

**DEPARTMENT OF ENERGY (DOE)
OFFICE OF NUCLEAR ENERGY (NE)**



DOE/NRC COLLABORATION FOR CRITICALITY SAFETY SUPPORT
FOR COMMERCIAL-SCALE HALEU FUEL CYCLE AND TRANSPORTATION (DNCSH)

CALL #1 FOR EXPERIMENTS AND ANALYSIS WORK PACKAGES (EAW)

Event	Date
Call #1 Draft Announced:	April 15, 2024, at 5:00 PM, Eastern Time
Information Meeting:	April 22, 2024, at 1:00 PM, Eastern Time
Call #1 Finalized:	April 26, 2024, at 5:00 PM, Eastern Time
Notification of Intent to Apply:	May 3, 2024, at 5:00 PM, Eastern Time Optional but encouraged
Deadline for Proposals:	May 31, 2024, at 5:00 PM, Eastern Time Must be submitted by a national lab representative
Notification of Awards:	July 1, 2024, at 5:00 PM, Eastern Time (TENTATIVE) Final award date may be updated when number of proposals exceeds expectations.

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I DESCRIPTION OF ANNOUNCEMENT

GENERAL INQUIRIES SHOULD BE DIRECTED TO:

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I.A. BACKGROUND

The DOE/NRC collaboration for Criticality Safety support for commercial-scale HALEU fuel cycle and Transportation (DNCSEH) project is seeking proposals for experiment and analysis work packages (EAW) that support criticality safety for commercial-scale high assay low enriched uranium (HALEU), defined as 5 to 20 wt% ^{235}U , within fuel cycle stages relevant to 10 CFR Part 70 and Part 71. Figure 1 outlines the DNCSEH scope, referenced to the standard light water reactor (LWR) fuel cycle.

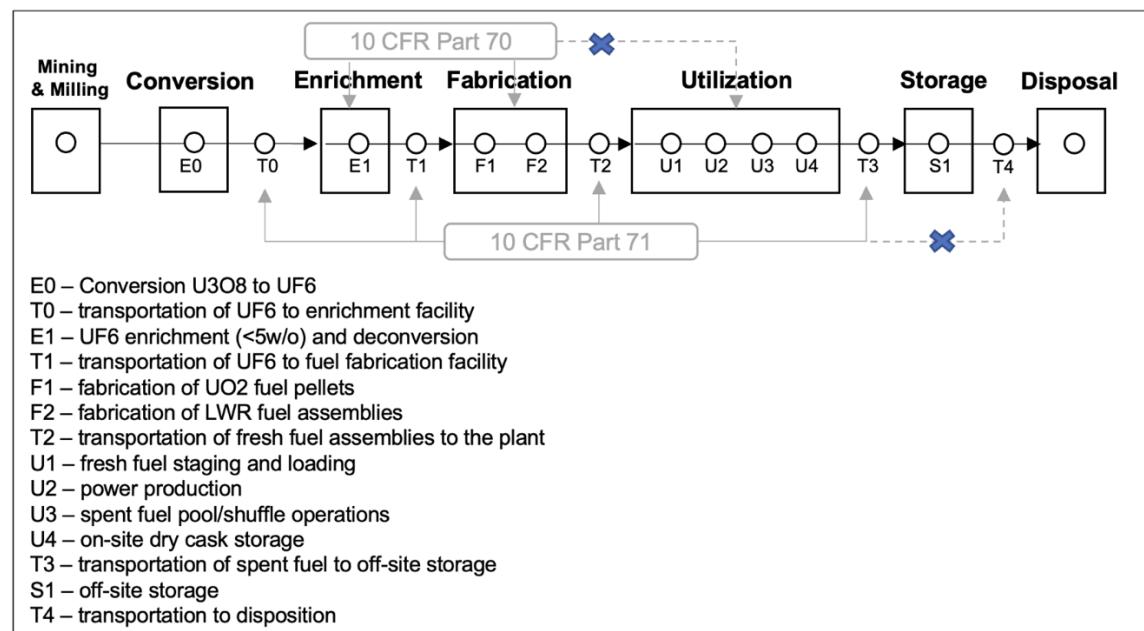


Figure 1. DNCSEH scope based on reference LWR fuel cycles¹.

