

**Comparison Study of Upper Subcritical Limits Derived Using
Sensitivity/Uncertainty Tools: Case Studies of**

U233-SOL-THERM-001-001,

MIX-COMP-THERM-001-001,

IEU-MET-FAST-002-001,

LEU-COMP-THERM-001-001,

LEU-SOL-THERM-004-001

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Introduction

Neutron transport methods used to establish subcriticality require validation by comparison to critical experiments considered to be benchmarks. Whisper is a sensitivity/uncertainty analysis tool developed to assist with the task of validation in nuclear criticality safety. Details on the Whisper methodology can be found in References 1-3 on the MCNP® reference collection website at <https://mcnp.lanl.gov>.

Whisper-1.0 was originally developed in 2014 and used to assist with nuclear criticality safety validation at Los Alamos National Laboratory. Whisper was upgraded in 2016 to Whisper-1.1 and prepared for release with MCNP6.2 [References 3-5]. Whisper contains a library of over 1100 critical experiment benchmarks and quantifies neutronic similarity of an application to benchmarks in the library. Using highest similarity benchmarks, Whisper computes a calculational margin (CM) encompassing of the worst-case bias and bias uncertainty at a 99% confidence level for each application. In addition, portions of the margin of subcriticality (MOS) for nuclear data uncertainty and potential code errors are computed. The baseline upper subcritical limit (USL) computed by Whisper is comprised of the CM, $MOS_{\text{nuclear data}}$, and $MOS_{\text{code errors}}$. The Whisper baseline USL is absent a portion of the MOS due to the area of application, which is applied based upon judgment by the criticality safety analyst.

An objective of this paper is to present the baseline USL, CM and portions of the MOS as computed by Whisper for comparison with similar sensitivity/uncertainty tools, such as those used by IRSN and ORNL. An initial comparison involved four critical experiment benchmarks: HEU-MET-FAST-013-001, HEU-SOL-THERM-001-008, PU-MET-FAST-022-001, AND PU-SOL-THERM-001-001, which have been documented in References 10-13. This study extends the comparison to include cases U233-SOL-THERM-001-001, MIX-COMP-THERM-001-001, IEU-MET-FAST-002-001, LEU-COMP-THERM-001-001, LEU-SOL-THERM-004-001. The cases are:

1. modeled independently by LANL, IRSN, and ORNL based upon information provided in the ICSBEP Handbook,
2. are common in S/U libraries for LANL, IRSN, and ORNL,
3. span a range of energy spectrum and fissile material, and
4. taken as applications for the purposes of this study and therefore excluded from use as a benchmark for calculating the upper subcritical limit.

Results presented in this paper have been computed using covariance data for all isotopes in ENDF/B-VII.0 using a 44-group energy structure [Reference 6]. Benchmarks in the Whisper library were run in MCNP6.2 using 100,000 neutrons per cycle, skipping 100 cycles for 500 active cycles. Reference 10 also compares the results for baseline USL with an order of magnitude greater neutrons, using the same total number of cycles with 1,000,000 neutrons per cycle. Additionally, benchmark libraries from Sandia National Laboratory (SNL) and Savannah River (SNRS) modeled for use with MCNP6 were used with Whisper.

During the process of validation there can be cases where a benchmark experiment may be found to be a statistical outlier, in which the calculated k-effective value and the experiment k-effective value differ by an amount atypical for similar experiments. A methodology optionally employed by Whisper is the exclusion of statistical outliers based upon the iterative diagonal chi-squared statistical rejection technique. Alternatively, there is an option to include all benchmarks in the Whisper library collection, even those benchmarks found to be statistical outliers, when computing the bias, bias uncertainty and margin of subcriticality (MOS) leading to establishment of the baseline upper subcritical limit (USL). Reference 10 includes a comparison study to compute USLs with and without statistical outliers in the Whisper benchmark collection to determine what effect rejection of statistical outliers has on the

recommended USL. The results show little overall difference in the recommended baseline USLs developed by Whisper when excluding statistical outliers. There does not appear to be a clear trend in predicting whether the baseline USL will be higher or lower when rejecting statistical outliers from the benchmark critical experiment collection used for validation. Results presented herein include all benchmarks in the library, including those identified to be statistical outliers. The 2017 revision to ANSI/ANS-8.24 requires that any exclusion of statistical outliers must be based upon physical justification; identification of outliers may be based upon statistical techniques, however the standard does not allow exclusion of identified outliers based upon statistical analysis.

Study

Application models used for this study are U233-SOL-THERM-001-001, MIX-COMP-THERM-001-001, IEU-MET-FAST-002-001, LEU-COMP-THERM-001-001, LEU-SOL-THERM-004-001 taken from the Whisper-1.1 benchmark library, and therefore excluded as benchmarks when computing the USL for this study. A short description of each is provided below.

IEU-MET-FAST-002-001: The critical assembly is a cylinder with a core of alternating plates of enriched and natural uranium surrounded by a natural uranium reflector. The core average enrichment was ~16 wt% ^{235}U . This experiment was performed at the Los Alamos Pajarito critical assembly facility around 1956. A schematic of the experimental assembly is shown in Figure 1.

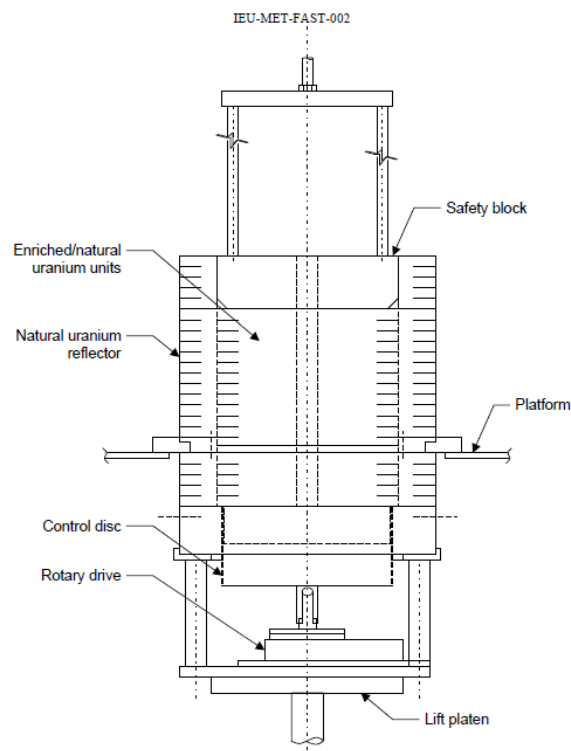


Figure 1. Experimental Assembly for IEU-MET-FAST-002

LEU-COMP-THERM-001-001: A critical assembly with a cluster of aluminum clad $\text{U}(2.35)\text{O}_2$ fuel rods in a large water-filled tank. A series of experiments were performed over the course of several years at the Critical Mass Laboratory at the Pacific Northwest National Laboratories around the last 1970's. A photo of the fuel rod cluster in the tank is shown in Figure 2.



Figure 2. Fuel Rod Cluster for LEU-COMP-THERM-001-001

LEU-SOL-THERM-004-001: The critical assembly consists of water-reflected 10%-enriched uranyl nitrate solution in a 60-cm diameter cylindrical tank, part of several critical experiments included in the STACY series (Static Experiment Critical Experiment Facility) performed at the Nuclear Fuel Cycle Safety Engineering Research Facility in the Tokai Research Establishment of the Japan Atomic Energy Research Institute. A view of the STACY Core Tank is shown in Figure 3.

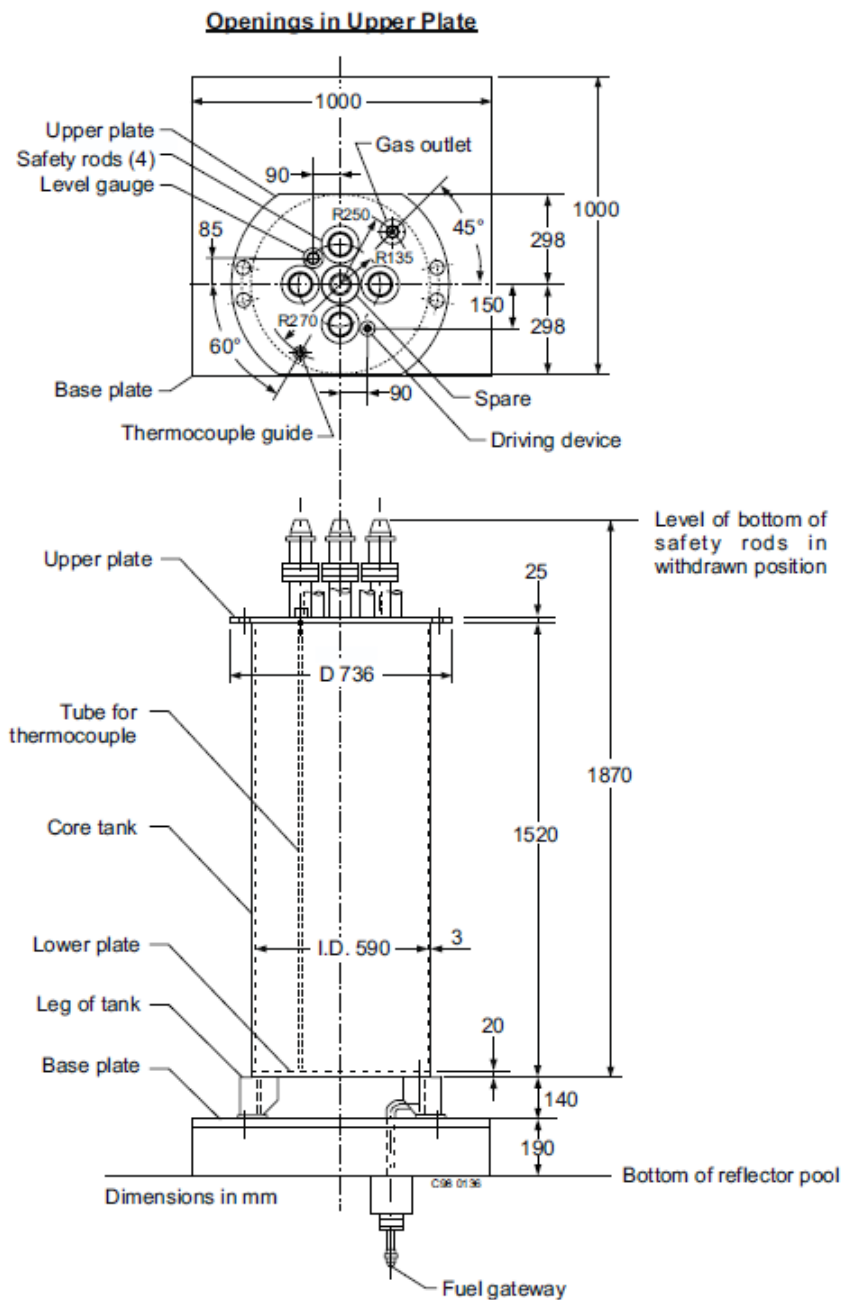


Figure 3. STACY Core Tank for LEU-SOL-THERM-004-001

MIX-COMP-THERM-001-001: The experimental configuration comprises an array of fast test reactor fuel pins within a large tank containing water. The fuel pins are located on a square pitch, which varied between experiments. The fuel is a mixture of PuO_2 and UO_2 with the pins comprising 19.70 wt% plutonium. The plutonium has 11.5 wt% ^{240}Pu and the uranium in the PuO_2 - UO_2 mixture is approximately natural uranium. The experimental and benchmark model k -effective is 1.0000 ± 0.0025 . An axial depiction of the experimental arrangement is shown in Figure 4 and a radial view of the pin array in Figure 5.

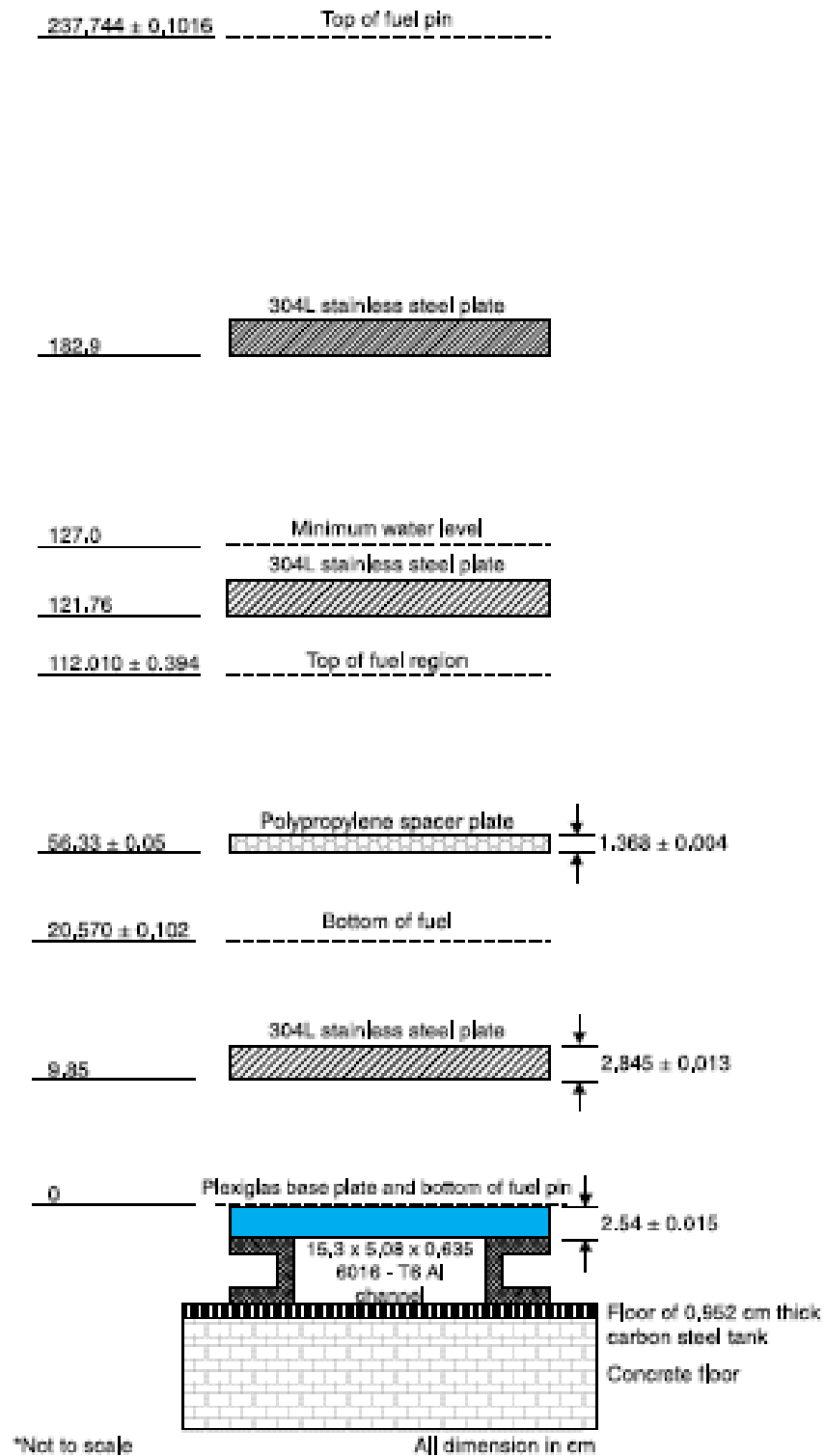


Figure 4. Experimental Arrangement, axial view, for MIX-COMP-THERM-001-001

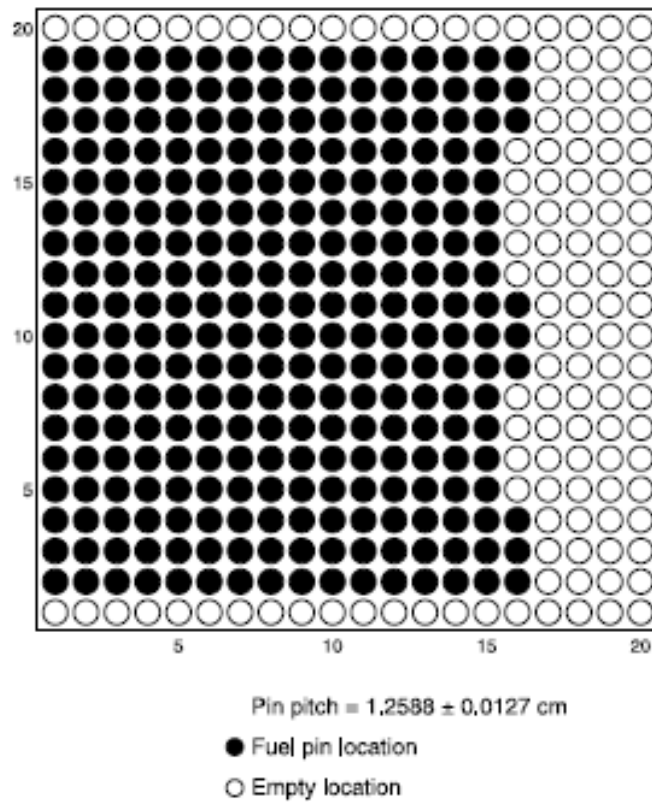


Figure 5. Experimental Arrangement, radial view, of Pin Array for MIX-COMP-THERM-001-001

[U233-SOL-THERM-001-001](#): The experiment consists of one of a series of measurements performed at Oak Ridge National Laboratory on unreflected 27.24-inch diameter spheres of homogenous aqueous ^{233}U nitrate solution. A photo of the experimental arrangement is shown in Figure 6.

