculated k_{eff} for the problem, due to the uncertainty in the dominant parameter(s) of the problem. Model bias is due to uncertainties in modeled parameters describing the problem, approximations made for the model to

conform to the input requirements of the code, and any significant simplifications of the problem introduced into the model by the analyst. The analyst must determine model bias for a particular application. Model bias could be addressed by modeling parameters at their worst case. Establishment of the worst case may require a parametric study. An allowance for model bias could be folded into the margin of safety as a single value. This would require justification that the margin is sufficiently high, and/or the model bias is low.

Margin of safety is set by NCSD analysts in accordance with DOE Orders, Standards, and NRC Regulations for activities under their jurisdiction. A typical range is from 0.02 to 0.05. When the analyst feels there is very little uncertainty in the application, it may be possible to justify using lower margin of safety. Also, it may be appropriate to provide margin by adjustment of correlating parameters other than k_{eff}.

There are many calculation methods suitable for calculating the reactivity (k_{eff}) of a system and for quantifying the terms of the acceptance criteria. The methods vary widely in basis and form, and each has its place in the broad spectrum of problems encountered in the nuclear criticality safety field.

There is presently no need to address safety margins where computer methods or hand calculations are used only for scoping or comparison purposes. This category of calculations is not intended for determining any subcritical limit used in a nuclear criticality evaluation.

5.3.4 Rigorous Statistical Approach

It may be possible to formulate a "statistical model" and to incorporate the uncertainties in a rigorous way. This approach will be developed and presented in a different report, which will also compare the results from the various approaches.

5.3.5 Grandfather or Retrofit Concerns

The validation documents used for establishing subcritical limits for criticality calculations shall be reviewed and approved by NCSD. There is no urgency to retrofit older evaluations since the common practice provided conservatism. Therefore, the incorporation of these methods into the evaluations of existing operations will be accomplished as the Criticality Safety Approvals become obsolete and are replaced due to equipment changes, rule changes, age, etc.

6 Conclusions

This work has demonstrated the calibration of the CSAS25 sequence of SCALE4.4a against 503 selected benchmark experiments. It provides assurance that the code predicts critical systems reasonably well, however, in general, based on bias results there is wide variation in performance depending on the type of system and cross section library. Using a rating scale similar to Reference 2, the performance ranges from "very good" or less than about +/- 0.01 to "very poor" or about +0.035/-0.025 depending on the category of experiments. It is noted, however, that the best performance is somewhat subject to question because it is for the categories with relatively few experiments. Furthermore, areas of even worse performance are reported in the OECD handbook for some experiments, which were rejected due to known cross section problems (e.g. HEU-MET-FAST-035). In general, the observed problems resulted in very high bias, which would be conservative for plant applications. Nevertheless, there is no guarantee against the possibility of an unusual scenario that could produce non-conservative results, and analysts must be always vigilant for this possibility.

Based on statistical analysis of the calculation results, the bias, bias trends and uncertainty of the benchmark calculations have been established for the included benchmark experiments. Numerical methods for applying margins are briefly described, but the determination of appropriate correlating parameter and values for additional margin, applicable to a particular analysis, must be determined as part of process analysis. As such, this document does not specify upper subcritical limits as has been done in the past. It is anticipated that a follow-on report will be written to assess the methods in more detail, provide comparisons, and recommend a preferred method. Analysts using these results are responsible for exercising sound engineering judgment using strong technical arguments to develop a margin in k_{eff} or other correlating parameter that is sufficiently large to ensure that conditions (calculated by this method to be subcritical by this margin) will actually be subcritical.

Documentation of determination and justification of the appropriate margin in the analyst's evaluation, in conjunction with this report, will constitute the complete Validation Report in accordance with ANSI/ANS-8.1-1998, Section 4.3.6(4).

7   Recommendations for Future Work

A report comparing the alternatives for determining subcritical limits applicable to calculated k_{eff}, and recommending the preferred approach, should be completed soon after this report.

As stated in Section 3, numerous additional OECD experiment descriptions are already available for experiments that would be directly applicable to Y-12 applications. In this regard, future efforts should be dedicated to the following: (1) developing more input decks in-house for experiments selected based on applicability to Y-12, and (2) including additional models as they become available in future revisions of the OECD report. In addition, changes in experiment categorization and interpretation/clarification sometimes are reported in the annual revisions of the

OECD handbook. These changes should be reviewed to determine whether they impact the conclusions in this report. This work will require a dedicated effort.

Additional work may be needed to better categorize trends and/or biases by including additional parameters in the statistical evaluation.

Additional work is needed on Area of Applicability (AoA) determination methods. Determining whether a particular application is within the AoA of a validation is currently almost exclusively based on subjective judgment. To be done correctly, it requires the analyst to have close familiarity with the details of the experiments in the validation. Efforts to develop input models for more experiments, particularly if done by several staff members, would have the additional benefit of increasing staff's familiarity with experiment descriptions, which would also help improve these AoA determinations. Doing such model input preparation work as part of the qualification program is suggested. In addition, methods have been proposed for more rigorous, and quantitative, AoA determinations. A dedicated effort is needed to evaluate these methods to determine if they are effective and practical to implement.

Finally, as suggested in Reference 2 and confirmed in the bias results, progressively better prediction is obtained with cross section libraries having increased number of cross section groups. Furthermore, areas of relatively poor performance are seen, probably due to cross section data issues. Efforts to produce improved cross section libraries for SCALE should be supported.