Call #1 (this call) is focused on filling validation gaps for HALEU transportation, UF₆ enrichment and deconversion, and fabrication of HALEU fresh fuel in various fuel forms;

¹ NRC Non-Light Water Reactor (NonLWR) Vision and Strategy, Volume 3 – Computer Code Development Plans for Severe Accident Progression, Source Term, and Consequence Analysis. ML20030A178. (January 31, 2020.)

including fuel forms representative of those being considered for higher enrichment in LWRs and Non-LWR systems.

Because of the focus on the fuel cycle front-end for this call (i.e., stages T0, E, T1, F1, F2, T2, U1 in Figure 1), HALEU enrichment in wt% ^{235}U may be unambiguously referred to simply by wt%, e.g., 10-20 wt%. DNCSH includes scope for the back-end (i.e., stages U3, U4, T3 in Figure 1) as well, however this is not considered in this call. There is no scope within DNCSH for the transportation of spent fuel to disposition, shown as stage T4 in Figure 1. Plutonium-bearing fuel may be considered by DNCSH in later calls, either for back-end or for front-end with fuel cycles that include the possibility of using recycled fuel, e.g., the sodium-cooled fast reactor (SFR). At this time, thorium-based fuels will not be considered within DNCSH.

This document outlines five topic areas for this call. Successful proposals will make a clear justification of the data need by showing current data gaps, including data refinements that can reduce uncertainties, and provide a clear discussion of how the proposed measurements and benchmarks will address those gaps (e.g., targeted sensitivities, energy ranges, specific cross-sections tested). For the benchmarking of historical experiments, the proposal should include an assessment of the completeness of the original data and the likelihood that it can be developed into a modern benchmark, along with clear justification of the data need as with new experiments. Priority will be given to measurements/experiments that can be used for criticality safety validation, specifically benchmarks that will be published in the International Criticality Safety Benchmark Evaluation Project (ICSBEP) Handbook².

Note, there will be multiple calls for EAWs made by the DNCSH project. This call is based on scoping study results primarily focused on transportation, presented at the first DNCSH Workshop, held on February 29, 2024. Approximately \$10 million in awards will be made for EAW Call #1. Tentatively, call #2 in early FY25 will have some microreactor focus in its topic areas. Tentatively, call #3 later in FY25 will have a back-end, spent fuel focus. We currently anticipate the same sequence of events of hosting a workshop, proposing a draft call, and distributing a final call for call #2 and #3, but will adapt as needed based on lessons learned in call #1.

I.B. PROJECT MISSION

The mission of the DNCSH project is to facilitate robust and efficient future licensing efforts for HALEU-based fuel cycle stages at the NRC. The funding for this project comes from congressional authorization as part of the Inflation Reduction Act. The primary customer is the NRC. All appropriate data produced by this project must be publicly available to support industry, academic, and regulatory activities.

² *International Handbook of Evaluated Criticality Safety Benchmark Experiments*, NEA/NSC/DOC(95)03, Organisation for Economic Co-operation and Development, Nuclear Energy Agency, Paris, France (2021).

I.C. PROPOSAL TOPIC AREAS

The following section describes the topic areas for EAW Call #1. Note that these areas may be present in future calls and that a proposal may be relevant for more than one topic area. For this call, proposals based on specific vendors' micro/small modular reactor transportation are discouraged. This call is focused on funding more generic types of benchmarks which will be applicable to a wider range of fuel and reactor types. A future Call is planned to focus on full core micro/small modular reactor transport. If you have questions on a particular idea or topic area, please do not hesitate to contact dncsh@ornl.gov.