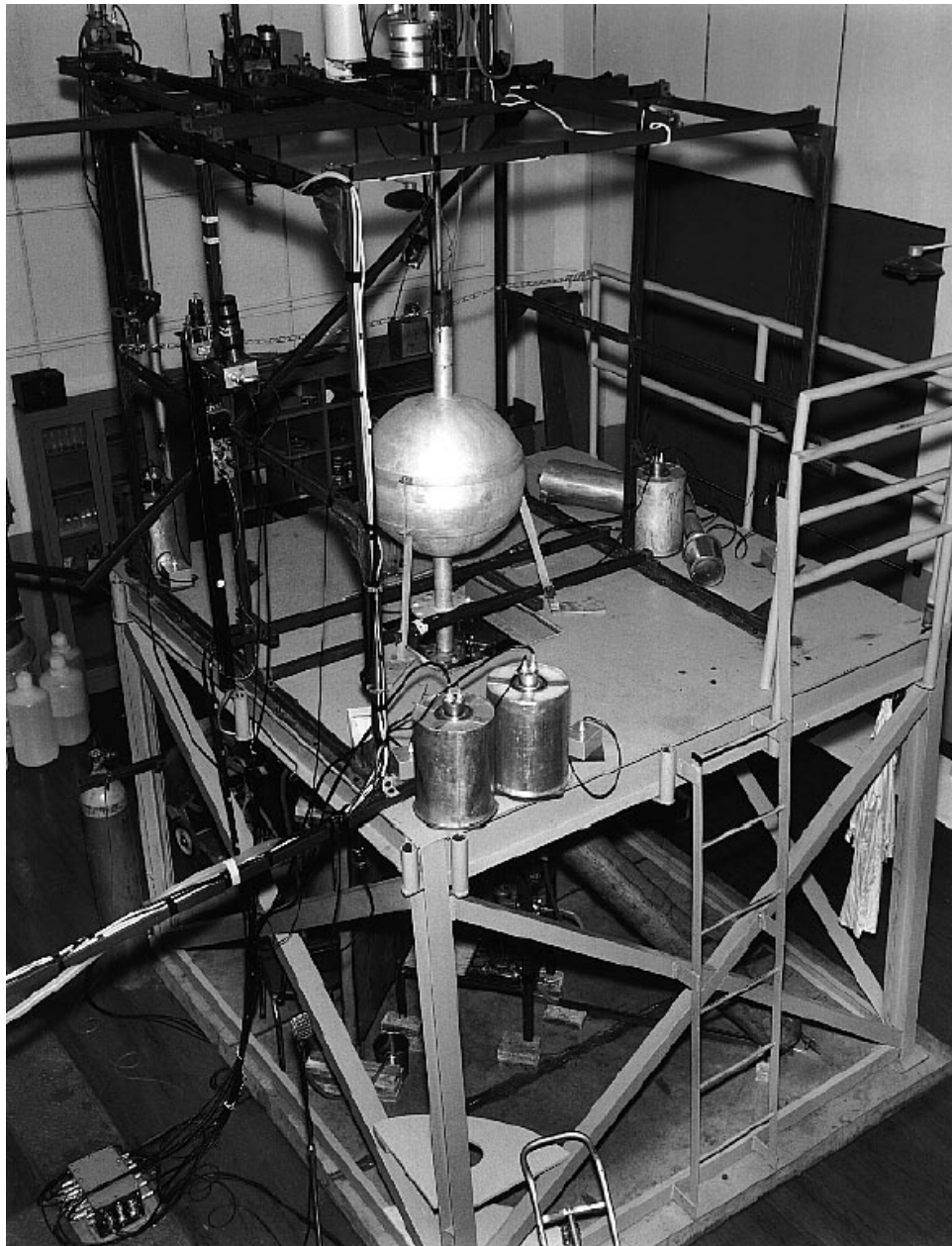


Figure 6. Experimental Arrangement for U233-SOL-THERM-001-001

Results were computed on the Los Alamos National Laboratory High Performance Computing (HPC) platform Snow. This platform is based on Linux OS with Intel Xeon Broadwell processors and 36 CPU nodes per core. The MCNP6.2 calculations were done using 16 tasks. Each MCNP6.2 case was modeled with 100,000 neutrons per cycle. Initially, skipping 100 cycles and running a total of 600 cycles for a total of 50 million neutrons overall.

Once the MCNP6.2 results were obtained, Whisper using all available benchmarks in the library, including those determined to be statistical outliers was used to compute USL. Each individual cases was excluded from the benchmark collection since they are used as application cases for the purposes of this study. Results for the calculational margin, the computed statistical bias and bias uncertainty, are compared in several studies.

Results

IEU-MET-FAST-002-001

Statistical results for the case are shown in Table 1. A subset of the benchmarks in each of the collections, enough found to be neutronically similar for valid statistical analysis in each case, are used to compute the baseline USL.

Whisper selected 219 benchmarks as similar when using the LANL Whisper-1.1 library; selections displayed in Table 6 in the Appendix. For the IEU-MET-FAST-002-001 case the series of relevant benchmark experiments are from IEU-MET-FAST and HEU-MET-FAST experiment series. One benchmark was found to be highly correlated, or to have high neutronic similarity, to the application case, with ck 0.9603. Most benchmarks had lower ck from 0.8249 to 0.5971, which explains why 219 benchmarks were selected for the collection used to compute USL. The baseline USL for a benchmark collection with Whisper library is 0.9805, although in actual application cases consideration should be given to applying an additional area of applicability margin due to the low similarity of a number of benchmarks..

Whisper selected 170 benchmarks as similar when using the SNL library; selections displayed in Table 7 in the Appendix. For the IEU-MET-FAST-002-001 case the series of relevant benchmark experiments are from IEU-MET-FAST, HEU-MET-FAST, MIX-MET-FAST, HEU-COMP-MIXED, and HEU-COMP-INTER experiment series. Five benchmarks were found to be highly correlated, or to have high neutronic similarity, to the application case, with ck 0.9824 to 0.9422. The remaining benchmarks had lower ck from 0.8267 to 0.5880, which explains why 170 benchmarks were selected for the collection used to compute USL. The baseline USL for a benchmark collection with SNL library is 0.9717, although in actual application cases consideration should be given to applying an additional area of applicability margin due to the low similarity of a number of benchmarks.

Whisper selected 148 benchmarks as similar when using the SRNS library; selections displayed in Table 8 in the Appendix. For the IEU-MET-FAST-002-001 case the series of relevant benchmark experiments are from IEU-MET-FAST, HEU-MET-FAST, HEU-COMP-INTER, and HEU-COMP-MIXED experiment series. Benchmarks were not found to be highly correlated, or to have high neutronic similarity, to the application case, with ck from 0.8251 to 0.5510, which explains why 148 benchmarks were selected for the collection used to compute USL. The baseline USL for a benchmark collection with SRNS library is 0.9667, although in actual application cases consideration should be given to applying an additional area of applicability margin due to the low similarity of a number of benchmarks.

Table 1. Comparison of Whisper output using IEU-MET-FAST-001-002 as an application case.

$K_{\text{experiment}}$	$\sigma_{\text{experiment}}$	$K_{\text{MCNP6.2}}$	$\sigma_{\text{MCNP6.2}}$
1.0000	0.0030	0.99892	0.00009
Whisper-1.1 Results			
	LANL Whisper Library	SNL Library	SRNS Library
Bias	-0.00722	-0.01143	-0.01552
Bias Uncertainty*	0.00551	0.01008	0.01098
Nuclear Data Uncertainty*	0.00088	0.00088	0.00088
MOS code errors	0.00500	0.00500	0.00500
Baseline USL	0.9805	0.9717	0.9667
Benchmark Population	219	170	148

*Statistical bias uncertainty reported at 99% confidence level

**Nuclear data uncertainty reported at 1-sigma level, *2.6 for USL calculation at 99%.

LEU-COMP-THERM-001-001

Statistical results for the case are shown in Table 2. A subset of the benchmarks in each of the collections, enough found to be neutronicallly similar for valid statistical analysis in each case, are used to compute the baseline USL.

Whisper selected 69 benchmarks as similar when using the LANL Whisper-1.1 library; selections displayed in Table 9 in the Appendix. For the LEU-COMP-THERM-001-001 case the series of relevant benchmark experiments are from LEU-COMP-THERM and HEU-MET-FAST experiment series. The benchmarks were found to be highly correlated, or to have high neutronic similarity, to the application case, with ck from 0.9991 to 0.9748. The baseline USL for a benchmark collection with Whisper library is 0.9844.

Whisper selected 63 benchmarks as similar when using the SNL library; selections displayed in Table 10 in the Appendix. For the LEU-COMP-THERM-001-001 case the series of relevant benchmark experiments are from LEU-COMP-THERM experiment series. The benchmarks were found to be highly correlated, or to have high neutronic similarity, to the application case, with ck from 0.9993 to 0.9630. The baseline USL for a benchmark collection with SNL library is 0.9829.

Whisper selected 50 benchmarks as similar when using the SRNS library; selections displayed in Table 11 in the Appendix. For the LEU-COMP-THERM-001-001 case the series of relevant benchmark experiments are from LEU-COMP-THERM experiment series. The benchmarks were found to be highly correlated, or to have high neutronic similarity, to the application case, with ck from 0.9994 to 0.9530. The baseline USL for a benchmark collection with SRNS library is 0.9846.

Table 2. Comparison of Whisper output using LEU-COMP-THERM-001-001 as an application case.

$K_{\text{experiment}}$	$\sigma_{\text{experiment}}$	$K_{\text{MCNP6.2}}$	$\sigma_{\text{MCNP6.2}}$
0.9998	0.0030	0.99985	0.00009
Whisper-1.1 Results			
	LANL Whisper Library	SNL Library	SRNS Library
Bias	-0.00696	-0.00755	-0.00686
Bias Uncertainty*	0.00289	0.00388	0.00287
Nuclear Data Uncertainty*	0.00033	0.00033	0.00033
MOS code errors	0.00500	0.00500	0.00500
Baseline USL	0.9844	0.9829	0.9846
Benchmark Population	69	63	50

*Statistical bias uncertainty reported at 99% confidence level

**Nuclear data uncertainty reported at 1-sigma level, *2.6 for USL calculation at 99%.

LEU-SOL-THERM-004-001

Statistical results for the case are shown in Table 3. A subset of the benchmarks in each of the collections, enough found to be neutronicallly similar for valid statistical analysis in each case, are used to compute the baseline USL.

Whisper selected 60 benchmarks as similar when using the LANL Whisper-1.1 library; selections displayed in Table 12 in the Appendix. For the LEU-SOL-THERM-004-001 case the series of relevant benchmark experiments are from LEU-SOL-THERM, LEU-COMP-THERM, HEU-SOL-THERM, and HEU-COMP-THERM experiment series. Benchmark were found to be highly correlated, or to have high neutronic similarity, to the application case, with ck from 0.9992 to 0.9434. The baseline USL for a benchmark collection with Whisper library is 0.9806.

Whisper selected 40 benchmarks as similar when using the SNL library; selections displayed in Table 13 in the Appendix. For the LEU-SOL-THERM-004-001 case the series of relevant benchmark experiments are from LEU-SOL-THERM experiment series. Benchmarks were found to be highly correlated, or to have high neutronic similarity, to the application case, with ck from 0.9992 to 0.9907. The baseline USL for a benchmark collection with SNL library is 0.9816.

Whisper selected 75 benchmarks as similar when using the SRNS library; selections displayed in Table 14 in the Appendix. For the LEU-SOL-THERM-004-001 case the series of relevant benchmark experiments are from LEU-SOL-THERM, IEU-SOL-THERM, LEU-COMP-THERM, HEU-SOL-THERM, and HEU-MET-THERM experiment series. Benchmark were found to be highly correlated, or to have high neutronic similarity, to the application case, with ck from 0.9993 to 0.9288. The baseline USL for a benchmark collection with SRNS library is 0.9798.

Table 3. Comparison of Whisper output using LEU-SOL-THERM-004-001 as an application case.

$K_{\text{experiment}}$	$\sigma_{\text{experiment}}$	$K_{\text{MCNP6.2}}$	$\sigma_{\text{MCNP6.2}}$
0.9994	0.0008	1.00042	0.00010
Whisper-1.1 Results			
	LANL Whisper Library	SNL Library	SRNS Library
Bias	-0.00745	-0.00718	-0.00984
Bias Uncertainty*	0.00620	0.00551	0.00464
Nuclear Data Uncertainty*	0.00035	0.00035	0.00035
MOS code errors	0.00500	0.00500	0.00500
Baseline USL	0.9806	0.9816	0.9798
Benchmark Population	60	40	75

*Statistical bias uncertainty reported at 99% confidence level

**Nuclear data uncertainty reported at 1-sigma level, *2.6 for USL calculation at 99%.

MIX-COMP-THERM-001-001

Statistical results for the case are shown in Table 4. A subset of the benchmarks in each of the collections, enough found to be neutronic similar for valid statistical analysis in each case, are used to compute the baseline USL.

Whisper selected 84 benchmarks as similar when using the LANL Whisper-1.1 library; selections displayed in Table 15 in the Appendix. For the MIX-COMP-THERM-001-001 case the series of relevant benchmark experiments are from MIX-COMP-THERM, MIX-SOL-THERM, PU-SOL-THERM, and PU-COMP-MIXED experiment series. Benchmarks were found to be highly correlated, or to have high neutronic similarity, to the application case, with ck from 0.9908 to 0.9583. The baseline USL for a benchmark collection with Whisper library is 0.9795.

Whisper selected 89 benchmarks as similar when using the SNL library; selections displayed in Table 16 in the Appendix. For the MIX-COMP-THERM-001-001 case the series of relevant benchmark experiments are from MIX-COMP-THERM, MIX-SOL-THERM, and PU-SOL-THERM experiment series. Benchmarks were found to be highly correlated, or to have high neutronic similarity, to the application case, with ck from 0.9836 to 0.9437. The baseline USL for a benchmark collection with SNL library is 0.9822.

Whisper selected 68 benchmarks as similar when using the SRNS library; selections displayed in Table 17 in the Appendix. For the MIX-COMP-THERM-001-001 case the series of relevant benchmark experiments are from MIX-MISC-THERM, MIX-SOL-THERM, PU-COMP-MIXED, and PU-SOL-THERM experiment series. Benchmarks were found to be highly correlated, or to have high neutronic similarity, to the application case, with ck from 0.9973 to 0.9536. The baseline USL for a benchmark collection with SRNS library is 0.9729.

Table 4. Comparison of Whisper output using MIX-COMP-THERM-001-001 as an application case.

$K_{\text{experiment}}$	$\sigma_{\text{experiment}}$	$K_{\text{MCNP6.2}}$	$\sigma_{\text{MCNP6.2}}$
1.0000	0.0025	1.00131	0.00012
Whisper-1.1 Results			
	LANL Whisper Library	SNL Library	SRNS Library
Bias	-0.01054	-0.00721	-0.01504
Bias Uncertainty*	0.00372	0.00430	0.00583
Nuclear Data Uncertainty*	0.00060	0.00060	0.00060
MOS code errors	0.00500	0.00500	0.00500
Baseline USL	0.9795	0.9822	0.9729
Benchmark Population	84	89	68

*Statistical bias uncertainty reported at 99% confidence level

**Nuclear data uncertainty reported at 1-sigma level, *2.6 for USL calculation at 99%.

In an additional collaboration under DOE NCSP involving IRSN, ORNL, LANL, and LLNL with a focus on comparing benchmark results, discrepancies have been revealed in LANL results for MIX-SOL-THERM-001 cases 6 and 11. When corrections are made the Whisper-1.1 library for these cases, the LANL Whisper library baseline USL results are the same as those presented in Table 4.

U233-SOL-THERM-001-001

Statistical results for the case are shown in Table 5. A subset of the benchmarks in each of the collections, enough found to be neutronically similar for valid statistical analysis in each case, are used to compute the baseline USL.

Whisper selected 88 benchmarks as similar when using the LANL Whisper-1.1 library; selections displayed in Table 18 in the Appendix. For the U233-SOL-THERM-001-001 case the series of relevant benchmark experiments are from U233-SOL-THERM, U233-COMP-THERM, and U233-SOL-INTER experiment series. Benchmarks were found to be fairly highly correlated, or to have high neutronic similarity, to the application case, with ck from 0.9998 to 0.8103. The baseline USL for a benchmark collection with Whisper library is 0.9728.