Appendix A - Comparison of Available Experiments Versus Calculated Experiments

	Number of benchmarks available in the 1999 OECD Manual	Number of KENO V.a benchmark models included in Y/DD-896	General Description/Comments
Totals:	1440	503	

Volume II, Highly Enriched Uranium Systems

    HEU METAL SYSTEMS

        FAST ENERGY HEU METAL SYSTEMS

HEU-MET-FAST-001	1	1	bare U(93.71) sphere
HEU-MET-FAST-002	6	6	U(nat) refl U(93.5) pseudosphere, pseudocylinder, sphere
HEU-MET-FAST-003	10	10	U(93.5) sphere refl by U(nat), Tungsten Carbide, or Ni
HEU-MET-FAST-004	1	1	U(97.67) sphere refl by water
HEU-MET-FAST-005	6		Be- or Mo-refl cyl assemblies of U(90) alloy with 3.3% Mo
HEU-MET-FAST-006	0		refer to HEU-MET-THERM-003
HEU-MET-FAST-007	43	43	U(93.15) slabs interleaved with poly, plexiglas, or teflon
HEU-MET-FAST-008	1		bare U(90) sphere
HEU-MET-FAST-009	2		U(90) sphere refl by Be or BeO
HEU-MET-FAST-010	2		U(90) sphere refl by B+Be or B+BeO
HEU-MET-FAST-011	1		U(90) sphere refl by poly
HEU-MET-FAST-012	1		Al refl spherical assembly of U(90) metal
HEU-MET-FAST-013	1		steel refl spherical assembly of U(90) metal
HEU-MET-FAST-014	1		U(dep) refl spherical assembly of U(90) metal
HEU-MET-FAST-015	1		bare cylindrical assembly of U(90) metal
HEU-MET-FAST-016	2		Be- or BeO-refl cylindrical assembly of U(90) metal
HEU-MET-FAST-017	1		Be-refl cylindrical assembly of U(90) metal interleaved with Be
HEU-MET-FAST-018	1	1	bare spherical assembly of U(90) metal
HEU-MET-FAST-019	1	1	graphite refl spherical assembly of U(90) metal
HEU-MET-FAST-020	1	1	poly refl spherical assembly of U(90) metal
HEU-MET-FAST-021	1	1	steel refl spherical assembly of U(90) metal
HEU-MET-FAST-022	1	1	duralumin refl spherical assembly of U(90) metal
HEU-MET-FAST-023	22	2	Tinkertoy arrays of 10.5 kg U(93.2) cyl

	Number of benchmarks available in the 1999 OECD Manual	Number of KENO V.a benchmark models included in Y/DD-896	General Description/Comments
HEU-MET-FAST-024	1		spherical assembly of U(90) metal refl by thin steel and thick poly
HEU-MET-FAST-026	32	5	Tinkertoy arrays of 15, 20, and 25 kg U(93.2) cyl
HEU-MET-FAST-027	1	1	Pb refl spherical assembly of U(90) metal
HEU-MET-FAST-028	1	1	U(93.24) sphere refl by U(nat)
HEU-MET-FAST-029	1	1	U(dep) refl spherical assembly of U(90) metal
HEU-MET-FAST-030	1	1	U(dep) refl cyl assemblies of U(96) metal discs interleaved with Be
HEU-MET-FAST-031	1	1	poly refl spherical shell of U(90) metal with central cavity of poly
HEU-MET-FAST-032	4	4	U(nat) refl spherical assemblies of U(94) metal
HEU-MET-FAST-033	2		unrefl cyl assemblies of U(96) metal discs interleaved with poly and steel
HEU-MET-FAST-034	3	3	unrefl cyl assemblies of U(96) metal discs interleaved with poly and Ti, Al, or steel
HEU-MET-FAST-035	1		cylindrical ZPR assembly with a U(93.2)-Fe core and stainless steel refl
HEU-MET-FAST-036	2		unrefl cyl assemblies of U(96) metal discs interleaved with poly and U(dep)
HEU-MET-FAST-037	2		poly refl cyl assemblies of U(96) metal discs interleaved with poly and U(dep)
HEU-MET-FAST-038	1		U(dep) refl cyl assembly of U(96) metal discs interleaved with Be and BeO
HEU-MET-FAST-041	6		Be- or graphite-refl spherical assemblies of U(94) metal

INTERMEDIATE ENERGY HEU METAL SYSTEMS

HEU-MET-INTER-001	0		refer to HEU-MET-FAST-035
HEU-MET-INTER-002	0		refer to HEU-MET-FAST-034
HEU-MET-INTER-003	0		refer to HEU-MET-FAST-030
HEU-MET-INTER-004	0		refer to HEU-MET-MIXED-004

THERMAL ENERGY HEU METAL SYSTEMS

HEU-MET-THERM-002	0		Be-refl Honeycomb assemblies of U(93) foils moderated by graphite
HEU-MET-THERM-003	7	7	lattices of U(94) cubes immersed in water
HEU-MET-THERM-006	23	23	SPERT-D fuel elements [assemblies of U(93)-Al alloy plates] in water