I.C.1. UF₆ transportation with moderator exclusion

The current enrichment and transportation infrastructure relies on uranium hexafluoride (UF₆). UF₆ is stored and transported in cylinders listed in the American National Standard Institute (ANSI) N14.1 standard³ (incorporated by reference into 49 CFR 173.420⁴), typically in cylinders with 30 in or 48 in diameters. A key consideration in the analysis and licensing of these cylinders is the exception provided in 10 CFR 71.55(g)⁵ to the water ingress analysis requirement of 10 CFR 71.55(b). The validation of k_{eff} calculations involving UF₆ cylinders in the normal conditions of transport (NCT) and hypothetical accident conditions (HAC) models is extremely challenging^{6,7}. The limiting k_{eff} results come from cases with an intermediate neutron energy spectrum, for which only a limited number of benchmarks are available in the ICSBEP Handbook.

One condition enumerated in 10 CFR 71.55(g) for the exception to apply is that “the uranium is enriched to not more than 5 weight percent uranium-235”⁵. This currently bars the use of the large-capacity UF₆ cylinders from HALEU applications without consideration of moderator intrusion. One option is to redesign the 30 in cylinders with neutron absorbers and include the moderator intrusion scenario, as has been done in at least one package design⁸. A potential solution could be developed to support the use of existing 30 in cylinders and overpacks without the consideration of moderator intrusion. While a change to 10 CFR 71.55(g) is beyond the scope of this project, the validation challenge associated with the intermediate spectrum design basis condition would remain. The current ICSBEP evaluations most likely to be applicable, IEU-COMP-INTER-003, IEU-COMP-MIXED-002, and IEU-COMP-THERM-001⁸, have been shown to have limited applicability for ²³⁵U enrichments of 7 wt% and 10 wt%⁹.

Benchmarks are therefore desired to support validation of UF₆ cylinders in the neutron energy spectra that result from NCT and HAC scenarios. The benchmarks should target both the lower end of the HALEU range, which is likely to be exploited in current light-water reactor plants, and the upper end of the HALEU range for non-LWR applications. These benchmarks would likely also be applicable to other packages containing other uranium chemical forms. Criticality safety assessment of these packages would become necessary in fuel cycle scenarios with

³ *Packaging of Uranium Hexafluoride for Transport*, ANSI N14.1, American National Standard Institute (2001).

⁴ *Uranium Hexafluoride (fissile, fissile excepted and non-fissile)*, 10 CFR 173.420, US Department of Transportation (2015).

⁵ *General requirements for fissile material packages*, 10 CFR 71.55, US Nuclear Regulatory Commission (2004).

⁶ R. A. Hall, W. J. Marshall, and W. A. Wieselquist, “Assessment of Existing Transportation Packages for Use with HALEU,” ORNL/TM-2020/1725 (2020).

⁷ E. M. Saylor, A. Lang, W. J. Marshall, and R. A. Hall, “Analysis of the 30B UF₆ Container for Use with Increased Enrichment,” ORNL/TM-2021/2043 (2021).

⁸ M. Hennebach, “Safety Analysis Report for the DN30-X Package,” 0045-BSH-2020-001, Rev. 3, NRC ADAMS Accession Number ML22327A183 (2022).

⁹ W. J. Marshall and T. M. Greene, “Applicability of the ORCEF UF₄/CF₂ Experiments to Validation of 30” UF₆ Cylinders,” *Proceedings of NCSD 2022*, Anaheim, CA (2022).

deconversion at enrichment facilities prior to transportation.

I.C.2. 10-20% enrichment gap

Many promising advanced reactors concepts are planning on using HALEU fuel with an enrichment as close as possible to the upper limit of 20 wt%, including 6 of the Advanced Reactor Demonstration Project (ARDP) awardees with enrichments between 19.55 and 20 wt%. The ICSBEP Handbook has historically been focused on experiments using low and high-enriched uranium and plutonium for energy and defense applications, but only 457 benchmarks of the 5,000 including uranium are in the 5–20 wt% HALEU range. Among those, 273 have a fuel enrichment between 5 and 9 wt%, 184 have a fuel enrichment between 9 and 21 wt%, and 40 have an enrichment between 18 and 21 wt%. The uranium-fueled critical benchmarks available as a function of enrichment in the latest release of the ICSBEP handbook with is shown in Figure 2.