Whisper selected 254 benchmarks as similar when using the SNL; selections displayed in Table 19 in the Appendix. For the U233-SOL-THERM-001-001 case the series of relevant benchmark experiments are from HEU-SOL-THERM, IEU-COMP-THERM, LEU-COMP-THERM, and LEU-SOL-THERM experiment series because there are no U233 benchmarks in the library. Benchmarks were found to be very poorly correlated, or to have a very low degree of neutronic similarity, to the application case, with ck from 0.3604 to 0.2764. The benchmarks selected are due to the thermal neutrons in the system. The baseline USL for a benchmark collection with SNL library is 0.9618, however because the benchmarks are so poorly correlated this baseline USL should not be considered applicable to U233.

Whisper selected 210 benchmarks as similar when using the SRNS library; selections displayed in Table 20 in the Appendix. For the U233-SOL-THERM-001-001 case the series of relevant benchmark experiments are from HEU-SOL-THERM, IEU-SOL-THERM, HEU-MET-THERM, LEU-COMP-THERM, and LEU-SOL-THERM experiment series because there are no U233 benchmarks in the library. The benchmarks selected are due to the thermal neutrons in the system. Benchmarks were found to be very poorly correlated, or to have a very low degree of neutronic similarity, to the application case, with ck from 0.3606 to 0.2764. The baseline USL for a benchmark collection with SRNS library is 0.9686, however because the benchmarks are so poorly correlated this baseline USL should not be considered applicable to U233.

Table 5. Comparison of Whisper output using U233-SOL-THERM-001-001 as an application case.

$K_{\text{experiment}}$	$\sigma_{\text{experiment}}$	$K_{\text{MCNP6.2}}$	$\sigma_{\text{MCNP6.2}}$
1.0000	0.0031	1.00126	0.00008
Whisper-1.1 Results			
	LANL Whisper Library	SNL Library	SRNS Library
Bias	-0.00989	-0.02038	-0.01591
Bias Uncertainty*	0.01006	0.01050	0.00816
Nuclear Data Uncertainty*	0.00112	0.00112	0.00112
MOS code errors	0.00500	0.00500	0.00500
Baseline USL	0.9728	0.9618	0.9686
Benchmark Population	88	254	210

*Statistical bias uncertainty reported at 99% confidence level

**Nuclear data uncertainty reported at 1-sigma level, *2.6 for USL calculation at 99%.

Summary of Benchmark Cases Run as Applications

This paper presents results for the USL, CM and portions of the MOS for U233-SOL-THERM-001-001, MIX-COMP-THERM-001-001, IEU-MET-FAST-002-001, LEU-COMP-THERM-001-001, LEU-SOL-THERM-004-001 chosen to run as applications using Whisper-1.1. The benchmark experiments are chosen as applications for comparison of statistical bias and bias uncertainty with the actual code bias and experimental uncertainty. In all cases the computed statistical bias and bias uncertainty are conservative with respect to the actual bias and bias uncertainty.

The benchmarks taken as cases:

1. are modeled independently by sites based upon information provided in the ICSBEP Handbook,
2. are common in S/U libraries for LANL, IRSN, and ORNL,
3. span a range of energy spectrum and fissile material, and
4. taken as applications and therefore excluded from respective benchmark libraries

Results presented in this paper have been computed using covariance data for all isotopes in ENDF/B-VII.0 using a 44-group energy structure [Reference 6]. Benchmarks in the Whisper library were run with MCNP6.2 using 100,000 neutrons per cycle, skipping 100 cycles for 500 active cycles. Reference 10 also compares the results for baseline USL with an order of magnitude greater neutrons, using the same total number of cycles with 1,000,000 neutrons per cycle. There was insignificant difference, ≤ 0.00005 , in the USL when running an order of magnitude more neutrons.

A comparison has been done to compute USLs with and without statistical outliers in the Whisper-1.1 benchmark collection to determine what effect rejection of statistical outliers has on the recommended USL in Reference 11. The effect of exclusion of benchmarks which are found to be statistical outliers from the collection of benchmarks used by Whisper-1.1 on nuclear criticality safety validation is found to be small. The results show little overall difference in the recommended baseline USLs developed by Whisper when excluding statistical outliers. Additionally, there does not appear to be a clear trend in predicting whether the baseline USL will be higher or lower when rejecting statistical outliers from the benchmark critical experiment collection used for validation.

This study examines the results from Whisper using the LANL Whisper, SNL, and SRNS benchmark libraries. The results are reported in preparation for a collaborative study to compare the results using different S/U methods and different libraries. The comparison will examine differences when using Whisper with the LANL Whisper library, the ORNL method with its library, and the IRSN method with its library.

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Appendix: Tables of Selected Benchmarks

Table 6. Benchmarks Selected by Whisper as Similar to Application IEU-MET-FAST-002-001 from LANL library

Benchmark Selected from LANL Library	ck	weight
ieu-met-fast-007-001.i	0.9603	1.0000
ieu-met-fast-005-001.i	0.8249	0.6277
heu-met-mixed-004-001.i	0.7974	0.5522
ieu-met-fast-004-001.i	0.7754	0.4915
ieu-met-fast-006-001.i	0.7753	0.4914
ieu-met-fast-001-004.i	0.7678	0.4707
ieu-met-fast-003-001.i	0.7641	0.4606
ieu-met-fast-001-003.i	0.7524	0.4284
heu-met-fast-038-002.i	0.7278	0.3609
ieu-met-fast-008-001.i	0.7271	0.3589
heu-met-fast-038-001.i	0.716	0.3283
heu-met-fast-030-001.i	0.7134	0.3212
ieu-met-fast-009-001.i	0.7117	0.3164
heu-met-fast-078-043.i	0.6742	0.2135
heu-met-fast-017-001.i	0.6709	0.2043
heu-met-fast-094-002.i	0.6673	0.1944
heu-met-fast-078-027.i	0.6654	0.1892
heu-met-fast-078-031.i	0.6639	0.1852
heu-met-fast-078-035.i	0.6637	0.1845
heu-met-fast-078-039.i	0.6633	0.1836
heu-met-fast-078-003.i	0.6631	0.1831
heu-met-fast-078-037.i	0.6626	0.1815
heu-met-fast-078-023.i	0.6624	0.1810
heu-met-fast-007-027.i	0.6621	0.1801
heu-met-fast-007-002.i	0.6611	0.1774
heu-met-fast-078-029.i	0.6607	0.1763
heu-met-fast-078-025.i	0.6603	0.1751
heu-met-fast-007-004.i	0.6589	0.1715
heu-met-fast-007-005.i	0.6586	0.1707
heu-met-fast-078-033.i	0.6586	0.1707
heu-met-fast-007-003.i	0.6577	0.1681
heu-met-fast-016-001.i	0.6566	0.1650
heu-met-fast-094-001.i	0.6562	0.1640
heu-met-fast-007-028.i	0.656	0.1635
heu-met-fast-007-008.i	0.6559	0.1633
heu-met-fast-063-002.i	0.6559	0.163
heu-met-fast-078-013.i	0.655	0.1608
heu-met-fast-066-009.i	0.6544	0.1590
heu-met-fast-007-007.i	0.6544	0.1590
heu-met-fast-007-009.i	0.6543	0.1588
heu-met-fast-078-017.i	0.654	0.1580
heu-met-fast-078-005.i	0.6536	0.1569
heu-met-fast-051-009.i	0.6531	0.1554
heu-met-fast-051-018.i	0.6531	0.1553
heu-met-fast-007-006.i	0.6523	0.1533

heu-met-fast-016-002.i	0.6521	0.1526
heu-met-fast-066-007.i	0.652	0.1524
heu-met-fast-078-009.i	0.6519	0.1522
heu-met-fast-078-015.i	0.6517	0.1515
heu-met-fast-041-006.i	0.6515	0.1510
heu-met-fast-078-011.i	0.6511	0.1499
heu-met-fast-007-020.i	0.6506	0.1486
heu-met-fast-066-005.i	0.6504	0.1480
heu-met-fast-066-006.i	0.6503	0.1479
heu-met-fast-041-005.i	0.6501	0.1472
heu-met-fast-041-004.i	0.6499	0.1466
heu-met-fast-007-029.i	0.6497	0.1461
heu-met-fast-088-001.i	0.6497	0.1460
heu-met-fast-005-003.i	0.6496	0.1458
heu-met-fast-051-017.i	0.6494	0.1453
heu-met-fast-007-022.i	0.6487	0.1435
heu-met-fast-078-001.i	0.6484	0.1425
heu-met-fast-007-021.i	0.6483	0.1423
heu-met-fast-066-008.i	0.6482	0.1420
heu-met-fast-078-041.i	0.6482	0.1420
ieu-met-fast-001-001.i	0.6465	0.1373
heu-met-fast-005-004.i	0.6465	0.1372
heu-met-fast-066-003.i	0.6465	0.1372
heu-met-fast-066-002.i	0.6463	0.1367
heu-met-fast-066-001.i	0.6461	0.1363
heu-met-fast-063-001.i	0.646	0.1361
heu-met-fast-087-001.i	0.6459	0.1357
heu-met-fast-077-008.i	0.6452	0.1337
heu-met-fast-007-032.i	0.6449	0.1330
heu-met-fast-077-007.i	0.6445	0.1318
heu-met-fast-066-004.i	0.6443	0.1314
heu-met-fast-043-005.i	0.6443	0.1312
heu-met-fast-051-004.i	0.6439	0.1303
ieu-met-fast-001-002.i	0.6437	0.1296
heu-met-fast-041-001.i	0.6436	0.1293
heu-met-fast-077-006.i	0.6433	0.1287
heu-met-fast-007-033.i	0.6432	0.1283
heu-met-fast-077-001.i	0.6424	0.1260
heu-met-fast-072-003.i	0.6423	0.1258
heu-met-fast-077-005.i	0.6421	0.1251
heu-met-fast-064-001.i	0.642	0.1249
heu-met-fast-043-004.i	0.6417	0.1240
heu-met-fast-043-003.i	0.6415	0.1236
heu-met-fast-041-002.i	0.6415	0.1236
heu-met-fast-007-034.i	0.6414	0.1232
heu-met-fast-077-002.i	0.6413	0.1231
heu-met-fast-007-001.i	0.6413	0.1231
heu-met-fast-079-004.i	0.6411	0.1225

heu-met-inter-006-004.i	0.6409	0.1219
heu-met-fast-058-002.i	0.6405	0.1209
heu-met-fast-077-004.i	0.6404	0.1205
heu-met-fast-051-016.i	0.6404	0.1205
heu-met-fast-058-003.i	0.6399	0.1193
heu-met-fast-079-005.i	0.6399	0.1192
heu-met-fast-057-003.i	0.6399	0.1191
heu-met-fast-005-005.i	0.6397	0.1187
heu-met-fast-043-002.i	0.639	0.1168
heu-met-fast-005-002.i	0.639	0.1168
heu-met-fast-057-005.i	0.6389	0.1164
heu-met-fast-051-002.i	0.6389	0.1163
heu-met-fast-051-003.i	0.6388	0.1162
heu-met-fast-044-004.i	0.6387	0.1159
heu-met-fast-051-001.i	0.6386	0.1155
heu-met-fast-064-003.i	0.6385	0.1153
heu-met-fast-058-001.i	0.6384	0.1150
heu-met-fast-041-003.i	0.638	0.1139
heu-met-inter-006-003.i	0.638	0.1138
heu-met-fast-089-001.i	0.6379	0.1137
heu-met-fast-064-002.i	0.6377	0.1130
heu-met-fast-084-005.i	0.6375	0.1127
heu-met-fast-034-003.i	0.6375	0.1126
heu-met-fast-044-005.i	0.6373	0.1121
heu-met-fast-079-002.i	0.6372	0.1118
heu-met-fast-077-003.i	0.6371	0.1116
heu-met-fast-084-027.i	0.6371	0.1116
heu-met-fast-079-001.i	0.637	0.1113
heu-met-fast-044-001.i	0.637	0.1111
heu-met-fast-043-001.i	0.6367	0.1104
heu-met-fast-084-026.i	0.6363	0.1094
heu-met-fast-084-007.i	0.6362	0.1091
heu-met-fast-084-003.i	0.6362	0.1090
heu-met-fast-079-003.i	0.6356	0.1074
heu-met-fast-034-001.i	0.6352	0.1063
heu-met-fast-058-004.i	0.635	0.1058
heu-met-fast-044-002.i	0.6348	0.1052
heu-met-fast-007-023.i	0.6346	0.1046
heu-met-fast-044-003.i	0.6344	0.1041
heu-met-fast-084-017.i	0.6344	0.1041
heu-met-fast-026-011.i	0.6342	0.1035
heu-met-fast-072-001.i	0.6337	0.1021
heu-met-fast-051-015.i	0.6336	0.1018
heu-met-fast-007-024.i	0.6333	0.1010
heu-met-fast-091-001.i	0.633	0.1003
heu-met-fast-084-016.i	0.6329	0.1000
heu-met-fast-084-004.i	0.6329	0.0998
heu-met-mixed-001-001.i	0.6328	0.0998

heu-met-fast-033-001.i	0.6327	0.0993
heu-met-fast-034-002.i	0.6324	0.0986
heu-met-fast-057-006.i	0.6322	0.0981
heu-met-fast-058-005.i	0.6321	0.0978
heu-met-fast-015-001.i	0.6316	0.0964
heu-met-fast-003-012.i	0.6315	0.0961
heu-met-fast-092-001.i	0.6315	0.0961
heu-met-fast-040-001.i	0.6314	0.0959
heu-met-fast-084-023.i	0.6312	0.0952
heu-met-fast-084-010.i	0.6308	0.0941
heu-met-fast-010-001.i	0.6307	0.0939
heu-met-fast-010-002.i	0.6307	0.0939
heu-met-fast-084-019.i	0.6307	0.0938
heu-met-fast-057-002.i	0.6306	0.0936
heu-met-fast-025-002.i	0.6305	0.0934
heu-met-fast-004-001.i	0.6303	0.0927
heu-met-fast-090-001.i	0.6297	0.0911
heu-met-fast-065-002.i	0.6297	0.0911
heu-met-fast-084-011.i	0.6297	0.0911
heu-met-fast-084-012.i	0.6291	0.0895
heu-met-inter-006-002.i	0.6287	0.0884
heu-met-fast-007-036.i	0.6286	0.0881
heu-met-fast-007-010.i	0.6285	0.0880
heu-met-fast-021-002.i	0.6285	0.0880
heu-met-fast-025-001.i	0.6278	0.0859
heu-met-fast-007-019.i	0.6277	0.0856
heu-met-fast-019-001.i	0.6277	0.0856
heu-met-fast-007-035.i	0.6275	0.0851
heu-met-fast-078-007.i	0.6274	0.0849
heu-met-fast-084-022.i	0.6269	0.0833
heu-met-fast-057-001.i	0.6267	0.0829
heu-met-fast-057-004.i	0.6258	0.0804
heu-met-fast-025-004.i	0.6257	0.0802
heu-met-fast-084-001.i	0.6249	0.0780
heu-met-fast-025-003.i	0.6246	0.0771
heu-met-fast-084-015.i	0.6245	0.0769
heu-met-fast-007-030.i	0.6244	0.0766
heu-met-fast-093-001.i	0.6238	0.0749
heu-met-fast-013-001.i	0.6235	0.0742
heu-met-fast-007-026.i	0.6233	0.0736
heu-met-fast-084-002.i	0.6226	0.0716
heu-met-fast-007-025.i	0.6223	0.0708
heu-met-fast-009-001.i	0.6220	0.0699
heu-met-fast-009-002.i	0.6209	0.0669
heu-met-fast-051-014.i	0.6208	0.0668
heu-met-fast-092-002.i	0.6207	0.0663
heu-met-fast-025-005.i	0.6203	0.0653
heu-met-inter-006-001.i	0.6195	0.0632

heu-met-fast-005-006.i	0.6194	0.0629
heu-met-fast-011-001.i	0.6188	0.0612
heu-met-fast-007-038.i	0.6186	0.0607
heu-met-fast-100-001.i	0.6185	0.0604
heu-met-fast-084-021.i	0.6184	0.0602
heu-met-fast-007-037.i	0.6181	0.0592
heu-met-fast-002-005.i	0.6181	0.0592
heu-met-fast-007-039.i	0.6180	0.0588
heu-met-fast-027-001.i	0.6175	0.0576
heu-met-fast-001-001.i	0.6171	0.0566
heu-met-fast-100-002.i	0.6169	0.0560
heu-met-fast-007-040.i	0.6169	0.0560
heu-met-fast-008-001.i	0.6167	0.0553
heu-met-fast-088-002.i	0.6162	0.0540
heu-met-fast-092-004.i	0.6145	0.0493
heu-met-fast-092-003.i	0.6139	0.0477
heu-met-fast-020-002.i	0.6121	0.0427
heu-met-fast-002-003.i	0.6095	0.0357
heu-met-fast-022-002.i	0.6086	0.0332
heu-met-fast-084-018.i	0.6084	0.0325
heu-met-fast-084-020.i	0.6078	0.0311
heu-met-fast-012-001.i	0.6075	0.0301
heu-met-fast-018-002.i	0.6059	0.0256
heu-met-fast-084-009.i	0.6052	0.0237
heu-met-fast-007-011.i	0.6051	0.0235
heu-met-fast-049-001.i	0.6048	0.0227
heu-met-fast-003-007.i	0.6036	0.0194
heu-met-fast-090-002.i	0.6024	0.0161
heu-met-fast-002-004.i	0.5983	0.0047
heu-met-fast-033-002.i	0.5971	0.0015
heu-met-fast-012-001.i	0.6075	0.0301
heu-met-fast-018-002.i	0.6059	0.0256
heu-met-fast-084-009.i	0.6052	0.0237
heu-met-fast-007-011.i	0.6051	0.0235
heu-met-fast-049-001.i	0.6048	0.0227
heu-met-fast-003-007.i	0.6036	0.0194
heu-met-fast-090-002.i	0.6024	0.0161
heu-met-fast-002-004.i	0.5983	0.0047
heu-met-fast-033-002.i	0.5971	0.0015