	Number of benchmarks available in the 1999 OECD Manual	Number of KENO V.a benchmark models included in Y/DD-896	General Description/Comments
MIXED ENERGY HEU METAL SYSTEMS			
HEU-MET-MIXED-001	1	1	poly refl cyl assemblies of U(96) metal discs interleaved with poly and Ti
HEU-MET-MIXED-002	1	1	poly refl spherical shell of U(90) metal with central cavity of poly
HEU-MET-MIXED-003	1	1	poly refl spherical shell of U(90) metal with central cavity of poly
HEU-MET-MIXED-004	1		U(dep) refl cyl assemblies of U(96) metal discs interleaved with poly and U(dep)
HEU-MET-MIXED-006	0		refer to HEU-MET-FAST-033
HEU-MET-MIXED-007	0		refer to HEU-MET-FAST-036
HEU-MET-MIXED-008	0		refer to HEU-MET-FAST-037
HEU COMPOUND SYSTEMS			
FAST ENERGY HEU COMPOUND SYSTEMS			
HEU-COMP-FAST-001	0		refer to HEU-COMP-MIXED-001
INTERMEDIATE ENERGY HEU COMPOUND SYSTEMS			
HEU-COMP-INTER-001	6		Be-refl Rx core assemblies of U(96)O_2 and Zr-hydride immersed in water
HEU-COMP-INTER-002	5		Be-refl Rx core assemblies of U(96)O_2 and Zr-hydride immersed in sand/water
HEU-COMP-INTER-004	1		k-inf measurements for a homogenous U(92)O_2-graphite-Ca metaborate system
HEU-COMP-INTER-005	5		k-inf measurements for a U(90)O_2 and Ni, SS, SS+Mo, Cr, or Zr system
THERMAL ENERGY HEU COMPOUND SYSTEMS			
HEU-COMP-THERM-001	0		refer to HEU-COMP-MIXED-001
HEU-COMP-THERM-002	25		arrays of hexagonal U(93)-graphite rods (ROVER) immersed in water
HEU-COMP-THERM-003	15		two-zone arrays of cross-shaped U(80)O_2-Cu rods immersed in water
HEU-COMP-THERM-004	4		arrays of cross-shaped U(90)O_2-Cu rods immersed in water with Gd or Sm rods
HEU-COMP-THERM-005	1		clusters of arrays of cross-shaped U(80)O_2-Cu rods immersed in water
HEU-COMP-THERM-006	3		arrays of cross-shaped U(80)O_2-Cu rods immersed in water
HEU-COMP-THERM-007	3		arrays of cross-shaped U(80)O_2-Cu rods immersed in water with Zr-hydride rods
HEU-COMP-THERM-008	2		arrays of cross-shaped U(80)O_2-Cu rods immersed in water with B_4C rods

	Number of benchmarks available in the 1999 OECD Manual	Number of KENO V.a benchmark models included in Y/DD-896	General Description/Comments
HEU-COMP-THERM-010	21	6	arrays of U(62.4)O_2-BeO rods immersed in water, U(92.6)NH, and/or boric acid
HEU-COMP-THERM-011	3	3	clusters of 21x21 lattices of U(80)O_2-Al rods immersed in water
HEU-COMP-THERM-012	2	2	clusters of 18x18 lattices of U(80)O_2-Al rods immersed in water
HEU-COMP-THERM-013	2	2	clusters of 14x14 lattices of U(80)O_2-Al rods immersed in water
HEU-COMP-THERM-014	2	2	clusters of 10x10 lattices of U(80)O_2-Al rods immersed in water
HEU-COMP-THERM-015	23		cans of U(90)O_2 powder arrayed and immersed in water or D_2O

INTERMEDIATE ENERGY HEU COMPOUND SYSTEMS

MIXED ENERGY HEU COMPOUND SYSTEMS

HEU-COMP-MIXED-001	26	7	arrays of cans of wet or dry U(93)O_2 powder with poly refl

HEU SOLUTION SYSTEMS
INTERMEDIATE ENERGY HEU SOLUTION SYSTEMS

HEU-SOL-INTER-001	0		refer to HEU-SOL-THERM-004 and HEU-SOL-THERM-020

THERMAL ENERGY HEU SOLUTION SYSTEMS

HEU-SOL-THERM-001	10	10	U(93.2)NH soln in cyl geom, 50-360 gU/l, minimal refl
HEU-SOL-THERM-002	14	14	U(93.2)NH soln in cyl geom, 60-335 gU/l, concrete refl
HEU-SOL-THERM-003	19	19	U(93.2)NH soln in cyl geom, 60-345 gU/l, Plexiglas refl
HEU-SOL-THERM-004	6	6	U(93.65)O_2F_2 in D_2O soln in sph geom, D/X from 34 to 430, D_2O refl
HEU-SOL-THERM-005	17	8	Pyrex glass poisoned U(87.4)NH or U(93.2)O_2F_2 soln in cyl geom, varied H_2O refl
HEU-SOL-THERM-006	29	7	boric acid poisoned U(93)NH soln in cyl geom, 295 gU/l, various refl combinations
HEU-SOL-THERM-007	17	17	concrete refl arrays of U(93.2)NH soln cylinders, 67-370 gU/l
HEU-SOL-THERM-008	14	14	Plexiglas refl arrays of U(93.2)NH soln cylinders, 60-356 gU/l
HEU-SOL-THERM-009	4	4	U(93.2)O_2F_2 soln in 6.4 liter sph geom, 213-696 gU/l, water refl
HEU-SOL-THERM-010	4	4	U(93.2)O_2F_2 soln in 9.7 liter sph geom, 95-107 gU/l, water refl
HEU-SOL-THERM-011	2	2	U(93.2)O_2F_2 soln in 17 liter sph geom, 48-50 gU/l, water refl
HEU-SOL-THERM-012	1	1	U(93.2)O_2F_2 soln in 91 liter sph geom, 20.5 gU/l, water refl
HEU-SOL-THERM-013	4	4	boric acid poisoned U(93.2)NH soln in 174 liter sph geom, 20-28 gU/l, unrefl
HEU-SOL-THERM-014	3	3	Gd poisoned U(89)NH soln in cyl geom, ~70 gU/l, water refl
HEU-SOL-THERM-015	5	5	Gd poisoned U(89)NH soln in cyl geom, ~100 gU/l, water refl