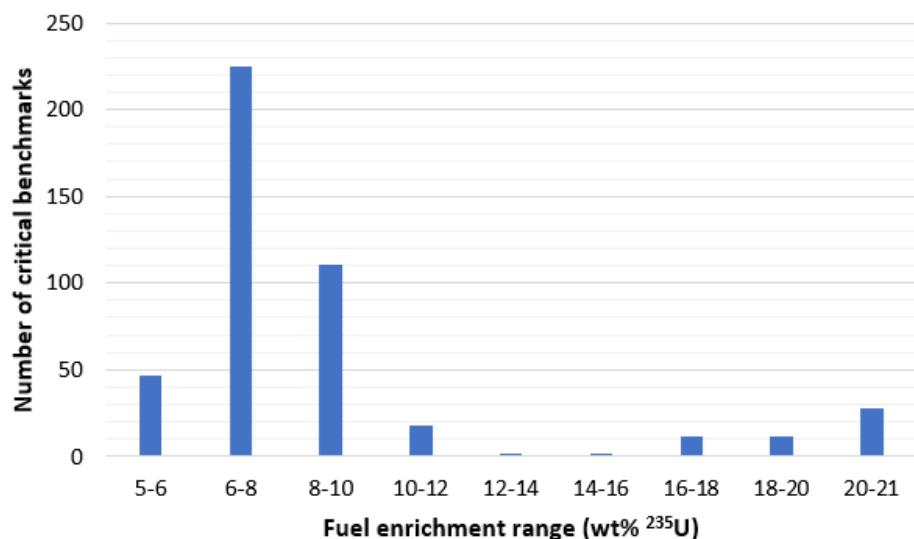


Figure 2. Number of critical experiment benchmarks per uranium enrichment range found in the ICSBEP handbook.

The gap of benchmarks in the 10-20 wt% range is clearly visible in Figure 2. In this range are benchmarks with high experimental uncertainty and/or a high/low calculational over expected C/E ratio, and therefore are not ideal for code and data validation. Additionally, many of the benchmarks within the HALEU enrichment range are performed in the same critical facilities, which introduces some difficult to quantify correlation among experiments.

Even though modern validation basis assessment techniques do not require matching enrichments, there is a clear gap of modern, high-quality critical experiment benchmarks particularly near the upper end of 19.75 wt%. The proposed benchmarks should demonstrate a focus on using and producing high-quality data, resulting in low experimental uncertainty and minimal experimental correlations with already available experiments. There is no restriction on the uranium fuel form, the neutron spectrum, or the moderator/reflector used in the proposed experiments of this topic area. This topic area is particularly well-suited to supporting

benchmarks based on existing or soon-to-be completed experiments.

I.C.3. Non-fissile material validation

Criticality safety must demonstrate HALEU systems are subcritical during transportation, fuel fabrication, and storage. During these operations, the HALEU materials can be collocated with several non-fissile materials that can impact criticality safety, such as structural materials that make up workstations, material containers, storage locations, and transport casks. Abnormal conditions, such as those associated with sprinkler actuation or firefighting activities, can introduce moderation and change the neutron spectrum of the system, resulting in a need to understand the criticality impact of these materials across the entire spectrum of neutron energy. Many important structural materials are inadequately represented in the ICSBEP handbook, including the major components of steels. New materials, such as solid moderators or alloys, transported with HALEU fuels may also have inadequate benchmark coverage.

The Organisation for Economic Cooperation and Development (OECD) Nuclear Energy Agency's (NEA) Working Party on Nuclear Criticality Safety (WPNCS) convened a subgroup in 2019 to review experimental needs from the international criticality safety community. A report was published in 2023 outlining several needs for non-fissile structural materials with inadequate validation coverage, including Fe, Mo, Ta, Ni, Cr, Mn, and Ni¹⁰.