Table 7. Benchmarks Selected by Whisper as Similar to Application IEU-MET-FAST-002-001 from SNL Library

Benchmark Selected from SNL Library	ck	weight
ieu-met-fast-013-001.i	0.9824	1.0000
ieu-met-fast-012-001.i	0.9667	0.9602
ieu-met-fast-007-001.i	0.9602	0.9437
ieu-met-fast-010-001.i	0.9505	0.9191
ieu-met-fast-014-001.i	0.9422	0.8981
ieu-met-fast-005-001.i	0.8267	0.6051
ieu-met-fast-014-002.i	0.7897	0.5113

ieu-met-fast-004-001.i	0.7800	0.4869
ieu-met-fast-001-004.i	0.7691	0.4591
ieu-met-fast-003-001.i	0.7635	0.4450
ieu-met-fast-006-001.i	0.7592	0.4340
ieu-met-fast-001-003.i	0.7474	0.4040
ieu-met-fast-008-001.i	0.7353	0.3735
heu-met-fast-038-002.i	0.7257	0.3491
ieu-met-fast-009-001.i	0.7151	0.3223
heu-met-fast-030-001.i	0.7116	0.3134
heu-met-fast-038-001.i	0.7100	0.3093
heu-met-fast-017-001.i	0.6718	0.2125
heu-met-fast-023-021.i	0.6717	0.2121
heu-met-fast-007-002.i	0.6655	0.1964
heu-met-inter-001-001.i	0.6645	0.1939
heu-met-fast-023-007.i	0.6636	0.1916
heu-met-fast-023-017.i	0.6614	0.1860
heu-met-fast-023-016.i	0.6610	0.1849
heu-met-fast-007-027.i	0.6608	0.1845
mix-met-fast-008-002.i	0.6596	0.1815
heu-met-fast-007-004.i	0.6596	0.1814
heu-met-fast-007-003.i	0.6590	0.1799
heu-met-fast-007-005.i	0.6579	0.1771
heu-met-fast-063-002.i	0.6577	0.1766
heu-met-fast-007-028.i	0.6573	0.1757
heu-met-fast-066-009.i	0.6569	0.1746
heu-met-fast-016-001.i	0.6568	0.1744
heu-met-fast-007-008.i	0.6554	0.1709
heu-met-fast-023-006.i	0.6549	0.1697
heu-met-fast-007-007.i	0.6549	0.1695
heu-met-fast-016-002.i	0.6541	0.1676
heu-met-fast-007-009.i	0.6536	0.1661
heu-met-fast-007-006.i	0.6521	0.1624
heu-met-fast-041-006.i	0.6515	0.1609
heu-met-fast-066-006.i	0.6510	0.1595
heu-met-fast-066-007.i	0.6509	0.1595
ieu-met-fast-001-001.i	0.6508	0.1591
heu-met-fast-066-005.i	0.6507	0.1589
heu-met-fast-041-005.i	0.6501	0.1574
heu-met-fast-007-020.i	0.6500	0.1572
heu-met-fast-041-004.i	0.6499	0.1568
heu-met-fast-007-029.i	0.6497	0.1564
heu-met-fast-005-003.i	0.6496	0.1562
heu-met-fast-063-001.i	0.6494	0.1556
heu-met-fast-066-008.i	0.6486	0.1535
heu-met-fast-048-017.i	0.6478	0.1515
heu-met-fast-005-004.i	0.6477	0.1513
heu-met-fast-007-022.i	0.6468	0.1490
heu-met-fast-066-001.i	0.6468	0.1489

heu-met-fast-066-002.i	0.6467	0.1488
heu-met-fast-023-012.i	0.6465	0.1483
heu-met-fast-007-021.i	0.6461	0.1473
heu-met-fast-007-032.i	0.6452	0.1450
heu-met-fast-066-003.i	0.6451	0.1448
heu-met-fast-048-016.i	0.6450	0.1445
heu-met-fast-023-002.i	0.6445	0.1433
heu-met-fast-041-001.i	0.6436	0.1408
heu-met-fast-066-004.i	0.6434	0.1404
heu-met-fast-007-001.i	0.6422	0.1375
heu-met-fast-007-033.i	0.6416	0.1359
heu-met-fast-041-002.i	0.6415	0.1356
heu-met-fast-023-018.i	0.6412	0.1349
heu-met-fast-023-013.i	0.6410	0.1343
heu-met-fast-023-010.i	0.6407	0.1334
heu-met-fast-048-015.i	0.6405	0.1331
heu-met-fast-048-012.i	0.6404	0.1328
ieu-met-fast-001-002.i	0.6401	0.1320
heu-met-fast-007-034.i	0.6401	0.1319
heu-met-fast-048-013.i	0.6400	0.1317
heu-met-fast-084-026.i	0.6399	0.1315
heu-met-fast-058-003.i	0.6395	0.1306
heu-met-fast-058-002.i	0.6393	0.1300
heu-met-fast-005-002.i	0.6389	0.1289
heu-met-fast-084-027.i	0.6385	0.1280
heu-met-fast-023-005.i	0.6383	0.1276
heu-met-fast-005-005.i	0.6382	0.1272
heu-met-fast-023-003.i	0.6381	0.1269
heu-met-fast-041-003.i	0.6380	0.1266
heu-met-fast-023-008.i	0.6376	0.1256
heu-met-fast-048-014.i	0.6373	0.1249
heu-met-fast-023-020.i	0.6371	0.1244
heu-met-fast-007-023.i	0.6368	0.1238
heu-met-fast-058-001.i	0.6363	0.1225
heu-met-fast-058-004.i	0.6357	0.1209
heu-met-fast-048-011.i	0.6355	0.1203
mix-met-fast-008-005.i	0.6352	0.1197
heu-met-fast-023-009.i	0.6351	0.1193
heu-met-fast-004-001.i	0.6350	0.1190
heu-met-fast-084-003.i	0.6345	0.1178
heu-met-fast-015-001.i	0.6341	0.1169
heu-met-fast-007-024.i	0.6333	0.1149
heu-met-fast-002-005.i	0.6333	0.1149
heu-met-fast-019-001.i	0.6325	0.1127
heu-met-fast-021-001.i	0.6324	0.1126
heu-met-fast-048-006.i	0.6322	0.1120
heu-met-fast-003-012.i	0.6320	0.1114
heu-met-fast-023-004.i	0.6319	0.1113

heu-met-fast-048-001.i	0.6318	0.1110
heu-met-fast-061-001.i	0.6315	0.1103
heu-met-fast-007-010.i	0.6307	0.1082
heu-met-fast-058-005.i	0.6305	0.1076
heu-met-fast-023-015.i	0.6299	0.1062
heu-met-fast-007-036.i	0.6291	0.1042
heu-met-fast-007-035.i	0.6284	0.1022
heu-met-fast-023-022.i	0.6283	0.1021
heu-met-fast-084-016.i	0.6279	0.1011
heu-met-fast-009-001.i	0.6275	0.1000
heu-met-fast-048-007.i	0.6264	0.0974
heu-met-fast-013-001.i	0.6263	0.0970
heu-met-fast-007-026.i	0.6257	0.0955
heu-met-fast-010-002.i	0.6255	0.0951
heu-met-fast-007-025.i	0.6246	0.0927
heu-met-fast-007-019.i	0.6246	0.0926
heu-met-fast-023-019.i	0.6228	0.0882
heu-met-fast-009-002.i	0.6222	0.0866
heu-met-fast-007-030.i	0.6220	0.0862
heu-met-fast-010-001.i	0.6217	0.0853
heu-met-fast-024-001.i	0.6216	0.0851
heu-met-fast-048-009.i	0.6210	0.0835
heu-met-fast-005-006.i	0.6203	0.0819
heu-met-fast-027-001.i	0.6195	0.0799
heu-met-fast-007-039.i	0.6189	0.0781
heu-met-therm-003-001.i	0.6185	0.0773
heu-met-fast-048-008.i	0.6183	0.0768
heu-met-fast-007-038.i	0.6182	0.0766
heu-met-fast-001-001.i	0.6181	0.0762
heu-met-fast-007-037.i	0.6180	0.0760
heu-met-fast-020-001.i	0.6179	0.0756
heu-met-fast-006-001.i	0.6178	0.0755
heu-met-fast-023-014.i	0.6169	0.0733
heu-met-fast-048-010.i	0.6165	0.0721
heu-met-fast-006-002.i	0.6162	0.0713
heu-met-fast-048-002.i	0.6155	0.0696
heu-met-fast-007-040.i	0.6154	0.0693
heu-met-fast-011-001.i	0.6135	0.0646
heu-met-fast-008-001.i	0.6132	0.0638
heu-met-therm-003-002.i	0.6121	0.0611
heu-met-fast-002-006.i	0.6117	0.0601
heu-comp-mixed-001-005.i	0.6104	0.0568
heu-comp-mixed-001-004.i	0.6094	0.0541
heu-met-fast-003-007.i	0.6077	0.0499
heu-met-fast-002-003.i	0.6068	0.0477
heu-met-fast-012-001.i	0.6067	0.0473
heu-comp-mixed-001-025.i	0.6063	0.0462
heu-met-fast-022-001.i	0.6061	0.0457

heu-met-fast-002-004.i	0.6034	0.0389
heu-comp-mixed-001-019.i	0.6025	0.0366
heu-met-fast-007-011.i	0.6024	0.0364
heu-met-fast-048-005.i	0.6023	0.0362
heu-comp-mixed-001-017.i	0.6012	0.0333
heu-met-fast-018-001.i	0.6010	0.0329
heu-comp-mixed-001-021.i	0.6007	0.0321
heu-comp-mixed-001-018.i	0.6007	0.0321
heu-comp-inter-003-005.i	0.5998	0.0298
heu-comp-mixed-001-022.i	0.5994	0.0289
heu-comp-mixed-001-024.i	0.5994	0.0288
heu-comp-mixed-001-023.i	0.5985	0.0265
heu-met-fast-007-012.i	0.5977	0.0245
heu-met-fast-048-004.i	0.5971	0.0230
heu-met-fast-031-001.i	0.5960	0.0202
heu-met-fast-048-003.i	0.5958	0.0198
heu-met-fast-007-014.i	0.5938	0.0146
heu-comp-mixed-001-006.i	0.5922	0.0107
heu-met-fast-007-015.i	0.5880	0.0000

Table 8. Benchmarks Selected by Whisper as Similar to Application IEU-MET-FAST-002-001 from SRNS Library

Benchmark Selected from SRNS Library	ck	weight
ieu-met-fast-005-01.i	0.8251	1.0000
ieu-met-fast-006-01.i	0.7757	0.8211
heu-met-fast-023-21.i	0.6712	0.4417
heu-met-fast-026-18.i	0.6684	0.4316
heu-met-fast-023-29.i	0.6660	0.4230
heu-met-fast-026-28.i	0.6657	0.4221
heu-met-fast-026-06.i	0.6643	0.4169
heu-met-fast-026-29.i	0.6640	0.4158
heu-met-fast-026-19.i	0.6638	0.4152
heu-met-fast-023-17.i	0.6633	0.4134
heu-met-fast-023-16.i	0.6619	0.4080
heu-met-fast-007-02.i	0.6615	0.4066
heu-met-fast-026-07.i	0.6613	0.4061
heu-met-fast-007-27.i	0.6612	0.4055
heu-met-fast-007-04.i	0.6612	0.4055
heu-met-fast-026-31.i	0.6602	0.4021
heu-met-fast-023-07.i	0.6596	0.3999
heu-met-fast-023-06.i	0.6584	0.3955
heu-met-fast-007-03.i	0.6573	0.3916
heu-met-fast-007-28.i	0.6573	0.3916
heu-met-fast-007-07.i	0.6564	0.3883
heu-met-fast-007-08.i	0.6558	0.3861
heu-met-fast-026-24.i	0.6558	0.3860
heu-met-fast-007-05.i	0.6558	0.3860
heu-met-fast-007-09.i	0.6547	0.3822
heu-met-fast-026-13.i	0.6546	0.3818
heu-met-fast-026-02.i	0.6531	0.3764
heu-met-fast-023-02.i	0.6524	0.3737
heu-met-fast-026-23.i	0.6522	0.3728
heu-met-fast-026-12.i	0.6521	0.3725
heu-met-fast-026-27.i	0.6515	0.3705
heu-met-fast-007-06.i	0.6511	0.3690
heu-met-fast-023-28.i	0.6509	0.3683
heu-met-fast-007-29.i	0.6506	0.3672
heu-met-fast-026-14.i	0.6498	0.3642
heu-met-fast-007-21.i	0.6482	0.3584
heu-met-fast-026-11.i	0.6480	0.3579
heu-met-fast-007-20.i	0.6476	0.3564
heu-met-fast-026-01.i	0.6471	0.3543
heu-met-fast-026-32.i	0.6462	0.3511
heu-met-fast-007-22.i	0.6451	0.3471
heu-met-fast-007-32.i	0.6447	0.3456
heu-met-fast-026-09.i	0.6445	0.3451
heu-met-fast-026-21.i	0.6432	0.3405
heu-met-fast-026-25.i	0.6432	0.3402
heu-met-fast-007-01.i	0.6429	0.3394

heu-met-fast-007-33.i	0.6428	0.3388
heu-met-fast-026-20.i	0.6421	0.3362
heu-met-fast-007-34.i	0.6413	0.3335
heu-met-fast-023-12.i	0.6409	0.3321
heu-met-fast-026-22.i	0.6408	0.3318
heu-met-fast-026-08.i	0.6406	0.3307
heu-met-fast-023-08.i	0.6401	0.3290
heu-met-fast-034-03.i	0.6390	0.3252
heu-met-fast-023-20.i	0.6382	0.3223
heu-met-fast-026-30.i	0.6378	0.3209
heu-met-fast-023-04.i	0.6371	0.3182
heu-met-fast-026-26.i	0.6367	0.3166
heu-met-fast-026-15.i	0.6353	0.3117
heu-met-fast-007-24.i	0.6349	0.3102
heu-met-fast-023-10.i	0.6348	0.3097
heu-met-fast-002-05.i	0.6347	0.3097
heu-met-fast-007-23.i	0.6344	0.3086
heu-met-fast-023-18.i	0.6344	0.3083
heu-met-fast-004-01.i	0.6344	0.3083
heu-met-fast-033-01.i	0.6340	0.3070
heu-met-fast-034-01.i	0.6339	0.3067
heu-met-fast-023-22.i	0.6338	0.3061
heu-met-fast-026-03.i	0.6335	0.3052
heu-met-fast-026-10.i	0.6334	0.3047
heu-met-fast-023-09.i	0.6334	0.3047
heu-met-fast-023-03.i	0.6330	0.3035
heu-met-fast-021-01.i	0.6330	0.3034
heu-met-fast-026-17.i	0.6329	0.3030
heu-met-fast-026-16.i	0.6326	0.3019
heu-met-mixed-001-01.i	0.6312	0.2968
heu-met-fast-007-35.i	0.6311	0.2963
heu-met-fast-034-02.i	0.6310	0.2960
heu-met-fast-003-12.i	0.6308	0.2953
heu-met-fast-026-05.i	0.6306	0.2948
heu-comp-inter-005-03.i	0.6298	0.2919
heu-met-fast-023-19.i	0.6295	0.2907
heu-met-fast-007-10.i	0.6293	0.2900
heu-met-fast-026-04.i	0.6284	0.2866
heu-comp-mixed-002-01.i	0.6278	0.2846
heu-met-fast-007-36.i	0.6276	0.2838
heu-met-fast-023-05.i	0.6271	0.2818
heu-met-fast-023-14.i	0.6270	0.2814
heu-met-fast-013-01.i	0.6264	0.2795
heu-met-fast-007-25.i	0.6257	0.2769
heu-met-fast-007-26.i	0.6243	0.2719
heu-met-fast-023-13.i	0.6240	0.2707
heu-met-fast-024-01.i	0.6239	0.2702
heu-met-fast-007-19.i	0.6238	0.2700