	Number of benchmarks available in the 1999 OECD Manual	Number of KENO V.a benchmark models included in Y/DD-896	General Description/Comments
HEU-SOL-THERM-016	3	3	Gd poisoned U(89)NH soln in cyl geom, ~150 gU/l, water refl
HEU-SOL-THERM-017	8	8	Gd poisoned U(89)NH soln in cyl geom, ~200 gU/l, water refl
HEU-SOL-THERM-018	12	12	Gd poisoned U(89)NH soln in cyl geom, ~300 gU/l, water refl
HEU-SOL-THERM-019	3	3	Gd poisoned U(89)NH soln in cyl geom, ~400 gU/l, water refl
HEU-SOL-THERM-020	5	5	U(93.65)O_2F_2 in D_2O soln in sph geom, D/X from 230 to 2080, unrefl
HEU-SOL-THERM-021	32	6	bare and hydrogenous refl arrays of U(93.2)NH soln cylinders, 63-415 gU/l
HEU-SOL-THERM-022	1		intersection of two steel pipes containing U(89)NH soln, 141 gU/l, water refl
HEU-SOL-THERM-023	1		steel pipe intersections containing U(89)NH soln, 408 gU/l, water refl
HEU-SOL-THERM-024	9		steel pipe intersections containing U(89)NH soln, 64-386 gU/l, bare and water refl
HEU-SOL-THERM-025	18	18	Gd poisoned U(89)NH soln in cyl geom, 48-400 gU/l, water refl
HEU-SOL-THERM-027	9	9	unrefl U(89)NH soln in cyl geom, 136 gU/l, central rod of B_4C, Cd, or n/a
HEU-SOL-THERM-028	18	18	water refl U(89)NH soln in cyl geom, 76 or 286 gU/l, central rod of B_4C or n/a
HEU-SOL-THERM-029	7	7	water refl U(89)NH soln in cyl geom, 286 gU/l, seven rods of B_4C or n/a
HEU-SOL-THERM-030	7	7	water refl U(89)NH soln in cyl geom, 76 or 286 gU/l, 3-6 rods of B_4C or n/a
HEU-SOL-THERM-031	4	4	water refl U(89)NH soln in cyl geom, 286 gU/l, 18 or 36 rods of B_4C
HEU-SOL-THERM-032	1	1	U(93.2)NH soln in 48" dia. sph geom, ~15 gU/l, unrefl
HEU-SOL-THERM-033	26	26	ann cyl tanks of U(93.2)NH soln, 357 gU/l, cavity of varius matls, concrete refl
HEU-SOL-THERM-035	9	9	water refl U(89)NH soln in cyl geom, 37-152 gU/l, multiple rods of B_4C or n/a
HEU-SOL-THERM-036	4	4	unrefl U(89)NH soln in cuboidal geom, 92.7 gU/l, multiple rods of B_4C or n/a
HEU-SOL-THERM-037	9	9	water refl U(89)NH soln in cyl geom, 42-83 gU/l, multiple rods of B_4C or n/a

MISCELLANEOUS HEU SYSTEMS

    FAST ENERGY MISCELLANEOUS HEU SYSTEMS

    INTERMEDIATE ENERGY MISCELLANEOUS HEU SYSTEMS

    THERMAL ENERGY MISCELLANEOUS HEU SYSTEMS

    MIXED ENERGY MISCELLANEOUS HEU SYSTEMS

	Number of benchmarks available in the 1999 OECD Manual	Number of KENO V.a benchmark models included in Y/DD-896	General Description/Comments

Volume III, Intermediate and Mixed Enrichment Uranium Systems
  IEU METAL SYSTEMS
    FAST ENERGY IEU METAL SYSTEMS

IEU-MET-FAST-001	4	unrefl cyl U(93.4) metal discs interleaved with U(nat), effectively U(36) or U(55)
IEU-MET-FAST-002	1	U(nat) refl cyl U(93.4) metal discs interleaved with U(nat), effectively U(16)
IEU-MET-FAST-003	1	bare spherical assembly of U(36) metal
IEU-MET-FAST-004	1	graphite refl spherical assembly of U(36) metal
IEU-MET-FAST-005	1	steel refl spherical assembly of U(36) metal
IEU-MET-FAST-006	1	Al refl spherical assembly of U(36) metal
IEU-MET-FAST-007	1	cyl assembly of U(93), U(10), and U(nat) metal, effectively U(10) core, U(dep) refl
IEU-MET-FAST-008	1	U(dep) refl spherical assembly of U(36) metal
IEU-MET-FAST-009	1	poly refl spherical assembly of U(36) metal
IEU-MET-FAST-010	1	cylindrical ZPR assembly with a U(93)-U(dep) core, effectively U(9), U(dep) refl

    INTERMEDIATE ENERGY IEU METAL SYSTEMS

    THERMAL ENERGY IEU METAL SYSTEMS

    MIXED ENERGY IEU METAL SYSTEMS

  IEU COMPOUND SYSTEMS
    FAST ENERGY IEU COMPOUND SYSTEMS

    INTERMEDIATE ENERGY IEU COMPOUND SYSTEMS

    THERMAL ENERGY IEU COMPOUND SYSTEMS

IEU-COMP-THERM-001	29	arrays of U(30)F_4-polytetrafluoroethylene and polyethylene cubes
IEU-COMP-THERM-002	6	latticed annular U(17)O_2 rods in H_2O, annuli of H_2O, Gd_2O_3-Al_2O_3, or CdO-Al_2O_3
IEU-COMP-THERM-003	2	lattices of cyl U(20)-Zr-hydride rods in H_2O, graphite refl