Proposals responding to this topic area should make a clear case of the non-fissile validation gap that will be addressed and its applicability to the HALEU fuel cycle or transportation.

Proposed critical experiment benchmarks do not necessarily need to use HALEU fuel as the fissile material if the experiment is adequately sensitive to the non-fissile material with a justified validation gap. This topic area may be especially well-suited to support benchmark evaluations based on historical or already-completed experiments.

¹⁰ Percher, C. and G. McKenzie. Experimental Needs for Criticality Safety Purposes. Organisation for Economic Cooperation and Development. Nuclear Energy Agency. NEA/NSC/R(2022)6. 14 September 2023. https://www.oecd-nea.org/upload/docs/application/pdf/2023-09/nea_nsc_r_2022_6_web.pdf

I.C.4. Fissile salts

Advanced reactors have diverse fuel forms, beyond metal or uranium dioxide. These fuel forms show unique performance and characteristics, especially in HALEU enrichment levels. For example, the NEA Small Modular Reactor Dashboard Second Edition¹¹ contains several small or micro reactor designs that include HALEU fissile salts. Less than 50 of ~5,000 ICSBEP benchmarks contain salt materials which highlights the lack of validation and potential challenge to fabricate and transport fissile salts at a commercial scale.

Fissile salts, such as uranium tetrafluoride (UF₄) and uranium hexafluoride (UF₆), may be the fissile feed material delivered to molten salt reactor (MSR) sites. Fabrication of fissile salts includes novel pathways and conversion steps which could present unique criticality safety challenges for bulk processing. Normal and abnormal conditions for processing steps include unique material forms and situations, such as sprinkler activation, solvent ingress, acid overload, and pyrophoric events, all which result in an altered and further unvalidated state. These situations need to be further understood from a criticality perspective. Some fissile salts include elements with absorptive properties in the thermal neutron spectrum which need to be credited as neutron poisons to achieve bulk production. Once fabricated, similar issues exist with transportation.

Benchmarks are needed to cover all fuel fabrication steps as well as transportation. Uranium salts are made using both wet and dry methods (e.g. electrorefining). For dry methods, the bounding conditions are often in containers and with water ingress from fire/flooding. The starting material may be oxide or metal. As such, experiments are needed that are both thermal with interstitial moderator and fast with thermal neutron reflectors. They should include heterogeneous and homogeneous configurations for thermal and fast experiments.

For transportation, experiments are needed with salt included in the uranium. They should consider what surrounding and containment material will be present.

¹¹ NEA (2024), The NEA Small Modular Reactor Dashboard: Second Edition, OECD Publishing, Paris (https://www.oecd-nea.org/jcms/pl_90816/the-nea-small-modular-reactor-dashboard-second-edition)

I.C.5. Graphite and advanced moderator nuclear data

In application reviews, the NRC considers the quality and relevance of the applicants' methods, codes, and nuclear data. For industry, there will always be a cost to change tools and data once validated for their purposes. Therefore, there will always be impetus from industry to use older data, despite the availability of new, potentially better data. From a regulatory point of view, it is therefore useful to NRC to have benchmarks or measurements that help them review applications and provide relevant feedback to applicants.

The release of ENDF/B-VIII.0 in 2018 greatly increased the available thermal scattering law (TSL) sub-libraries, particularly focusing on thermal neutron moderators¹². Of particular significance is nuclear graphite, a key moderator in many advanced reactors, which, owing to its porous microstructure, exhibits high complexity in its interaction with thermal neutrons. The upcoming release of ENDF/B-VIII.1 in 2024 includes five distinct graphite thermal scattering sub-law libraries, with three dedicated to nuclear graphite. Studies presented in DNCSH Workshop #1 showed that under hypothetical accident conditions (HAC) with extensive flooding, a commercial-scale pebble transport scenario has a reasonable validation basis. However, due to the lack of certainty in future industrial operations, there is still a desire for high-quality nuclear data benchmarks which can give confidence to the NRC, for example, in allowing applicants to use the older ENDF/B-VII.1 or ENDF/B-VIII.0 nuclear data libraries which may already be adopted in particular vendors' workflows.