heu-met-fast-007-30.i	0.6209	0.2595
heu-comp-inter-005-02.i	0.6207	0.2588
heu-met-fast-023-15.i	0.6190	0.2527
heu-comp-inter-005-04.i	0.6188	0.2518
heu-met-fast-007-37.i	0.6182	0.2497
heu-met-fast-007-38.i	0.6178	0.2481
heu-met-fast-007-39.i	0.6177	0.2479
heu-met-fast-001-01.i	0.6162	0.2423
heu-met-fast-007-40.i	0.6155	0.2399
heu-met-fast-001-02.i	0.6130	0.2308
heu-comp-mixed-001-03.i	0.6127	0.2296
heu-comp-mixed-001-05.i	0.6116	0.2257
heu-met-fast-002-04.i	0.6111	0.2238
heu-met-fast-022-01.i	0.6097	0.2188
heu-comp-mixed-001-04.i	0.6094	0.2176
heu-met-fast-002-06.i	0.6086	0.2150
heu-met-fast-012-01.i	0.6086	0.2147
heu-met-fast-003-07.i	0.6052	0.2024
heu-comp-mixed-001-25.i	0.6044	0.1997
heu-comp-mixed-001-26.i	0.6038	0.1974
heu-met-fast-007-11.i	0.6026	0.1932
heu-comp-mixed-001-24.i	0.6022	0.1917
heu-comp-mixed-001-22.i	0.6018	0.1900
heu-comp-mixed-001-17.i	0.6017	0.1899
heu-comp-mixed-001-18.i	0.6014	0.1887
heu-comp-mixed-001-20.i	0.6011	0.1875
heu-comp-mixed-001-21.i	0.6010	0.1872
heu-comp-mixed-001-23.i	0.6006	0.1858
heu-met-fast-002-03.i	0.5999	0.1833
heu-comp-mixed-001-19.i	0.5985	0.1783
heu-met-fast-033-02.i	0.5976	0.1751
heu-met-fast-007-12.i	0.5958	0.1685
heu-met-fast-007-14.i	0.5957	0.1680
heu-comp-mixed-002-04.i	0.5942	0.1627
heu-comp-mixed-002-19.i	0.5933	0.1594
heu-comp-mixed-001-06.i	0.5924	0.1560
heu-met-fast-002-02.i	0.5921	0.1549
heu-comp-mixed-002-18.i	0.5898	0.1467
heu-comp-mixed-002-05.i	0.5885	0.1419
heu-met-fast-007-16.i	0.5882	0.1409
heu-met-fast-007-15.i	0.5879	0.1397
heu-met-fast-007-13.i	0.5862	0.1336
heu-comp-mixed-001-07.i	0.5804	0.1124
heu-met-fast-007-31.i	0.5769	0.0998
heu-comp-mixed-001-08.i	0.5749	0.0927
heu-comp-mixed-001-11.i	0.5739	0.0888
heu-comp-mixed-001-10.i	0.5738	0.0885
heu-comp-mixed-001-09.i	0.5716	0.0807

heu-met-fast-007-42.i	0.5710	0.0784
heu-met-fast-007-41.i	0.5708	0.0776
heu-met-fast-002-01.i	0.5703	0.0760
heu-met-fast-003-06.i	0.5703	0.0760
heu-met-fast-003-05.i	0.5540	0.0168
heu-comp-inter-005-01.i	0.5510	0.0058

Table 9. Benchmarks Selected by Whisper as Similar to Application LEU-COMP-THERM-001-001 from the LANL library.

Benchmark Selected from LANL Library	ck	weight
leu-comp-therm-001-002.i	0.9991	1.0000
leu-comp-therm-001-004.i	0.9988	0.9875
leu-comp-therm-001-006.i	0.9984	0.9705
leu-comp-therm-001-003.i	0.9983	0.9653
leu-comp-therm-001-008.i	0.9972	0.9220
leu-comp-therm-001-007.i	0.9971	0.9190
leu-comp-therm-001-005.i	0.9970	0.9120
leu-comp-therm-006-015.i	0.9962	0.8799
leu-comp-therm-006-014.i	0.9962	0.8794
leu-comp-therm-017-009.i	0.9959	0.8675
leu-comp-therm-017-003.i	0.9946	0.8147
leu-comp-therm-006-018.i	0.9945	0.8111
leu-comp-therm-006-016.i	0.9943	0.8056
leu-comp-therm-006-017.i	0.9942	0.7982
leu-comp-therm-017-002.i	0.9925	0.7328
leu-comp-therm-017-014.i	0.9925	0.7300
leu-comp-therm-006-009.i	0.9912	0.6795
leu-comp-therm-017-013.i	0.9909	0.6680
leu-comp-therm-017-001.i	0.9909	0.6670
leu-comp-therm-006-011.i	0.9908	0.6625
leu-comp-therm-006-010.i	0.9907	0.6597
leu-comp-therm-010-007.i	0.9888	0.5821
leu-comp-therm-006-012.i	0.9885	0.5696
leu-comp-therm-017-012.i	0.9881	0.5510
leu-comp-therm-006-013.i	0.9879	0.5435
leu-comp-therm-017-011.i	0.9853	0.4398
leu-comp-therm-017-008.i	0.9850	0.4248
leu-comp-therm-010-006.i	0.9843	0.3964
leu-comp-therm-010-008.i	0.9831	0.3499
leu-comp-therm-010-013.i	0.9820	0.3027
leu-comp-therm-006-004.i	0.9817	0.2925
leu-comp-therm-010-004.i	0.9811	0.2693
leu-comp-therm-010-012.i	0.9810	0.2631
leu-comp-therm-017-010.i	0.9801	0.2291
leu-comp-therm-017-007.i	0.9797	0.2101
leu-comp-therm-035-001.i	0.9792	0.1899
leu-comp-therm-006-005.i	0.9789	0.1789
leu-comp-therm-035-003.i	0.9777	0.1313
leu-comp-therm-002-005.i	0.9774	0.1180

leu-comp-therm-035-002.i	0.9773	0.1150
leu-comp-therm-006-007.i	0.9772	0.1085
leu-comp-therm-009-016.i	0.9770	0.1020
leu-comp-therm-009-023.i	0.9768	0.0946
leu-comp-therm-009-005.i	0.9767	0.0888
leu-comp-therm-009-018.i	0.9766	0.0863
leu-comp-therm-009-021.i	0.9766	0.0838
leu-comp-therm-009-022.i	0.9765	0.0819
leu-comp-therm-006-006.i	0.9764	0.0773
leu-comp-therm-009-017.i	0.9764	0.0771
leu-comp-therm-009-007.i	0.9764	0.0765
leu-comp-therm-009-019.i	0.9763	0.0733
leu-comp-therm-009-020.i	0.9760	0.0596
leu-comp-therm-009-006.i	0.9759	0.0570
leu-comp-therm-009-024.i	0.9759	0.0560
leu-comp-therm-009-004.i	0.9757	0.0470
leu-comp-therm-009-001.i	0.9756	0.0454
leu-comp-therm-009-013.i	0.9755	0.0407
leu-comp-therm-009-008.i	0.9755	0.0394
leu-comp-therm-017-005.i	0.9754	0.0372
leu-comp-therm-009-002.i	0.9754	0.0366
leu-comp-therm-009-015.i	0.9754	0.0355
leu-comp-therm-009-011.i	0.9753	0.0336
leu-comp-therm-009-010.i	0.9752	0.0301
leu-comp-therm-009-025.i	0.9752	0.0290
leu-comp-therm-002-004.i	0.9752	0.0282
leu-comp-therm-006-008.i	0.9751	0.0264
leu-comp-therm-009-003.i	0.9751	0.0258
leu-comp-therm-017-006.i	0.9749	0.0147
leu-comp-therm-009-026.i	0.9748	0.0139

Table 10. Benchmarks Selected by Whisper as Similar to Application LEU-COMP-THERM-001-001 from SNL library.

Benchmark Selected from SNL Library	ck	weight
leu-comp-therm-016-007.i	0.9993	1.0000
leu-comp-therm-001-004.i	0.9992	0.9971
leu-comp-therm-001-002.i	0.9992	0.9971
leu-comp-therm-016-006.i	0.9991	0.9946
leu-comp-therm-016-010.i	0.9990	0.9907
leu-comp-therm-016-009.i	0.9990	0.9906
leu-comp-therm-001-006.i	0.9987	0.9819
leu-comp-therm-016-011.i	0.9986	0.9806
leu-comp-therm-016-008.i	0.9986	0.9800
leu-comp-therm-016-013.i	0.9984	0.9739
leu-comp-therm-001-003.i	0.9982	0.9678
leu-comp-therm-016-012.i	0.9979	0.9611
leu-comp-therm-001-005.i	0.9977	0.9555

leu-comp-therm-001-008.i	0.9974	0.9462
leu-comp-therm-001-007.i	0.9972	0.9418
leu-comp-therm-010-008.i	0.9838	0.5753
leu-comp-therm-010-013.i	0.9822	0.5318
leu-comp-therm-010-004.i	0.9813	0.5074
leu-comp-therm-002-005.i	0.9773	0.3986
leu-comp-therm-009-005.i	0.9769	0.3857
leu-comp-therm-009-009.i	0.9767	0.3801
leu-comp-therm-009-007.i	0.9765	0.3767
leu-comp-therm-009-008.i	0.9760	0.3618
leu-comp-therm-009-002.i	0.9758	0.3567
leu-comp-therm-009-006.i	0.9754	0.3470
leu-comp-therm-009-001.i	0.9751	0.3373
leu-comp-therm-002-004.i	0.9750	0.3358
leu-comp-therm-009-003.i	0.9747	0.3259
leu-comp-therm-009-004.i	0.9746	0.3226
leu-comp-therm-050-007.i	0.9734	0.2920
leu-comp-therm-050-014.i	0.9732	0.2861
leu-comp-therm-050-006.i	0.9731	0.2819
leu-comp-therm-050-015.i	0.9730	0.2800
leu-comp-therm-010-030.i	0.9715	0.2390
leu-comp-therm-050-005.i	0.9711	0.2278
leu-comp-therm-050-013.i	0.9709	0.2236
leu-comp-therm-050-017.i	0.9709	0.2220
leu-comp-therm-050-016.i	0.9707	0.2185
leu-comp-therm-050-010.i	0.9696	0.1883
leu-comp-therm-079-010.i	0.9696	0.1863
leu-comp-therm-050-018.i	0.9695	0.1835
leu-comp-therm-002-003.i	0.9693	0.1802
leu-comp-therm-050-004.i	0.9688	0.1642
leu-comp-therm-010-001.i	0.9685	0.1584
leu-comp-therm-050-012.i	0.9681	0.1463
leu-comp-therm-002-002.i	0.9677	0.1356
leu-comp-therm-079-009.i	0.9677	0.1354
leu-comp-therm-013-004.i	0.9670	0.1157
leu-comp-therm-050-003.i	0.9670	0.1156
leu-comp-therm-050-011.i	0.9668	0.1114
leu-comp-therm-014-002.i	0.9668	0.1104
leu-comp-therm-002-001.i	0.9666	0.1064
leu-comp-therm-079-008.i	0.9665	0.1032
leu-comp-therm-010-019.i	0.9661	0.0917
leu-comp-therm-050-009.i	0.9659	0.0867
leu-comp-therm-050-002.i	0.9659	0.0855
leu-comp-therm-013-005.i	0.9659	0.0849
leu-comp-therm-013-003.i	0.9644	0.0464
leu-comp-therm-050-008.i	0.9635	0.0192
leu-comp-therm-010-017.i	0.9633	0.0150
leu-comp-therm-010-023.i	0.9633	0.0148

leu-comp-therm-014-001.i	0.9631	0.0104
leu-comp-therm-013-007.i	0.9630	0.0062

Table 11. Benchmarks Selected by Whisper as Similar to Application LEU-COMP-THERM-001-001 from SRNS library.

Benchmark Selected from SRNS Library	ck	weight
leu-comp-therm-001-02.i	0.9994	1.0000
leu-comp-therm-001-04.i	0.9990	0.9907
leu-comp-therm-001-06.i	0.9987	0.9863
leu-comp-therm-001-03.i	0.9980	0.9699
leu-comp-therm-001-08.i	0.9977	0.9642
leu-comp-therm-001-05.i	0.9976	0.9626
leu-comp-therm-001-07.i	0.9969	0.9479
leu-comp-therm-017-03.i	0.9943	0.8923
leu-comp-therm-017-02.i	0.9923	0.8515
leu-comp-therm-017-14.i	0.9918	0.8402
leu-comp-therm-017-13.i	0.9917	0.8386
leu-comp-therm-017-01.i	0.9914	0.8312
leu-comp-therm-017-12.i	0.9883	0.7664
leu-comp-therm-017-11.i	0.9863	0.7246
leu-comp-therm-010-13.i	0.9825	0.6433
leu-comp-therm-017-22.i	0.9818	0.6292
leu-comp-therm-017-10.i	0.9815	0.6223
leu-comp-therm-010-04.i	0.9814	0.6205
leu-comp-therm-010-12.i	0.9809	0.6100
leu-comp-therm-002-05.i	0.9779	0.5473
leu-comp-therm-017-25.i	0.9764	0.5147
leu-comp-therm-017-21.i	0.9753	0.4921
leu-comp-therm-002-04.i	0.9749	0.4830
leu-comp-therm-010-03.i	0.9738	0.4607
leu-comp-therm-010-11.i	0.9738	0.4601
leu-comp-therm-017-20.i	0.9729	0.4413
leu-comp-therm-010-02.i	0.9715	0.4130
leu-comp-therm-017-19.i	0.9698	0.3767
leu-comp-therm-002-03.i	0.9693	0.3650
leu-comp-therm-017-24.i	0.9687	0.3531
leu-comp-therm-010-10.i	0.9687	0.3531
leu-comp-therm-010-01.i	0.9683	0.3441
leu-comp-therm-002-02.i	0.9680	0.3397
leu-comp-therm-017-23.i	0.9678	0.3352
leu-comp-therm-002-01.i	0.9673	0.3235
leu-comp-therm-017-18.i	0.9669	0.3150
leu-comp-therm-010-19.i	0.9637	0.2473
leu-comp-therm-010-18.i	0.9635	0.2436
leu-comp-therm-010-16.i	0.9632	0.2385
leu-comp-therm-017-17.i	0.9632	0.2384
leu-comp-therm-010-17.i	0.9621	0.2152

leu-comp-therm-010-22.i	0.9615	0.2022
leu-comp-therm-010-23.i	0.9609	0.1895
leu-comp-therm-010-15.i	0.9602	0.1751
leu-comp-therm-010-09.i	0.9601	0.1717
leu-comp-therm-010-20.i	0.9596	0.1615
leu-comp-therm-017-16.i	0.9592	0.1529
leu-comp-therm-010-21.i	0.9577	0.1224
leu-comp-therm-010-14.i	0.9555	0.0748
leu-comp-therm-017-15.i	0.9530	0.0222

Table 12. Benchmarks Selected by Whisper as Similar to Application LEU-SOL-THERM-004-001 from the LANL library.

Benchmark Selected from LANL Library	ck	weight
leu-sol-therm-004-002.i	0.9992	1.0000
leu-sol-therm-007-002.i	0.9989	0.9946
leu-sol-therm-007-030.i	0.9988	0.9925
leu-sol-therm-007-014.i	0.9985	0.9876
leu-sol-therm-007-001.i	0.9984	0.9866
leu-sol-therm-007-003.i	0.9979	0.9771
leu-sol-therm-007-032.i	0.9977	0.9745
leu-sol-therm-004-003.i	0.9974	0.9683
leu-sol-therm-007-036.i	0.9948	0.9227
leu-sol-therm-007-004.i	0.9945	0.9177
leu-sol-therm-004-004.i	0.9938	0.9061
leu-sol-therm-021-001.i	0.9924	0.8810
leu-sol-therm-007-005.i	0.9914	0.8640
leu-sol-therm-007-049.i	0.9910	0.8560
leu-sol-therm-020-001.i	0.9903	0.8449
leu-sol-therm-004-005.i	0.9889	0.8197
leu-sol-therm-021-002.i	0.9854	0.7576
leu-sol-therm-004-006.i	0.9836	0.7263
leu-sol-therm-020-002.i	0.9834	0.7224
leu-sol-therm-004-007.i	0.9776	0.6209
leu-sol-therm-021-003.i	0.9710	0.5069
leu-sol-therm-020-003.i	0.9680	0.4534
heu-sol-therm-013-003.i	0.9615	0.3400
heu-sol-therm-013-004.i	0.9613	0.3368
leu-sol-therm-002-002.i	0.9603	0.3197
heu-sol-therm-025-003.i	0.9592	0.3002
heu-sol-therm-013-002.i	0.9591	0.2986
heu-sol-therm-043-002.i	0.9581	0.2802
heu-sol-therm-025-006.i	0.9569	0.2592
heu-comp-therm-002-022.i	0.9562	0.2474
heu-sol-therm-025-007.i	0.9561	0.2446
heu-sol-therm-025-008.i	0.9557	0.2387
heu-comp-therm-002-009.i	0.9554	0.2326
leu-sol-therm-021-004.i	0.9550	0.2266

heu-sol-therm-013-001.i	0.9550	0.2258
heu-comp-therm-002-008.i	0.9549	0.2249
heu-comp-therm-002-016.i	0.9546	0.2195
heu-sol-therm-012-001.i	0.9542	0.2130
heu-sol-therm-025-009.i	0.9531	0.1923
heu-comp-therm-002-015.i	0.9517	0.1675
heu-sol-therm-025-011.i	0.9514	0.1629
heu-comp-therm-002-007.i	0.9509	0.1543
leu-comp-therm-007-004.i	0.9503	0.1440
leu-sol-therm-020-004.i	0.9502	0.1422
heu-comp-therm-002-010.i	0.9499	0.1368
heu-sol-therm-025-010.i	0.9495	0.1292
heu-sol-therm-043-003.i	0.9492	0.1249
heu-sol-therm-025-012.i	0.9477	0.0978
heu-sol-therm-025-013.i	0.9469	0.0844
leu-comp-therm-007-010.i	0.9468	0.0834
heu-comp-therm-002-021.i	0.9468	0.0829
leu-comp-therm-007-007.i	0.9467	0.0805
heu-sol-therm-025-015.i	0.9467	0.0804
heu-comp-therm-002-014.i	0.9460	0.0679
heu-comp-therm-002-017.i	0.9455	0.0590
leu-sol-therm-002-001.i	0.9449	0.0497
heu-comp-therm-002-006.i	0.9448	0.0479
heu-sol-therm-025-014.i	0.9445	0.0426
heu-sol-therm-025-018.i	0.9444	0.0411
leu-comp-therm-007-003.i	0.9434	0.0233

Table 13. Benchmarks Selected by Whisper as Similar to Application LEU-SOL-THERM-004-001 from the SNL library.