    MIXED ENERGY IEU COMPOUND SYSTEMS

	Number of benchmarks available in the 1999 OECD Manual	Number of KENO V.a benchmark models included in Y/DD-896	General Description/Comments
IEU SOLUTION SYSTEMS			
THERMAL ENERGY IEU SOLUTION SYSTEMS			
IEU-SOL-THERM-001		4	U(20.9)O_2SO_4 soln in cyl geom, 263-505 gU/l, graphite refl
MISCELLANEOUS IEU SYSTEMS			
FAST ENERGY MISCELLANEOUS IEU SYSTEMS			
INTERMEDIATE ENERGY MISCELLANEOUS IEU SYSTEMS			
THERMAL ENERGY MISCELLANEOUS IEU SYSTEMS			
MIXED ENERGY MISCELLANEOUS IEU SYSTEMS			
Volume IV, Low Enriched Uranium Systems			
LEU METAL SYSTEMS			
FAST ENERGY LEU METAL SYSTEMS			
INTERMEDIATE ENERGY LEU METAL SYSTEMS			
THERMAL ENERGY LEU METAL SYSTEMS			
LEU-MET-THERM-001		1	lattice of cyl U(nat) metal rods immersed in D_2O
LEU-MET-THERM-002		12	lattices of annular cyl U(2) metal rods immersed in D_2O
MIXED ENERGY LEU METAL SYSTEMS			
LEU COMPOUND SYSTEMS			
FAST ENERGY LEU COMPOUND SYSTEMS			
INTERMEDIATE ENERGY LEU COMPOUND SYSTEMS			
THERMAL ENERGY LEU COMPOUND SYSTEMS			

	Number of benchmarks available in the 1999 OECD Manual	Number of KENO V.a benchmark models included in Y/DD-896	General Description/Comments
LEU-COMP-THERM-001	8	8	lattices of cyl U(2.35)O$_2$ rods immersed in water
LEU-COMP-THERM-002	5	5	lattices of cyl U(4.31)O$_2$ rods immersed in water
LEU-COMP-THERM-003	23	22	lattices of cyl U(2.35)O$_2$ rods immersed in water, water contains Gd impurity
LEU-COMP-THERM-004	20	20	lattices of cyl U(4.31)O$_2$ rods immersed in water, water contains Gd impurity
LEU-COMP-THERM-006	18		lattices of cyl U(2.6)O$_2$ rods immersed in water
LEU-COMP-THERM-007	10		lattices of cyl U(4.738)O$_2$ rods immersed in water
LEU-COMP-THERM-008	17		U(2.459)O$_2$ rods latticed in borated H$_2$O, pertubed by Vicor, Pyrex, or Al$_2$O$_3$ rods
LEU-COMP-THERM-009	27		clusters of U(4.31)O$_2$ rods in water purturbed by various matls as plates
LEU-COMP-THERM-010	30		lattices of U(4.31)O$_2$ rods in water refl by two Pb, U(dep), or steel walls
LEU-COMP-THERM-012	10		clusters of U(2.35)O$_2$ rods in H$_2$O (Gd impurity) purturbed by various matls as plates
LEU-COMP-THERM-015	165		VVER Experiments, Part I
LEU-COMP-THERM-016	32	32	clusters of U(2.35)O$_2$ rods in water purturbed by various matls as plates
LEU-COMP-THERM-017	29		lattices of U(2.35)O$_2$ rods in water refl by two Pb, U(dep), or steel walls
LEU-COMP-THERM-018	1		U(7)O$_2$ rods immersed in water
LEU-COMP-THERM-019	3		stainless steel clad U(5)O$_2$ rods immersed in water
LEU-COMP-THERM-020	7		Zr-clad U(5)O$_2$ rods immersed in water
LEU-COMP-THERM-021	6		Zr-clad U(5)O$_2$ rods immersed in borated water
LEU-COMP-THERM-022	7		stainless steel clad U(10)O$_2$ rods immersed in water
LEU-COMP-THERM-023	6		stainless steel clad U(10)O$_2$ rods immersed in water
LEU-COMP-THERM-024	2		stainless steel clad U(10)O$_2$ rods immersed in water
LEU-COMP-THERM-025	4		stainless steel clad U(7.5)O$_2$ rods immersed in water
LEU-COMP-THERM-026	6		Zr-clad U(4.92)O$_2$ rods immersed in water at varied temperatures
LEU-COMP-THERM-027	4		Al-clad U(4.74)O$_2$ rods immersed in water, Pb refl
LEU-COMP-THERM-029	12		Al-clad U(4.74)O$_2$ rods immersed in water surrounded by Hf plates
LEU-COMP-THERM-031	6		Zr-clad U(5)O$_2$ rods immersed in water
LEU-COMP-THERM-032	9		stainless steel clad U(10)O$_2$ rods immersed in water at varied temperatures

	Number of benchmarks available in the 1999 OECD Manual	Number of KENO V.a benchmark models included in Y/DD-896	General Description/Comments
LEU-COMP-THERM-034	24		U(4.738)O$_2$ rod clusters in Cd, bor-ss, or Boral cannisters and immersed in H$_2$O
LEU-COMP-THERM-035	3		U(2.6)O$_2$ rods immersed in Gd- or B-poisoned water
LEU-COMP-THERM-036	69		VVER Experiments, Part II
LEU-COMP-THERM-037	11		U(4.738)O$_2$ rods immersed in water, partial refl by concrete
LEU-COMP-THERM-038	14		U(4.738)O$_2$ rods immersed in water, partial refl by borated concrete
LEU-COMP-THERM-039	17		incomplete/irregular lattices of U(4.738)O$_2$ rods immersed in water
LEU-COMP-THERM-040	10		U(4.738)O$_2$ rod clusters in Cd, bor-ss, or Boral cannisters in water, Pb or steel refl
LEU-COMP-THERM-041	5		HEU driven U(3)O$_2$ rod clusters in water separated by ss, bor-ss, or Cd plates
LEU-COMP-THERM-042	7		U(2.35)O$_2$ rod clusters in H$_2$O separated by various matls as plates, refl by steel walls
LEU-COMP-THERM-049	18		poly refl split-table arrays of cuboidal cans containing U(5)O2 powder at low H/U