Beyond graphite, it is likely that small and micro reactors will use other solid moderators either as integral moderators or reflectors for increased neutron economy and core size reductions. Table 1 lists the most common solid moderators and highlights the gaps in differential and integral cross section measurements as well as critical benchmarks.

Table 1. Neutron Moderators Available ENDF/B-VIII.1 TSL Sub-Libraries and Corresponding Differential, Integral (Transmission) Cross Sections and Benchmark Experiments.

Material	Available TSL ENDF Files	Differential Measurement	Integral Measurements	Critical Benchmarks
Graphite	Yes	Yes	Yes	Yes
ZrH _{1.6} & ZrH ₂	Yes	Yes	Yes	Yes
YH ₂	Yes	Yes	Yes	No
Be metal	Yes	Yes	Yes	No*
BeO	Yes	No	Yes	No*
MgO	No	No	Yes	No
Be ₂ C	Yes	No	No	No
SiC	Yes	No	No	No

*The existing Be metal and BeO benchmarks are outside the HALEU enrichment range and/or do not exhibit the thermal neutron energy spectra that is most relevant to the DNCSH project.

It is clear that, other than graphite and zirconium hydrides (ZrH_x), all other moderators lack experiments. Note that differential measurements are very targeted and precise and are

¹² D. A. BROWN *et al.*, "ENDF/B-VIII.0: The 8th Major Release of the Nuclear Reaction Data Library with CIELO-project Cross Sections, New Standards and Thermal Scattering Data," *Nucl. Data Sheets* **148**, 1 (2018).

typically used as part of the evaluation process, preceding distribution in nuclear data libraries such as ENDF/B. For purposes of this call, integral measurements are measurements besides criticality experiments which can give confidence in the data but might not fit into a traditional criticality safety validation scheme.

Note that different from the other areas, these experiments and resulting benchmarks may not necessarily be critical experiments or result in an ICSBEP benchmark. The key requirement is to provide high-quality nuclear data which can be used by both the NRC and applicants to assess a particular nuclear data library. The rating system for this call has been designed to prioritize critical experiments, as described in Section IX, where the ICSBEP rating would be Poor (1) for any proposal that does not result in an ICSBEP benchmark. Proposals may also satisfy more than one topic area. Those that have an aspect in topic area 5 and another area, for example a TRISO benchmark for topic area 2 and 5, may have particularly high value. For single-purpose proposals to topic area 5, proposals are encouraged to be very clear how the data is relevant to criticality safety validation bases for the HALEU-based fuel cycles.

I.D. PROPOSAL CONTENT

The ideal proposal will meet the following criteria. Proposals will be reviewed and prioritized by how close they come to these ideals, not necessarily by meeting all of them.

1. Includes an experiment/measurement that has already been performed or will be performed by the end of Fiscal Year (FY) 2025.
2. Has a high likelihood of resulting in a new critical benchmark in the ICSBEP handbook, or other validation measurement.
3. Fills a gap in the criticality safety validation basis for commercial-scale HALEU operations.
4. Has a team with members of the following breakdown, noting that some members may fill multiple roles:
 - a. Industry point of contact who frames the need and confirms its relevance for commercial-scale HALEU transport.
 - b. U.S. National Laboratory point of contact. (mandatory)
 - c. For new experiments, critical experiment or relevant validation measurement point of contact who frames experiment feasibility, timeline, and materials required.
 - d. Criticality safety expert who can show the need is satisfied by the proposed validation measurement, benchmark, and/or benchmark experiment.
 - e. Experienced contributor to ICSBEP.
5. All models developed and data collected will be publicly available (mandatory).

Note that only the U.S. National Laboratory point of contact and public availability are mandatory. We recognize the ideal for the measurement/experiment to be performed by end of FY 2025 is difficult. For this call, funding will be prioritized for any experiments that could take place in FY 2025; however, this should not discourage proposals that are expected later. Future calls will continue to look at later experiment windows.