Benchmark Selected from SNL Library	ck	weight
leu-sol-therm-004-002.i	0.9992	1.0000
leu-sol-therm-007-002.i	0.9988	0.9549
leu-sol-therm-007-001.i	0.9984	0.9027
leu-sol-therm-007-003.i	0.9976	0.8216
leu-sol-therm-003-001.i	0.9976	0.8150
leu-sol-therm-019-003.i	0.9970	0.7534
leu-sol-therm-019-006.i	0.9970	0.7528
leu-sol-therm-018-003.i	0.9970	0.7515
leu-sol-therm-016-005.i	0.9970	0.7497
leu-sol-therm-003-002.i	0.9969	0.7454
leu-sol-therm-018-002.i	0.9969	0.7452
leu-sol-therm-019-004.i	0.9969	0.7410
leu-sol-therm-019-005.i	0.9968	0.7351
leu-sol-therm-004-003.i	0.9968	0.7328
leu-sol-therm-018-004.i	0.9967	0.7203
leu-sol-therm-016-006.i	0.9967	0.7163

leu-sol-therm-019-001.i	0.9967	0.7159
leu-sol-therm-018-006.i	0.9966	0.7059
leu-sol-therm-019-002.i	0.9966	0.7046
leu-sol-therm-018-005.i	0.9965	0.7031
leu-sol-therm-016-004.i	0.9965	0.6981
leu-sol-therm-017-006.i	0.9964	0.6900
leu-sol-therm-003-003.i	0.9964	0.6883
leu-sol-therm-018-001.i	0.9962	0.6706
leu-sol-therm-017-005.i	0.9962	0.6637
leu-sol-therm-003-004.i	0.9958	0.6188
leu-sol-therm-016-007.i	0.9957	0.6062
leu-sol-therm-016-003.i	0.9955	0.5929
leu-sol-therm-017-004.i	0.9954	0.5833
leu-sol-therm-006-002.i	0.9949	0.5206
leu-sol-therm-006-003.i	0.9949	0.5199
leu-sol-therm-007-004.i	0.9946	0.4906
leu-sol-therm-006-004.i	0.9946	0.4906
leu-sol-therm-017-003.i	0.9945	0.4745
leu-sol-therm-004-004.i	0.9936	0.3835
leu-sol-therm-006-001.i	0.9931	0.3214
leu-sol-therm-021-001.i	0.9921	0.2195
leu-sol-therm-016-002.i	0.9920	0.2034
leu-sol-therm-007-005.i	0.9912	0.1181
leu-sol-therm-020-001.i	0.9907	0.0678

Table 14. Benchmarks Selected by Whisper as Similar to Application LEU-SOL-THERM-004-001 from the SRNS library.

Benchmark Selected from SRNS Library	ck	weight
leu-sol-therm-004-02.i	0.9993	1.0000
leu-sol-therm-003-01.i	0.9976	0.9761
leu-sol-therm-003-02.i	0.9970	0.9673
leu-sol-therm-004-03.i	0.9968	0.9650
leu-sol-therm-003-03.i	0.9964	0.9592
leu-sol-therm-003-04.i	0.9959	0.9530
leu-sol-therm-004-04.i	0.9935	0.9185
leu-sol-therm-004-05.i	0.9890	0.8547
leu-sol-therm-004-06.i	0.9840	0.7836
leu-sol-therm-004-07.i	0.9785	0.7066
leu-sol-therm-003-05.i	0.9725	0.6210
leu-sol-therm-003-08.i	0.9658	0.5264
leu-sol-therm-003-06.i	0.9650	0.5151
leu-sol-therm-002-08.i	0.9647	0.5106
leu-sol-therm-013-04.i	0.9619	0.4711
leu-sol-therm-013-03.i	0.9615	0.4655
leu-sol-therm-002-02.i	0.9614	0.4648
leu-sol-therm-003-07.i	0.9614	0.4641

ieu-sol-therm-002-04.i	0.9609	0.4568
heu-sol-therm-013-02.i	0.9592	0.4336
ieu-sol-therm-002-03.i	0.9590	0.4303
ieu-sol-therm-003-07.i	0.9588	0.4282
ieu-sol-therm-002-03.i	0.9558	0.3859
ieu-sol-therm-003-21.i	0.9554	0.3797
heu-sol-therm-013-01.i	0.9546	0.3678
heu-sol-therm-008-11.i	0.9544	0.3659
heu-sol-therm-012-01.i	0.9542	0.3625
ieu-sol-therm-003-06.i	0.9533	0.3497
ieu-sol-therm-003-20.i	0.9532	0.3481
heu-met-therm-011-30.i	0.9506	0.3113
heu-met-therm-011-29.i	0.9504	0.3087
heu-sol-therm-008-03.i	0.9500	0.3029
heu-met-therm-011-27.i	0.9499	0.3013
heu-met-therm-011-28.i	0.9497	0.2987
ieu-sol-therm-001-01.i	0.9492	0.2919
heu-sol-therm-007-01.i	0.9483	0.2787
ieu-sol-therm-002-02.i	0.9479	0.2732
heu-sol-therm-008-05.i	0.9479	0.2729
heu-sol-therm-008-01.i	0.9476	0.2688
heu-met-therm-011-07.i	0.9470	0.2612
heu-met-therm-011-09.i	0.9467	0.2572
heu-met-therm-011-08.i	0.9467	0.2559
heu-sol-therm-007-03.i	0.9466	0.2554
heu-sol-therm-008-07.i	0.9466	0.2548
heu-met-therm-011-06.i	0.9465	0.2536
heu-met-therm-011-41.i	0.9463	0.2502
ieu-sol-therm-002-01.i	0.9462	0.2494
ieu-sol-therm-003-19.i	0.9459	0.2447
heu-met-therm-011-25.i	0.9422	0.1936
heu-met-therm-011-26.i	0.9412	0.1789
heu-sol-therm-007-05.i	0.9408	0.1731
heu-sol-therm-007-10.i	0.9405	0.1684
heu-sol-therm-007-12.i	0.9400	0.1622
ieu-sol-therm-003-18.i	0.9382	0.1366
ieu-sol-therm-003-05.i	0.9382	0.1360
heu-sol-therm-007-07.i	0.9375	0.1271
ieu-sol-therm-002-07.i	0.9375	0.1266
heu-met-therm-011-17.i	0.9370	0.1193
heu-met-therm-011-16.i	0.9365	0.1124
heu-sol-therm-008-09.i	0.9356	0.0991
heu-sol-therm-007-09.i	0.9348	0.0882
ieu-sol-therm-002-01.i	0.9346	0.0861
heu-met-therm-011-40.i	0.9342	0.0795
heu-met-therm-011-15.i	0.9337	0.0725
ieu-sol-therm-003-17.i	0.9333	0.0675
heu-met-therm-011-24.i	0.9324	0.0537

heu-met-therm-011-23.i	0.9322	0.0519
heu-met-therm-011-05.i	0.9320	0.0493
heu-sol-therm-011-02.i	0.9316	0.0428
heu-sol-therm-011-01.i	0.9313	0.0384
heu-sol-therm-002-10.i	0.9312	0.0377
heu-sol-therm-003-01.i	0.9301	0.0212
heu-sol-therm-003-07.i	0.9297	0.0162
heu-met-therm-011-14.i	0.9297	0.0155
heu-sol-therm-003-13.i	0.9288	0.0036

Table 15. Benchmarks Selected by Whisper as Similar to Application MIX-COMP-THERM-001-001 from the LANL library.

Benchmark Selected from LANL Library	ck	weight
mix-comp-therm-001-002.i	0.9908	1.0000
mix-comp-therm-003-004.i	0.9856	0.8413
mix-comp-therm-003-005.i	0.9846	0.8097
mix-sol-therm-001-005.i	0.9839	0.7893
mix-sol-therm-001-002.i	0.9835	0.7755
mix-comp-therm-001-003.i	0.9832	0.7674
mix-sol-therm-001-004.i	0.9831	0.7660
mix-sol-therm-001-001.i	0.9829	0.7579
mix-sol-therm-001-003.i	0.9819	0.7287
mix-sol-therm-001-006.i	0.9812	0.7066
mix-comp-therm-003-002.i	0.9799	0.6670
mix-sol-therm-001-010.i	0.9791	0.6426
mix-comp-therm-003-003.i	0.9788	0.6328
mix-sol-therm-001-011.i	0.9763	0.5571
mix-comp-therm-001-004.i	0.9762	0.5521
mix-comp-therm-003-006.i	0.9756	0.5338
mix-sol-therm-003-004.i	0.9735	0.4706
mix-comp-therm-003-001.i	0.9727	0.4467
mix-sol-therm-001-007.i	0.9724	0.4357
mix-sol-therm-003-003.i	0.9722	0.4304
pu-sol-therm-012-006.i	0.9720	0.4229
mix-sol-therm-003-001.i	0.9716	0.4135
pu-sol-therm-022-001.i	0.9714	0.4049
pu-sol-therm-034-003.i	0.9711	0.3979
mix-sol-therm-003-002.i	0.9706	0.3817
mix-sol-therm-001-008.i	0.9704	0.3745
pu-comp-mixed-002-023.i	0.9703	0.3733
pu-sol-therm-012-007.i	0.9699	0.3606
pu-comp-mixed-002-024.i	0.9699	0.3593
pu-sol-therm-034-002.i	0.9698	0.3579
pu-sol-therm-022-002.i	0.9696	0.3508
pu-comp-mixed-002-025.i	0.9693	0.3416
pu-comp-mixed-002-026.i	0.9693	0.3413
pu-sol-therm-034-007.i	0.9689	0.3305

pu-comp-mixed-002-027.i	0.9689	0.3301
pu-comp-mixed-002-028.i	0.9685	0.3163
pu-comp-mixed-002-029.i	0.9685	0.3160
pu-sol-therm-034-008.i	0.9684	0.3150
pu-sol-therm-034-004.i	0.9680	0.3001
pu-sol-therm-034-009.i	0.9677	0.2938
mix-sol-therm-001-009.i	0.9675	0.2853
pu-sol-therm-022-003.i	0.9664	0.2513
pu-sol-therm-028-007.i	0.9661	0.2419
pu-sol-therm-012-008.i	0.9660	0.2415
pu-sol-therm-034-010.i	0.9658	0.2333
mix-comp-therm-002-005.i	0.9654	0.2229
pu-sol-therm-028-008.i	0.9654	0.2212
pu-sol-therm-022-004.i	0.9649	0.2073
pu-sol-therm-034-001.i	0.9648	0.2049
pu-sol-therm-028-009.i	0.9645	0.1951
pu-sol-therm-034-011.i	0.9644	0.1900
mix-comp-therm-002-003.i	0.9640	0.1786
pu-sol-therm-032-013.i	0.9638	0.1731
pu-sol-therm-032-014.i	0.9636	0.1664
pu-sol-therm-032-001.i	0.9633	0.1578
pu-comp-mixed-002-017.i	0.9632	0.1529
pu-sol-therm-028-001.i	0.9629	0.1452
pu-sol-therm-022-005.i	0.9629	0.1446
pu-sol-therm-032-015.i	0.9627	0.1394
pu-sol-therm-032-002.i	0.9627	0.1382
pu-sol-therm-028-002.i	0.9624	0.1304
pu-sol-therm-032-004.i	0.9623	0.1279
pu-sol-therm-032-003.i	0.9620	0.1183
pu-sol-therm-028-003.i	0.9620	0.1183
pu-sol-therm-028-004.i	0.9619	0.1150
pu-sol-therm-034-012.i	0.9618	0.1119
pu-sol-therm-032-005.i	0.9614	0.0997
pu-sol-therm-034-005.i	0.9613	0.0964
pu-sol-therm-028-005.i	0.9613	0.0963
pu-sol-therm-032-016.i	0.9608	0.0805
pu-sol-therm-022-006.i	0.9607	0.0780
pu-sol-therm-032-006.i	0.9605	0.0707
mix-sol-therm-003-007.i	0.9600	0.0560
mix-sol-therm-003-006.i	0.9600	0.0557
pu-sol-therm-032-007.i	0.9600	0.0549
pu-sol-therm-032-017.i	0.9596	0.0432
mix-sol-therm-003-005.i	0.9595	0.0418
pu-comp-mixed-002-010.i	0.9595	0.0404
pu-comp-mixed-001-005.i	0.9594	0.0380
pu-sol-therm-028-006.i	0.9591	0.0274
pu-sol-therm-022-007.i	0.9588	0.0186
pu-sol-therm-034-013.i	0.9586	0.0135

pu-sol-therm-032-008.i	0.9585	0.0090
pu-sol-therm-012-009.i	0.9583	0.0043

Table 16. Benchmarks Selected by Whisper as Similar to Application MIX-COMP-THERM-001-001 from the SNL library.

Benchmark Selected from SNL Library	ck	weight
mix-sol-therm-001-001.i	0.9836	1.0000
mix-sol-therm-001-011.i	0.9782	0.8767
mix-comp-therm-003-006.i	0.9756	0.8182
mix-sol-therm-004-002.i	0.9596	0.4563
pu-sol-therm-013-021.i	0.9575	0.4094
pu-sol-therm-013-015.i	0.9573	0.4050
pu-sol-therm-013-018.i	0.9566	0.3889
mix-sol-therm-004-001.i	0.9561	0.3784
pu-sol-therm-013-019.i	0.9561	0.3771
pu-sol-therm-013-022.i	0.9560	0.3749
pu-sol-therm-013-020.i	0.9557	0.3678
pu-sol-therm-008-020.i	0.9555	0.3628
pu-sol-therm-013-011.i	0.9554	0.3623
pu-sol-therm-001-006.i	0.9551	0.3550
pu-sol-therm-013-016.i	0.9551	0.3537
pu-sol-therm-015-015.i	0.9545	0.3411
pu-sol-therm-013-012.i	0.9541	0.3322
pu-sol-therm-014-024.i	0.9541	0.3318
pu-sol-therm-008-016.i	0.9540	0.3287
pu-sol-therm-013-017.i	0.9539	0.3285
pu-sol-therm-008-021.i	0.9539	0.3270
pu-sol-therm-013-007.i	0.9537	0.3241
pu-sol-therm-013-013.i	0.9535	0.3194
pu-sol-therm-013-004.i	0.9535	0.3181
pu-sol-therm-008-025.i	0.9533	0.3143
pu-sol-therm-008-029.i	0.9529	0.3052
pu-sol-therm-001-004.i	0.9529	0.3047
pu-sol-therm-015-007.i	0.9529	0.3043
pu-sol-therm-014-018.i	0.9528	0.3033
pu-sol-therm-013-014.i	0.9527	0.3010
pu-sol-therm-014-013.i	0.9527	0.3009
pu-sol-therm-013-008.i	0.9527	0.3009
pu-sol-therm-005-007.i	0.9524	0.2946
pu-sol-therm-013-006.i	0.9524	0.2936
pu-sol-therm-014-030.i	0.9524	0.2933
pu-sol-therm-001-003.i	0.9524	0.2931
pu-sol-therm-005-005.i	0.9523	0.2902
pu-sol-therm-013-010.i	0.9519	0.2821
pu-sol-therm-001-005.i	0.9519	0.2820
pu-sol-therm-005-006.i	0.9518	0.2811
pu-sol-therm-013-005.i	0.9518	0.2806

pu-sol-therm-005-004.i	0.9517	0.2778
pu-sol-therm-015-011.i	0.9517	0.2770
pu-sol-therm-013-001.i	0.9516	0.2764
pu-sol-therm-013-009.i	0.9516	0.2747
pu-sol-therm-005-009.i	0.9515	0.2736
pu-sol-therm-005-008.i	0.9515	0.2726
pu-sol-therm-013-002.i	0.9514	0.2720
pu-sol-therm-005-002.i	0.9512	0.2670
pu-sol-therm-004-010.i	0.9512	0.2656
pu-sol-therm-005-003.i	0.9509	0.2600
pu-sol-therm-006-002.i	0.9509	0.2593
pu-sol-therm-005-001.i	0.9508	0.2582
pu-sol-therm-004-007.i	0.9508	0.2577
pu-sol-therm-001-002.i	0.9507	0.2561
pu-sol-therm-004-013.i	0.9506	0.2535
pu-sol-therm-004-009.i	0.9506	0.2531
pu-sol-therm-014-007.i	0.9506	0.2531
pu-sol-therm-003-004.i	0.9506	0.2517
pu-sol-therm-002-005.i	0.9505	0.2508
pu-sol-therm-003-005.i	0.9505	0.2507
pu-sol-therm-004-006.i	0.9505	0.2506
pu-sol-therm-004-008.i	0.9505	0.2506
pu-sol-therm-004-011.i	0.9504	0.2493
pu-sol-therm-003-006.i	0.9504	0.2488
pu-sol-therm-003-003.i	0.9504	0.2477
pu-sol-therm-002-006.i	0.9503	0.2458
pu-sol-therm-004-012.i	0.9502	0.2440
pu-sol-therm-006-003.i	0.9502	0.2430
pu-sol-therm-006-001.i	0.9501	0.2418
pu-sol-therm-001-001.i	0.9499	0.2380
pu-sol-therm-004-005.i	0.9497	0.2329
pu-sol-therm-014-001.i	0.9496	0.2311
pu-sol-therm-002-004.i	0.9496	0.2301
pu-sol-therm-015-001.i	0.9493	0.2229
pu-sol-therm-002-007.i	0.9492	0.2203
pu-sol-therm-003-001.i	0.9491	0.2193
pu-sol-therm-002-001.i	0.9489	0.2146
pu-sol-therm-002-003.i	0.9487	0.2099
pu-sol-therm-002-002.i	0.9487	0.2097
pu-sol-therm-004-001.i	0.9486	0.2074
pu-sol-therm-003-008.i	0.9485	0.2045
pu-sol-therm-004-003.i	0.9484	0.2034
pu-sol-therm-004-004.i	0.9483	0.2006
pu-sol-therm-003-002.i	0.9483	0.2001
pu-sol-therm-003-007.i	0.9482	0.1996
pu-sol-therm-004-002.i	0.9480	0.1941
pu-sol-therm-008-027.i	0.9466	0.1622
mix-comp-therm-006-001.i	0.9437	0.0974

Table 17. Benchmarks Selected by Whisper as Similar to Application MIX-COMP-THERM-001-001 from the SRNS library.