MIXED ENERGY LEU COMPOUND SYSTEMS

LEU SOLUTION SYSTEMS
    THERMAL ENERGY LEU SOLUTION SYSTEMS

	Number of benchmarks available in the 1999 OECD Manual	Number of KENO V.a benchmark models included in Y/DD-896	General Description/Comments
LEU-SOL-THERM-001	1		unrefl U(5)O$_2$F$_2$ soln in cyl geom, 1000 gU/l
LEU-SOL-THERM-002	3		U(4.9)O$_2$F$_2$ soln in 147 liter sph geom, ~450 or ~490 gU/l, unrefl or water refl
LEU-SOL-THERM-003	9	9	full and truncated spheres of U(10)NH soln
LEU-SOL-THERM-004	7		water refl U(10)NH soln in cyl geom, 225-310 gU/l
LEU-SOL-THERM-005	3		water refl U(5.64)NH soln in cyl geom, ~400 gU/l, with or without B$_4$C rods
LEU-SOL-THERM-006	5		water refl U(10)NH soln in cyl geom, ~420 gU/l, with or without B$_4$C rods
LEU-SOL-THERM-007	5		unrefl U(10)NH soln in cyl geom, 242-313 gU/l
LEU-SOL-THERM-008	4		concrete refl U(10)NH soln in cyl geom, ~240 gU/l
LEU-SOL-THERM-009	3		borated concrete refl U(10)NH soln in cyl geom, ~240 gU/l
LEU-SOL-THERM-010	4		poly refl U(10)NH soln in cyl geom, ~240 gU/l

	Number of benchmarks available in the 1999 OECD Manual	Number of KENO V.a benchmark models included in Y/DD-896	General Description/Comments

MISCELLANEOUS LEU SYSTEMS
    FAST ENERGY MISCELLANEOUS LEU SYSTEMS

    INTERMEDIATE ENERGY MISCELLANEOUS LEU SYSTEMS

    THERMAL ENERGY MISCELLANEOUS LEU SYSTEMS

    MIXED ENERGY MISCELLANOUS LEU SYSTEMS

Appendix B - Determination of the Bias, Bias Trends, and Uncertainty Through Statistical Methods

I. Statistical Discussion of the Critical Experiment Data

The critical experiment data consisted of 503 cases from the OECD Handbook.[1] The data from the benchmark experiments involving uranium represents a sufficiently wide range of enrichments and chemical forms to cover many existing or presently planned activities for the Y-12 site. The benchmark experiments evaluated were both critical and subcritical experiments. For each case, a total of 500 generations were run with 2000 neutrons per generation. The first 100 generations were skipped for the determination of the k_cal, the final k-effective after 800,000 neutron histories. Simulation results for these critical experiments to be used for validation of CSAS 25 in SCALE4.4a code package were compiled into an OUTPUT data set.[2]

The data set (OUTPUT) for this evaluation consisted of the following parameters:
    1.) lifetime - average life span of a neutron;
    2.) generation time - average time between successive neutron generations;
    3.) nu bar - the average total number of neutron produced per fission;
    4.) k_cal- the final k-effective after 800,000 neutron histories;
    5.) k_exp - the target k-effective for the experiment as modeled;
    6.) AFG - the average energy group at which fission occurs;
    7.) EALCF - the energy of the average lethargy of neutron causing fission;
    8.) k vs run - the average k-effective corresponding to the smallest mean standard deviation when the average k-effective and the mean standard deviation of the k-effective are computed for each generation over the range of nskip (user input number of generations to skip) through the total number of generations; and,
    9.) k vs skip - the average k-effective corresponding to the smallest mean standard deviation when the average k-effective and the mean standard deviation of the average k-effective are computed for the number of generations skipped over the range of nskip+1 through 2/3 the total number of generations calculated.

The following parts of the data set (OUTPUT) were used in the statistical evaluation:

SCALE simulations identified by categorical variables of Number of Cross Section Groups (27, 44, and 238); Uranium-Enrichment (High or Low); and Physical Form (Compound, Metal, or Solution). The final k-effective (k_cal) results for the 27-group cross sections delineated by enrichment and physical form can be found in Table 1, the final k-effective (k_cal) results for the 44-group cross sections delineated by enrichment and physical form can be found in Table 2, and the final k-effective (k_cal) results for the 238-group cross sections delineated by enrichment and

physical form can be found in Table 3.

Due to time constraints, dependent variables such as enrichment or mass used as INPUT to the simulation cases could not be quantified in the OUTPUT data set provided. Therefore, the final k-effective result (k_cal) could not be regressed on any of the input dependent variables such as the amount of material or enrichment. In addition, the correlation of k-effective with AFG is $r^2 = 0.04$ for the 27-group cross sections, a $r^2 = 0.01$ for the 44-group cross sections, and $r^2 = 0.01$ for the 238-group cross sections. Similarly, the correlation of k-effective with EALCF is $r^2 = 0.02$ for the 27-group cross sections, $r^2 = 0.01$ for the 44-group cross sections, and $r^2 = 0.0003$ for the 238-group cross sections. These results are an indication that there is no linear relationship between the two variables. For this reason, regression and weighted regression do not seem to be applicable because of the lack of quantified independent variables in the data set (OUTPUT) and the low correlation with AFG and EALCF as discussed.