Note that the DNCSH will be responsible for all logistics and cost of new HALEU fuel for use in new experiments, including fabrication of the specific fuel form requested and transportation to the experiment site. Proposed new experiments requiring new HALEU fuel should not include cost of that fuel in their EAW budget.

II AWARD INFORMATION

II.A. TYPE OF AWARD INSTRUMENT

DOE anticipates awarding laboratory work authorizations under this DOE National Laboratory Program Announcement.

Any awards made under this Announcement will be subject to the provisions of the contract between DOE and the awardee National Laboratory.

II.B. ESTIMATED FUNDING

A total of \$10,000,000 in current and future fiscal year funds may be available to support awards.

DOE is under no obligation to pay for any costs associated with preparation or submission of proposals. DOE reserves the right to fund, in whole or in part, any, all, or none of the proposals submitted in response to this Announcement.

II.C. MAXIMUM AWARD SIZE

Eligibility requirements are found in Section III. Based on quotes from the DOE Nuclear Criticality Safety Program, a typical ICSBEP benchmark costs \$1-\$2 million, not including materials acquisition. The DNCSH team will coordinate HALEU fuel acquisition, as needed. The upper limits for the components of a \$2 million benchmark are as follows:

1. \$600,000 for experiment design and planning
2. \$600,000 for performing the experiment (sequence of many cases)
3. \$600,000 for ICSBEP benchmark report creation
4. \$200,000 for activity management

The DNCSH team is particularly interested in proposals to create benchmarks from existing experiments. For this type of proposal, the only costs should be for items 3 and 4, which leads to an upper limit of \$800,000 for a benchmark created based on existing data.

Non-ICSBEP experiments, such as transmission measurements, will have items 1, 2, and 4, but planning and experiment costs are expected to be much less, so items 1 and 2 will be limited to \$300,000.

Table 2. Types of Proposals and Their Associated Award Ceilings

Proposal Type	Award Ceiling
Benchmark with New Experiment	\$2,000,000
Benchmark with Existing Experiment	\$800,000
Other Measurement	\$800,000

II.D. EXPECTED NUMBER OF AWARDS

The number of awards will depend on the number of meritorious proposals and the availability of appropriated funds.

II.D.1. PERIOD OF PERFORMANCE

DOE anticipates making awards with a period of performance of two years for benchmarks with existing experiments or other measurements and up to four years for new experiments.

II.D.2. TYPE OF PROPOSAL

Proposals must adhere to the proposal template, available as a separate document from the www.ornl.gov/dncsh website, also included in Section VIII .

III ELIGIBILITY INFORMATION

III.A. ELIGIBLE APPLICANTS AND TOPICS

Proposals must be submitted from the lead at the national laboratory on the www.ornl.gov/dnchsh website. Awards will be given directly to the national laboratory to disburse among team members. The DNCSH does not impose any constraints on team members and the distribution of funding within the team, which permits the lead lab to have international, university, and industry team members. The lab is responsible to ensure any subcontracts can meet funding and time constraints and all data generated is in the public domain—for example, in the form of laboratory reports. Key team members, at least one per institution, should be listed in the proposal submission. The DNCSH review team may contact the proposing national laboratory to confirm if a listed member, especially in the case of international collaborators, can be involved in the relevant aspects of the work in a timely manner.

III.B. COST SHARING

Cost sharing is not required.

III.C. ELIGIBLE INDIVIDUALS

Eligible individuals with the skills, knowledge, and resources necessary to carry out the proposed research as a Laboratory Principal Investigator (PI) are invited to work with their organizations to develop a proposal.

III.D. LIMITATIONS ON SUBMISSIONS

For this call, only national laboratories within the DOE complex can receive funding which will come through the DOE financial plan. There is no limit on the number of proposals which may come from each national laboratory.