Benchmark Selected from SRNS Library	ck	weight
mix-misc-therm-001-111.i	0.9973	1.0000
mix-misc-therm-001-107.i	0.9971	0.9965
mix-misc-therm-001-109.i	0.9958	0.9653
mix-misc-therm-001-112.i	0.9947	0.9407
mix-misc-therm-001-110.i	0.9943	0.9314
mix-misc-therm-001-106.i	0.9904	0.8430
mix-misc-therm-001-113.i	0.9900	0.8344
mix-misc-therm-004-03.i	0.9836	0.6886
mix-misc-therm-001-114.i	0.9835	0.6850
mix-misc-therm-004-02.i	0.9834	0.6822
mix-misc-therm-004-01.i	0.9799	0.6035
mix-sol-therm-006-01.i	0.9796	0.5963
mix-sol-therm-006-02.i	0.9786	0.5742
mix-misc-therm-004-04.i	0.9780	0.5607
mix-misc-therm-001-117.i	0.9779	0.5583
mix-misc-therm-001-115.i	0.9750	0.4926
mix-sol-therm-007-03.i	0.9748	0.4875
mix-sol-therm-006-03.i	0.9747	0.4860
mix-sol-therm-007-02.i	0.9742	0.4724
mix-sol-therm-007-04.i	0.9734	0.4552
mix-sol-therm-007-05.i	0.9726	0.4367
mix-misc-therm-001-116.i	0.9719	0.4210
mix-sol-therm-007-01.i	0.9717	0.4155
mix-misc-therm-004-05.i	0.9715	0.4125
pu-sol-therm-012-06.i	0.9713	0.4072
pu-sol-therm-034-03.i	0.9712	0.4044
mix-misc-therm-004-06.i	0.9709	0.3978
pu-sol-therm-012-07.i	0.9703	0.3852
pu-comp-mixed-002-23.i	0.9703	0.3847
pu-sol-therm-034-02.i	0.9701	0.3801
pu-comp-mixed-002-24.i	0.9701	0.3792
pu-sol-therm-034-07.i	0.9697	0.3702
pu-comp-mixed-002-25.i	0.9696	0.3679
pu-comp-mixed-002-26.i	0.9695	0.3663
pu-comp-mixed-002-28.i	0.9689	0.3535
pu-comp-mixed-002-27.i	0.9688	0.3514
pu-comp-mixed-002-29.i	0.9686	0.3468
pu-sol-therm-034-08.i	0.9684	0.3403
pu-sol-therm-034-04.i	0.9680	0.3323
pu-sol-therm-034-09.i	0.9678	0.3274
pu-sol-therm-012-08.i	0.9664	0.2965
pu-sol-therm-034-10.i	0.9661	0.2879
mix-sol-therm-007-06.i	0.9658	0.2807

mix-sol-therm-006-04.i	0.9655	0.2740
pu-sol-therm-034-01.i	0.9645	0.2517
pu-sol-therm-034-11.i	0.9645	0.2517
pu-sol-therm-012-14.i	0.9641	0.2433
mix-sol-therm-007-07.i	0.9630	0.2180
pu-comp-mixed-002-17.i	0.9630	0.2174
pu-sol-therm-034-12.i	0.9619	0.1923
pu-sol-therm-034-05.i	0.9618	0.1916
mix-sol-therm-006-05.i	0.9598	0.1457
pu-comp-mixed-001-05.i	0.9595	0.1373
pu-comp-mixed-002-10.i	0.9590	0.1273
pu-sol-therm-012-09.i	0.9584	0.1134
pu-sol-therm-034-13.i	0.9583	0.1104
pu-sol-therm-012-15.i	0.9575	0.0917
pu-comp-mixed-002-18.i	0.9566	0.0715
pu-comp-mixed-002-22.i	0.9560	0.0579
pu-comp-mixed-002-11.i	0.9558	0.0541
pu-sol-therm-001-06.i	0.9555	0.0467
pu-comp-mixed-002-19.i	0.9555	0.0462
pu-sol-therm-007-02.i	0.9553	0.0419
pu-sol-therm-034-14.i	0.9550	0.0348
mix-sol-therm-006-06.i	0.9547	0.0278
pu-comp-mixed-002-21.i	0.9540	0.0124
pu-sol-therm-012-10.i	0.9539	0.0113
pu-sol-therm-012-16.i	0.9536	0.0028

Table 18. Benchmarks Selected by Whisper as Similar to Application U233-SOL-THERM-001-001.

Benchmark Selected from LANL Library	ck	weight
u233-sol-therm-001-002.i	0.9998	1.0000
u233-sol-therm-001-003.i	0.9993	0.9976
u233-sol-therm-001-004.i	0.9987	0.9941
u233-sol-therm-001-005.i	0.9979	0.9901
u233-sol-therm-009-001.i	0.9670	0.8285
u233-sol-therm-009-002.i	0.9404	0.6899
u233-sol-therm-017-007.i	0.9146	0.5547
u233-sol-therm-017-006.i	0.9134	0.5487
u233-sol-therm-012-007.i	0.9130	0.5466
u233-sol-therm-012-008.i	0.9126	0.5444
u233-sol-therm-005-002.i	0.9107	0.5343
u233-sol-therm-008-001.i	0.9060	0.5097
u233-sol-therm-016-032.i	0.9057	0.5083
u233-sol-therm-016-031.i	0.9051	0.5055
u233-sol-therm-016-033.i	0.9051	0.5051
u233-sol-therm-013-021.i	0.9025	0.4918
u233-sol-therm-009-003.i	0.8962	0.4585
u233-sol-therm-005-001.i	0.8950	0.4524

u233-sol-therm-013-020.i	0.8913	0.4333
u233-sol-therm-012-006.i	0.8764	0.3552
u233-sol-therm-017-005.i	0.8761	0.3539
u233-sol-therm-017-004.i	0.8748	0.3469
u233-sol-therm-016-027.i	0.8714	0.3290
u233-sol-therm-016-026.i	0.8705	0.3244
u233-sol-therm-016-025.i	0.8705	0.3243
u233-sol-therm-016-029.i	0.8699	0.3211
u233-sol-therm-012-005.i	0.8695	0.3192
u233-sol-therm-016-030.i	0.8694	0.3188
u233-sol-therm-016-028.i	0.8690	0.3166
u233-sol-therm-013-019.i	0.8684	0.3135
u233-sol-therm-013-018.i	0.8671	0.3064
u233-sol-therm-017-001.i	0.8666	0.3038
u233-sol-therm-013-017.i	0.8639	0.2901
u233-sol-therm-017-002.i	0.8632	0.2862
u233-sol-therm-017-003.i	0.8631	0.2860
u233-sol-therm-012-004.i	0.8626	0.2833
u233-sol-therm-013-016.i	0.8610	0.2746
u233-sol-therm-013-015.i	0.8555	0.2459
u233-sol-therm-012-003.i	0.8550	0.2434
u233-sol-therm-012-002.i	0.8519	0.2274
u233-sol-therm-012-001.i	0.8511	0.2230
u233-sol-therm-016-017.i	0.8491	0.2128
u233-sol-therm-016-016.i	0.8491	0.2124
u233-sol-therm-016-018.i	0.8484	0.2087
u233-sol-therm-016-014.i	0.8467	0.2000
u233-sol-therm-016-015.i	0.8466	0.1995
u233-sol-therm-016-013.i	0.8465	0.1992
u233-sol-therm-016-022.i	0.8446	0.1889
u233-sol-therm-016-023.i	0.8442	0.1872
u233-sol-therm-016-021.i	0.8439	0.1853
u233-sol-therm-013-008.i	0.8423	0.1769
u233-sol-therm-013-011.i	0.8423	0.1768
u233-sol-therm-013-007.i	0.8422	0.1768
u233-sol-therm-013-009.i	0.8422	0.1767
u233-sol-therm-013-013.i	0.8421	0.1761
u233-sol-therm-013-006.i	0.8419	0.1748
u233-sol-therm-013-014.i	0.8418	0.1745
u233-sol-therm-013-010.i	0.8417	0.1742
u233-sol-therm-013-012.i	0.8412	0.1714
u233-sol-therm-013-001.i	0.8408	0.1692
u233-sol-therm-013-004.i	0.8408	0.1691
u233-sol-therm-013-003.i	0.8407	0.1689
u233-sol-therm-013-005.i	0.8407	0.1685
u233-sol-therm-015-031.i	0.8406	0.1681
u233-sol-therm-013-002.i	0.8402	0.1663
u233-sol-therm-015-025.i	0.8398	0.1640

u233-sol-therm-016-003.i	0.8341	0.1342
u233-sol-therm-016-002.i	0.8339	0.1331
u233-sol-therm-016-001.i	0.8338	0.1328
u233-sol-therm-015-030.i	0.8312	0.1192
u233-sol-therm-016-008.i	0.8312	0.1191
u233-sol-therm-016-007.i	0.8311	0.1183
u233-sol-therm-016-006.i	0.8306	0.1157
u233-sol-therm-016-011.i	0.8293	0.1094
u233-sol-therm-016-010.i	0.8291	0.1079
u233-sol-therm-016-012.i	0.8289	0.1072
u233-sol-therm-009-004.i	0.8278	0.1014
u233-sol-therm-015-014.i	0.8275	0.0998
u233-sol-therm-015-017.i	0.8245	0.0841
u233-sol-therm-015-029.i	0.8224	0.0732
u233-sol-inter-001-016.i	0.8224	0.0732
u233-sol-therm-015-004.i	0.8187	0.0538
u233-sol-therm-015-007.i	0.8181	0.0507
u233-sol-therm-015-010.i	0.8110	0.0134
u233-sol-inter-001-030.i	0.8109	0.0129
u233-comp-therm-001-003.i	0.8107	0.0119
u233-sol-therm-015-028.i	0.8103	0.0101
u233-sol-inter-001-027.i	0.8103	0.0100

Table 19. Benchmarks Selected by Whisper as Similar to Application U233-SOL-THERM-001-001 from SNL library.

Benchmark Selected from SNL Library	ck	weight
heu-sol-therm-012-01.i	0.3606	1.0000
ieu-sol-therm-002-04.i	0.3567	0.9540
heu-sol-therm-013-01.i	0.3550	0.9346
ieu-sol-therm-002-08.i	0.3535	0.9168
heu-met-therm-011-29.i	0.3511	0.8883
heu-met-therm-011-30.i	0.3499	0.8738
heu-met-therm-011-28.i	0.3498	0.8724
ieu-sol-therm-002-03.i	0.3494	0.8685
heu-met-therm-011-27.i	0.3482	0.8535
heu-met-therm-011-07.i	0.3481	0.8534
heu-met-therm-011-09.i	0.3480	0.8513
ieu-sol-therm-003-08.i	0.3474	0.8445
heu-met-therm-011-06.i	0.3474	0.8442
heu-met-therm-011-08.i	0.3471	0.8412
heu-met-therm-011-41.i	0.3471	0.8406
heu-met-therm-011-25.i	0.3459	0.8264
ieu-sol-therm-003-07.i	0.3450	0.8166
heu-met-therm-011-26.i	0.3434	0.7971
heu-sol-therm-011-02.i	0.3431	0.7940
ieu-sol-therm-002-02.i	0.3418	0.7780
ieu-sol-therm-003-20.i	0.3417	0.7773
heu-met-therm-011-17.i	0.3413	0.7730
heu-sol-therm-011-01.i	0.3405	0.7633

heu-met-therm-011-16.i	0.3402	0.7594
heu-met-therm-011-24.i	0.3389	0.7439
heu-sol-therm-013-02.i	0.3387	0.7424
heu-met-therm-011-40.i	0.3387	0.7417
heu-met-therm-011-15.i	0.3380	0.7336
ieu-sol-therm-003-06.i	0.3377	0.7304
ieu-sol-therm-003-21.i	0.3375	0.7277
ieu-sol-therm-003-19.i	0.3370	0.7220
heu-met-therm-011-23.i	0.3370	0.7218
heu-met-therm-011-05.i	0.3366	0.7175
heu-met-therm-011-14.i	0.3352	0.7002
heu-met-therm-011-13.i	0.3327	0.6715
ieu-sol-therm-002-07.i	0.3321	0.6638
heu-met-therm-011-20.i	0.3313	0.6551
heu-met-therm-011-31.i	0.3313	0.6544
heu-met-therm-011-33.i	0.3309	0.6501
heu-met-therm-011-21.i	0.3309	0.6498
heu-met-therm-011-34.i	0.3308	0.6482
ieu-sol-therm-002-01.i	0.3307	0.6473
heu-sol-therm-001-05.i	0.3307	0.6471
heu-met-therm-011-32.i	0.3303	0.6428
heu-met-therm-011-42.i	0.3303	0.6423
heu-met-therm-011-11.i	0.3300	0.6396
heu-met-therm-011-38.i	0.3300	0.6394
heu-met-therm-011-18.i	0.3296	0.6340
heu-sol-therm-001-06.i	0.3293	0.6310
heu-met-therm-011-19.i	0.3290	0.6269
heu-sol-therm-003-12.i	0.3289	0.6266
heu-met-therm-011-43.i	0.3284	0.6206
heu-met-therm-011-10.i	0.3280	0.6155
heu-met-therm-011-39.i	0.3279	0.6142
heu-met-therm-011-12.i	0.3275	0.6094
heu-sol-therm-003-13.i	0.3274	0.6087
ieu-sol-therm-003-18.i	0.3274	0.6082
heu-sol-therm-003-14.i	0.3272	0.6065
heu-sol-therm-010-04.i	0.3267	0.6004
heu-sol-therm-013-03.i	0.3263	0.5957
heu-sol-therm-001-10.i	0.3262	0.5941
heu-sol-therm-010-03.i	0.3260	0.5922
heu-sol-therm-010-02.i	0.3260	0.5915
heu-sol-therm-002-09.i	0.3258	0.5900
heu-sol-therm-003-07.i	0.3254	0.5847
heu-sol-therm-010-01.i	0.3253	0.5838
heu-sol-therm-003-02.i	0.3251	0.5813
heu-met-therm-011-03.i	0.3247	0.5768
heu-sol-therm-008-07.i	0.3246	0.5755
ieu-sol-therm-003-05.i	0.3246	0.5749
heu-sol-therm-003-01.i	0.3244	0.5729