The distribution of the k_cal estimates is examined by the Wilk-Shapiro test[3] using the W-statistic. The W-statistic for a normal distribution ranges from 0 to 1 with small values leading to rejection of normality. The probability of a small W-statistic is given by Pr<W in Tables 1, 2, and 3. For Pr<W less than 0.05, we reject the null hypothesis that the k_cal estimates have a normal distribution. Otherwise, the k-cal estimates are assume to be normally distributed until additional data is collected to disprove the null hypothesis.

Tables 1, 2, and 3 list both a between standard deviation and a within standard deviation for the k_cal estimates. The between standard deviation represents the variability of the average k_cal estimates between the different criticality cases (e.g., for high enriched uranium metals, there are 118 cases). The between standard deviation of the k_cal is estimated by computing the variation between cases. This is performed by squaring each deviation in the k_cal, summing and dividing by "n-1", where "n" is the number of cases and taking the square root of the result. The within standard deviation represents the variability of the averaged k_cal value for a single simulation run. The within standard deviation is adjusted for the number of generations in the simulation and is estimated by pooling the within standard deviation in the different criticality cases. Thus, the within standard deviation of k_cal is the square root of the sum of the squares of the standard deviations of "n" cases divided by "n" number of cases

Table 1. The k_cal results for the 27-group cross sections.

Physical Form by Uranium Enrichment	Number of Simulations	Average k_cal	Between Standard Deviation	Within Standard Deviation	Minimum k_cal	Maximum k_cal	Probability of Normality Pr<W
High Enriched Uranium							
Metal	118	1.0048	0.0079	0.0010	0.9780	1.0349	0.0001
Compound	22	1.0000	0.0097	0.0010	0.9874	1.0185	0.1022
Solution	267	1.0063	0.0065	0.0012	0.9844	1.0332	0.6611
Combined Category for High Enriched Uranium	407	1.0055	0.0073	0.0011	0.9780	1.0349	0.0031
Low Enriched Uranium							
Metal	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Compound	87	0.9877	0.0056	0.0009	0.9769	0.9970	0.0001
Solution	9	0.9967	0.0021	0.0008	0.9934	1.0005	0.9933
Combined Category for Low Enriched Uranium	96	0.9886	0.0060	0.0009	0.9769	1.0005	0.0001
Combined Category for Both High Enriched Uranium and Low Enriched Uranium	503	1.0023	0.0097	0.0011	0.9769	1.0349	0.0001

Table 2. The k_cal results for the 44-group cross sections.

Physical Form by Uranium Enrichment	Number of Simulations	Average k_cal	Between Standard Deviation	Within Standard Deviation	Minimum k_cal	Maximum k_cal	Probability of Normality Pr<W
High Enriched Uranium							
Metal	118	0.9987	0.0080	0.0010	0.9717	1.0307	0.0008
Compound	22	1.0015	0.0050	0.0010	0.9903	1.0101	0.6621
Solution	267	1.0039	0.0068	0.0011	0.9812	1.0310	0.0113
Combined Category for High Enriched Uranium	407	1.0023	0.0074	0.0011	0.9717	1.0310	0.0006
Low Enriched Uranium							
Metal	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Compound	87	0.9908	0.0054	0.0009	0.9804	0.9986	0.0001
Solution	9	0.9977	0.0021	0.0009	0.9944	1.0013	0.9736
Combined Category for Low Enriched Uranium	96	0.9915	0.0055	0.0009	0.9804	1.0013	0.0001
Combined Category for Both High Enriched Uranium and Low Enriched Uranium	503	1.0002	0.0082	0.0011	0.9717	1.0310	0.0353

Table 3. The k_cal results for the 238-group cross sections.

Physical Form by Uranium Enrichment	Number of Simulations	Average k_cal	Between Standard Deviation	Within Standard Deviation	Minimum k_cal	Maximum k_cal	Probability of Normality Pr<W
High Enriched Uranium							
Metal	118	0.9974	0.0079	0.0010	0.9681	1.0284	0.0001
Compound	22	0.9978	0.0056	0.0010	0.9858	1.0085	0.7869
Solution	267	1.0031	0.0072	0.0012	0.9802	1.0301	0.0002
Combined Category for High Enriched Uranium	407	1.0011	0.0078	0.0011	0.9681	1.0301	0.0001
Low Enriched Uranium							
Metal	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Compound	87	0.9881	0.0060	0.0009	0.9751	0.9966	0.0001
Solution	9	0.9981	0.0025	0.0008	0.9941	1.0029	0.7133
Combined Category for Low Enriched Uranium	96	0.9890	0.0065	0.0009	0.9751	1.0029	0.0001
Combined Category for Both High Enriched Uranium and Low Enriched Uranium	503	0.9988	0.0089	0.0011	0.9681	1.0301	0.0011

Tables 1, 2, and 3 partition the simulation runs by cross section groups, uranium enrichment and physical form. Additional partitions can also be made using the energy spectrum and cases. These additional partitions would reduce the between standard deviation of k_cal results but only a few or no cases would be available for each combination. Thus, additional partitions of the data set were not done.

II.   Discussion of Benchmark Data

The benchmark data is provided in the OECD Handbook for each of the critical experiments evaluated. The benchmark (k_exp) or target k-effective is the best estimate of k-effective to be expected if the code performed a perfect calculation. Also, included in the OUTPUT data set is the uncertainty attached to the k_exp. Note, for the majority of critical experiments the k_exp is equal to one (1). Table 4 gives the statistical summary for the k_exp values.

Table 4. The k_exp values statistical summary

Physical Form by Uranium Enrichment	Number of Simulations	Average k_exp	Between Standard Deviation	Minimum k_exp	Maximum k_exp
High Enriched Uranium					
Metal	118	0.9991	0.0027	0.9826	1.0028
Compound	22	0.9999	0.0022	0.9953	1.0060
Solution	267	0.9995	0.0014	0.9942	1.0015
Combined Category for High Enriched Uranium	407	0.9994	0.0019	0.9826	1.0060
Low Enriched Uranium					
Metal	N/A	N/A	N/A	N/A	N/A
Compound	87	0.9999	0.0001	0.9997	1.0000
Solution	9	1.0005	0.0002	1.0003	1.0009
Combined Category for Low Enriched Uranium	96	1.0000	0.0002	0.9997	1.0009
Combined Category for Both High Enriched Uranium and Low Enriched Uranium	503	0.9995	0.0017	0.9826	1.0060

III.   Discussion of Bias Data

The bias estimated from the OUTPUT data set is defined as

$$Bias= k\_cal - k\_exp.$$

Table 5 gives the summary results for the bias results for the 27-group cross sections; Table 6 gives the summary results for the 44-group cross sections; and Table 7 gives the summary results for the 238-group cross sections. The signed-rank test was used to test the null hypothesis that the expected value of the bias is 0 (i.e., E[k_cal - k_exp] = 0) for a significance level of á = 0.05. The use of the signed-rank test for significance does not require that the populations be symmetric.[4] The signed-rank test for the bias results showed that for all partitions of the 27-group cross sections, except the high enriched compound result, are significantly different from zero. The sign-rank test for the bias results showed that for three partitions of the 44-group cross sections; highly enriched solution results, low enriched compound and solution results, are significantly different from zero. Likewise, the sign-rank test for the bias results showed that for all partitions of the 238-group cross sections except for the high enriched compound results were significantly different than zero. A positive average bias represents a high bias and a negative average bias represents a low bias.

Table 5. The bias results for the 27-group cross sections.

Physical Form by Uranium Enrichment	Number of Simulations	Average Bias	Standard Deviation Bias	Minimum Bias	Maximum Bias	Probability of Bias Test Signed-Rank Test
High Enriched Uranium						
Metal	118	0.0057	0.0067	-0.0092	0.0349	0.0001
Compound	22	0.0000	0.0085	-0.0114	0.0148	0.9126
Solution	267	0.0067	0.0065	-0.0156	0.0332	0.0001
Combined Category for High Enriched Uranium	407	0.0061	0.0069	-0.0156	0.0349	0.0001
Low Enriched Uranium						
Metal	N/A	N/A	N/A	N/A	N/A	N/A
Compound	87	-0.0122	0.0056	-0.0231	-0.0027	0.0001
Solution	9	-0.0038	0.0022	-0.0071	-0.0001	0.0039
Combined Category for Low Enriched Uranium	96	-0.0114	0.0059	-0.0231	-0.0001	0.0001
Combined Category for Both High Enriched Uranium and Low Enriched Uranium	503	0.0027	0.0096	-0.0231	0.0349	0.0001

Table 6. The bias results for the 44-group cross sections.

Physical Form by Uranium Enrichment	Number of Simulations	Average Bias	Standard Deviation Bias	Minimum Bias	Maximum Bias	Probability of Bias Test Signed-Rank Test
High Enriched Uranium						
Metal	118	-0.0004	0.0067	-0.0154	0.0307	0.1520
Compound	22	0.0015	0.0042	-0.0097	0.0087	0.0650
Solution	267	0.0044	0.0070	-0.0188	0.0310	0.0001
Combined Category for High Enriched Uranium	407	0.0029	0.0071	-0.0188	0.0310	0.0001
Low Enriched Uranium						
Metal	N/A	N/A	N/A	N/A	N/A	N/A
Compound	87	-0.0091	0.0054	-0.0196	-0.0011	0.0001
Solution	9	-0.0029	0.0021	-0.0061	0.0008	0.0117
Combined Category for Low Enriched Uranium	96	-0.0085	0.0055	-0.0196	0.0008	0.0001
Combined Category for Both High Enriched Uranium and Low Enriched Uranium	503	0.0007	0.0082	-0.0196	0.0310	0.0950

Table 7. The bias results for the 238-group cross sections.

Physical Form by Uranium Enrichment	Number of Simulations	Average Bias	Standard Deviation Bias	Minimum Bias	Maximum Bias	Probability of Bias Test Signed-Rank Test
High Enriched Uranium						
Metal	118	-0.0017	0.0064	-0.0203	0.0284	0.0003
Compound	22	-0.0021	0.0047	-0.0142	0.0073	0.0509
Solution	267	0.0035	0.0074	-0.0198	0.0301	0.0001
Combined Category for high Enriched Uranium	407	0.0017	0.0074	-0.0203	0.0301	0.0001
Low Enriched Uranium						
Metal	N/A	N/A	N/A	N/A	N/A	N/A
Compound	87	-0.0118	0.0060	-0.0247	-0.0031	0.0001
Solution	9	-0.0025	0.0025	-0.0064	0.0024	0.0273
Combined Category for Low Enriched Uranium	96	-0.0110	0.0088	-0.0247	0.0024	0.0001
Combined Category for Both High Enriched Uranium and Low Enriched Uranium	503	-0.0007	0.0088	-0.0247	0.0301	0.0001

IV.   Appendix B References

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