ieu-sol-therm-003-17.i	0.3238	0.5665
heu-met-therm-011-22.i	0.3236	0.5639
heu-sol-therm-003-15.i	0.3233	0.5603
heu-met-therm-011-04.i	0.3233	0.5601
ieu-sol-therm-003-02.i	0.3230	0.5561
ieu-sol-therm-003-03.i	0.3216	0.5399
ieu-sol-therm-003-04.i	0.3211	0.5344
heu-sol-therm-008-03.i	0.3204	0.5260
heu-met-therm-011-37.i	0.3203	0.5241
heu-sol-therm-013-04.i	0.3202	0.5230
heu-sol-therm-002-10.i	0.3195	0.5157
heu-sol-therm-008-11.i	0.3187	0.5060
ieu-sol-therm-003-01.i	0.3176	0.4927
ieu-sol-therm-002-03.i	0.3166	0.4809
heu-sol-therm-009-04.i	0.3165	0.4794
ieu-sol-therm-002-02.i	0.3160	0.4740
heu-sol-therm-008-05.i	0.3146	0.4571
ieu-sol-therm-003-16.i	0.3145	0.4568
ieu-sol-therm-002-01.i	0.3132	0.4407
heu-sol-therm-009-03.i	0.3129	0.4379
heu-met-therm-011-01.i	0.3110	0.4148
heu-met-therm-011-02.i	0.3106	0.4102
ieu-sol-therm-003-30.i	0.3104	0.4083
ieu-sol-therm-003-07.i	0.3102	0.4055
ieu-sol-therm-003-06.i	0.3101	0.4046
ieu-sol-therm-003-05.i	0.3100	0.4037
ieu-sol-therm-003-29.i	0.3097	0.4001
ieu-sol-therm-003-04.i	0.3093	0.3948
ieu-sol-therm-004-03.i	0.3087	0.3876
ieu-sol-therm-004-01.i	0.3086	0.3864
heu-sol-therm-003-16.i	0.3086	0.3861
heu-sol-therm-001-07.i	0.3084	0.3844
heu-sol-therm-001-03.i	0.3079	0.3784
heu-met-therm-006-06.i	0.3077	0.3758
heu-met-therm-011-36.i	0.3077	0.3755
heu-sol-therm-003-09.i	0.3071	0.3685
heu-met-therm-006-07.i	0.3069	0.3671
heu-met-therm-011-35.i	0.3069	0.3667
heu-sol-therm-002-05.i	0.3067	0.3641
heu-sol-therm-009-02.i	0.3067	0.3640
ieu-sol-therm-003-28.i	0.3065	0.3623
ieu-sol-therm-002-05.i	0.3065	0.3617
heu-sol-therm-003-08.i	0.3062	0.3581
ieu-sol-therm-004-02.i	0.3059	0.3548
ieu-sol-therm-003-27.i	0.3058	0.3538
heu-sol-therm-007-09.i	0.3057	0.3524
heu-sol-therm-003-03.i	0.3056	0.3514
heu-sol-therm-001-08.i	0.3055	0.3501

heu-sol-therm-001-01.i	0.3053	0.3472
ieu-sol-therm-004-04.i	0.3052	0.3468
heu-sol-therm-008-01.i	0.3051	0.3456
ieu-sol-therm-003-15.i	0.3051	0.3455
heu-sol-therm-002-01.i	0.3051	0.3451
heu-sol-therm-003-17.i	0.3050	0.3446
heu-sol-therm-002-11.i	0.3050	0.3442
heu-met-therm-006-19.i	0.3039	0.3312
heu-sol-therm-007-05.i	0.3039	0.3312
heu-sol-therm-003-04.i	0.3039	0.3311
ieu-sol-therm-003-26.i	0.3036	0.3281
ieu-sol-therm-003-25.i	0.3032	0.3230
heu-sol-therm-007-07.i	0.3026	0.3160
heu-met-therm-006-05.i	0.3026	0.3155
heu-met-therm-006-12.i	0.3019	0.3081
ieu-sol-therm-003-24.i	0.3014	0.3019
ieu-sol-therm-003-03.i	0.3013	0.3006
heu-sol-therm-009-01.i	0.3013	0.3004
heu-sol-therm-002-06.i	0.3010	0.2969
ieu-sol-therm-004-05.i	0.3005	0.2912
ieu-sol-therm-003-14.i	0.2998	0.2826
heu-sol-therm-007-03.i	0.2998	0.2823
heu-met-therm-006-08.i	0.2998	0.2823
heu-sol-therm-002-02.i	0.2997	0.2816
heu-met-therm-006-14.i	0.2988	0.2707
ieu-sol-therm-004-06.i	0.2974	0.2540
heu-sol-therm-002-12.i	0.2968	0.2473
ieu-sol-therm-003-13.i	0.2957	0.2346
heu-sol-therm-003-18.i	0.2957	0.2344
heu-sol-therm-003-10.i	0.2955	0.2325
heu-sol-therm-002-13.i	0.2947	0.2226
ieu-comp-therm-002-01.i	0.2945	0.2204
heu-met-therm-006-11.i	0.2945	0.2199
ieu-sol-therm-004-07.i	0.2944	0.2191
heu-sol-therm-008-14.i	0.2944	0.2186
heu-met-therm-006-04.i	0.2942	0.2163
heu-sol-therm-003-05.i	0.2941	0.2156
ieu-comp-therm-002-02.i	0.2940	0.2144
heu-sol-therm-001-09.i	0.2939	0.2130
heu-sol-therm-002-07.i	0.2936	0.2092
heu-sol-therm-003-11.i	0.2935	0.2089
heu-sol-therm-001-02.i	0.2931	0.2039
heu-sol-therm-007-01.i	0.2927	0.1989
heu-met-therm-006-03.i	0.2927	0.1985
heu-sol-therm-002-03.i	0.2926	0.1972
heu-comp-mixed-001-02.i	0.2925	0.1969
heu-sol-therm-003-19.i	0.2924	0.1956
heu-sol-therm-008-09.i	0.2922	0.1934

heu-sol-therm-008-08.i	0.2922	0.1934
heu-sol-therm-001-04.i	0.2922	0.1934
leu-comp-therm-002-05.i	0.2919	0.1897
ieu-sol-therm-003-11.i	0.2913	0.1827
leu-comp-therm-002-03.i	0.2910	0.1790
ieu-sol-therm-003-02.i	0.2909	0.1782
ieu-sol-therm-003-12.i	0.2908	0.1763
leu-comp-therm-002-04.i	0.2908	0.1762
heu-comp-mixed-001-01.i	0.2905	0.1734
heu-sol-therm-003-06.i	0.2902	0.1700
heu-sol-therm-008-12.i	0.2902	0.1690
heu-met-therm-006-16.i	0.2901	0.1687
heu-met-therm-006-09.i	0.2894	0.1601
heu-sol-therm-006-08.i	0.2890	0.1557
heu-sol-therm-008-04.i	0.2885	0.1494
heu-sol-therm-002-08.i	0.2883	0.1468
heu-met-therm-006-15.i	0.2877	0.1396
heu-sol-therm-008-06.i	0.2871	0.1329
heu-sol-therm-002-04.i	0.2868	0.1298
heu-sol-therm-006-01.i	0.2865	0.1260
heu-sol-therm-007-12.i	0.2865	0.1252
heu-sol-therm-008-13.i	0.2852	0.1102
heu-sol-therm-006-02.i	0.2846	0.1034
heu-sol-therm-006-09.i	0.2845	0.1020
heu-sol-therm-002-14.i	0.2844	0.1005
heu-sol-therm-006-27.i	0.2843	0.0995
heu-met-therm-006-02.i	0.2842	0.0986
ieu-sol-therm-003-01.i	0.2838	0.0937
heu-sol-therm-006-12.i	0.2833	0.0881
ieu-sol-therm-002-06.i	0.2832	0.0870
leu-comp-therm-010-04.i	0.2826	0.0800
leu-sol-therm-001-01.i	0.2813	0.0650
leu-sol-therm-003-08.i	0.2811	0.0626
heu-sol-therm-007-08.i	0.2805	0.0548
heu-sol-therm-007-06.i	0.2794	0.0425
heu-sol-therm-008-10.i	0.2794	0.0420
heu-sol-therm-007-10.i	0.2793	0.0412
leu-sol-therm-003-09.i	0.2793	0.0404
heu-sol-therm-006-13.i	0.2787	0.0333
heu-sol-therm-008-02.i	0.2786	0.0323
heu-sol-therm-006-28.i	0.2775	0.0196
ieu-comp-therm-001-04.i	0.2769	0.0131
ieu-comp-therm-001-13.i	0.2764	0.0061

Table 20. Benchmarks Selected by Whisper as Similar to Application U233-SOL-THERM-001-001 from SRNS library.

Benchmark Selected from SRNS Library	ck	weight
ieu-met-fast-005-01.i	0.8251	1.0000
ieu-met-fast-006-01.i	0.7757	0.8211
heu-met-fast-023-21.i	0.6712	0.4417
heu-met-fast-026-18.i	0.6684	0.4316
heu-met-fast-023-29.i	0.6660	0.4230
heu-met-fast-026-28.i	0.6657	0.4221
heu-met-fast-026-06.i	0.6643	0.4169
heu-met-fast-026-29.i	0.6640	0.4158
heu-met-fast-026-19.i	0.6638	0.4152
heu-met-fast-023-17.i	0.6633	0.4134
heu-met-fast-023-16.i	0.6619	0.4080
heu-met-fast-007-02.i	0.6615	0.4066
heu-met-fast-026-07.i	0.6613	0.4061
heu-met-fast-007-27.i	0.6612	0.4055
heu-met-fast-007-04.i	0.6612	0.4055
heu-met-fast-026-31.i	0.6602	0.4021
heu-met-fast-023-07.i	0.6596	0.3999
heu-met-fast-023-06.i	0.6584	0.3955
heu-met-fast-007-03.i	0.6573	0.3916
heu-met-fast-007-28.i	0.6573	0.3916
heu-met-fast-007-07.i	0.6564	0.3883
heu-met-fast-007-08.i	0.6558	0.3861
heu-met-fast-026-24.i	0.6558	0.3860
heu-met-fast-007-05.i	0.6558	0.3860
heu-met-fast-007-09.i	0.6547	0.3822
heu-met-fast-026-13.i	0.6546	0.3818
heu-met-fast-026-02.i	0.6531	0.3764
heu-met-fast-023-02.i	0.6524	0.3737
heu-met-fast-026-23.i	0.6522	0.3728
heu-met-fast-026-12.i	0.6521	0.3725
heu-met-fast-026-27.i	0.6515	0.3705
heu-met-fast-007-06.i	0.6511	0.3690
heu-met-fast-023-28.i	0.6509	0.3683
heu-met-fast-007-29.i	0.6506	0.3672
heu-met-fast-026-14.i	0.6498	0.3642
heu-met-fast-007-21.i	0.6482	0.3584
heu-met-fast-026-11.i	0.6480	0.3579
heu-met-fast-007-20.i	0.6476	0.3564
heu-met-fast-026-01.i	0.6471	0.3543
heu-met-fast-026-32.i	0.6462	0.3511
heu-met-fast-007-22.i	0.6451	0.3471
heu-met-fast-007-32.i	0.6447	0.3456
heu-met-fast-026-09.i	0.6445	0.3451
heu-met-fast-026-21.i	0.6432	0.3405
heu-met-fast-026-25.i	0.6432	0.3402
heu-met-fast-007-01.i	0.6429	0.3394

heu-met-fast-007-33.i	0.6428	0.3388
heu-met-fast-026-20.i	0.6421	0.3362
heu-met-fast-007-34.i	0.6413	0.3335
heu-met-fast-023-12.i	0.6409	0.3321
heu-met-fast-026-22.i	0.6408	0.3318
heu-met-fast-026-08.i	0.6406	0.3307
heu-met-fast-023-08.i	0.6401	0.3290
heu-met-fast-034-03.i	0.6390	0.3252
heu-met-fast-023-20.i	0.6382	0.3223
heu-met-fast-026-30.i	0.6378	0.3209
heu-met-fast-023-04.i	0.6371	0.3182
heu-met-fast-026-26.i	0.6367	0.3166
heu-met-fast-026-15.i	0.6353	0.3117
heu-met-fast-007-24.i	0.6349	0.3102
heu-met-fast-023-10.i	0.6348	0.3097
heu-met-fast-002-05.i	0.6347	0.3097
heu-met-fast-007-23.i	0.6344	0.3086
heu-met-fast-023-18.i	0.6344	0.3083
heu-met-fast-004-01.i	0.6344	0.3083
heu-met-fast-033-01.i	0.6340	0.3070
heu-met-fast-034-01.i	0.6339	0.3067
heu-met-fast-023-22.i	0.6338	0.3061
heu-met-fast-026-03.i	0.6335	0.3052
heu-met-fast-026-10.i	0.6334	0.3047
heu-met-fast-023-09.i	0.6334	0.3047
heu-met-fast-023-03.i	0.6330	0.3035
heu-met-fast-021-01.i	0.6330	0.3034
heu-met-fast-026-17.i	0.6329	0.3030
heu-met-fast-026-16.i	0.6326	0.3019
heu-met-mixed-001-01.i	0.6312	0.2968
heu-met-fast-007-35.i	0.6311	0.2963
heu-met-fast-034-02.i	0.6310	0.2960
heu-met-fast-003-12.i	0.6308	0.2953
heu-met-fast-026-05.i	0.6306	0.2948
heu-comp-inter-005-03.i	0.6298	0.2919
heu-met-fast-023-19.i	0.6295	0.2907
heu-met-fast-007-10.i	0.6293	0.2900
heu-met-fast-026-04.i	0.6284	0.2866
heu-comp-mixed-002-01.i	0.6278	0.2846
heu-met-fast-007-36.i	0.6276	0.2838
heu-met-fast-023-05.i	0.6271	0.2818
heu-met-fast-023-14.i	0.6270	0.2814
heu-met-fast-013-01.i	0.6264	0.2795
heu-met-fast-007-25.i	0.6257	0.2769
heu-met-fast-007-26.i	0.6243	0.2719
heu-met-fast-023-13.i	0.6240	0.2707
heu-met-fast-024-01.i	0.6239	0.2702
heu-met-fast-007-19.i	0.6238	0.2700

heu-met-fast-007-30.i	0.6209	0.2595
heu-comp-inter-005-02.i	0.6207	0.2588
heu-met-fast-023-15.i	0.6190	0.2527
heu-comp-inter-005-04.i	0.6188	0.2518
heu-met-fast-007-37.i	0.6182	0.2497
heu-met-fast-007-38.i	0.6178	0.2481
heu-met-fast-007-39.i	0.6177	0.2479
heu-met-fast-001-01.i	0.6162	0.2423
heu-met-fast-007-40.i	0.6155	0.2399
heu-met-fast-001-02.i	0.6130	0.2308
heu-comp-mixed-001-03.i	0.6127	0.2296
heu-comp-mixed-001-05.i	0.6116	0.2257
heu-met-fast-002-04.i	0.6111	0.2238
heu-met-fast-022-01.i	0.6097	0.2188
heu-comp-mixed-001-04.i	0.6094	0.2176
heu-met-fast-002-06.i	0.6086	0.2150
heu-met-fast-012-01.i	0.6086	0.2147
heu-met-fast-003-07.i	0.6052	0.2024
heu-comp-mixed-001-25.i	0.6044	0.1997
heu-comp-mixed-001-26.i	0.6038	0.1974
heu-met-fast-007-11.i	0.6026	0.1932
heu-comp-mixed-001-24.i	0.6022	0.1917
heu-comp-mixed-001-22.i	0.6018	0.1900
heu-comp-mixed-001-17.i	0.6017	0.1899
heu-comp-mixed-001-18.i	0.6014	0.1887
heu-comp-mixed-001-20.i	0.6011	0.1875
heu-comp-mixed-001-21.i	0.6010	0.1872
heu-comp-mixed-001-23.i	0.6006	0.1858
heu-met-fast-002-03.i	0.5999	0.1833
heu-comp-mixed-001-19.i	0.5985	0.1783
heu-met-fast-033-02.i	0.5976	0.1751
heu-met-fast-007-12.i	0.5958	0.1685
heu-met-fast-007-14.i	0.5957	0.1680
heu-comp-mixed-002-04.i	0.5942	0.1627
heu-comp-mixed-002-19.i	0.5933	0.1594
heu-comp-mixed-001-06.i	0.5924	0.1560
heu-met-fast-002-02.i	0.5921	0.1549
heu-comp-mixed-002-18.i	0.5898	0.1467
heu-comp-mixed-002-05.i	0.5885	0.1419
heu-met-fast-007-16.i	0.5882	0.1409
heu-met-fast-007-15.i	0.5879	0.1397
heu-met-fast-007-13.i	0.5862	0.1336
heu-comp-mixed-001-07.i	0.5804	0.1124
heu-met-fast-007-31.i	0.5769	0.0998
heu-comp-mixed-001-08.i	0.5749	0.0927
heu-comp-mixed-001-11.i	0.5739	0.0888
heu-comp-mixed-001-10.i	0.5738	0.0885
heu-comp-mixed-001-09.i	0.5716	0.0807

heu-met-fast-007-42.i	0.5710	0.0784
heu-met-fast-007-41.i	0.5708	0.0776
heu-met-fast-002-01.i	0.5703	0.0760
heu-met-fast-003-06.i	0.5703	0.0760
heu-met-fast-003-05.i	0.5540	0.0168
heu-comp-inter-005-01.i	0.5510	0.0058