IV PROPOSAL AND SUBMISSION INFORMATION

IV.A. ADDRESS TO REQUEST PROPOSAL PACKAGE

Please upload submissions using the provided template to www.ornl.gov/dncsh by May 31, 2024, which will contain both this proposal and template documents. A public meeting was held April 22, 2024, to answer questions regarding the call and those comments have been incorporated into this final call.

IV.B. NOTIFICATION OF INTENT

Email dncsh@ornl.gov with a few sentences describing your proposal topic by May 3, 2024, for the main purpose of logistics and scheduling reviewers. This will be kept confidential within the DNCSH management team until awards are made for Call #1.

IV.C. PROPOSAL SUBMISSION AND CONTENT

Key information to be included in the proposal is as follows:

1. Planned validation measurement or ICSBEP benchmark characteristics. For example, ‘low-uncertainty’ mixed graphite/water moderated system with 14% enrichment. Cases as a function of moderator mixture.
2. Validation gap the proposal addresses (see below). Ideally this would be backed by calculations, such as those presented at Workshop #1 that show the new experiment satisfies a gap or reduces an important uncertainty.
3. Facility where experiment will be performed or facility where experiment was performed if based on existing data.
4. Timeline and cost breakdown (in both dollars and full time equivalent (FTE) fraction) covering the experiment design, execution, data collection, and ICSBEP delivery (if applicable). Costs should be for each team member and briefly justified, showing no more precision than 0.1 in FTE or increments of \$10,000.
5. Measurable deliverables shall be included. For example, new benchmark projects should produce a design report, an experimental measurement report, and an ICSBEP benchmark. If not using established quality assurance (QA) processes (like those followed by the Nuclear Criticality Safety Program (NCSP)) for experiments, then a short description of the QA process is necessary.
6. Preliminary procurement plan for items needed for experiments showing expected costs for materials/equipment broken down by year. Preference will be given in this call to experiments using existing material. However, experiments requiring new material should still apply. The DNCSH will be responsible for all costs and logistics for new HALEU fuel and should not be included in the proposed EAW budget.
7. The members of the team satisfying the above criteria. Each team must have a US National Laboratory point of contact. Other members are optional but strongly encouraged. A single team member may satisfy multiple attributes, e.g., a criticality safety expert who is also an experienced contributor to the ICSBEP. A CV for each team member will be submitted with each application to assist the review team.

IV.D. SUBMISSIONS FROM SUCCESSFUL APPLICANTS

If selected for funding, DOE reserves the right to request additional or clarifying information.

IV.E. SUBMISSION DATES AND TIMES

IV.E.1. Notification of Intent Due Date

May 3, 2024 (optional).

IV.E.2. Proposal Due Date

May 31, 2024.

IV.E.3. Late Submissions

Proposals received after the deadline will not be reviewed or considered for award.

V PROPOSAL REVIEW INFORMATION

V.A. CRITERIA

Given the short timeline of this project, an efficient proposal review process will be employed which identifies benchmarks most likely to succeed. Due to timelines driven by the appropriations language, the goal throughout the project is to fast track the highest priority benchmarks and where there is a conflict, e.g., two experiments competing for the same facility, prioritize one over the other based on the merits of the experiment. Even if a proposal is not selected for funding, the proposal is a good way to formalize a request to the DNCSH and may help the project identify needs for a future call.

Multiple technical reviewers will contribute a rating of Excellent (3), Good (2), Fair (1), Poor (0) to criteria of **relevance, risk, and timeliness**. The DOE PM will, based on all ratings, perform a final decision on awards, under advisement of the NRC and DOE. Not all reviewers will provide ratings for each criterion. As a guideline, reviewers may start at a rating of Excellent and reduce it by one when they answer “no” to one of the criterion’s questions.

- Excellent - yes to all rating questions.
- Good - yes to the majority of rating questions.
- Fair - yes to at least one rating question.
- Poor - no to all rating questions.

Note, there is flexibility allowed to reviewers to assign ratings that do not follow the above suggestion. However, if the technical review team’s ratings differ by more than one level, e.g. one member says Excellent (3) and another Fair (1), there should be a discussion initiated by the team lead to attempt to resolve the disparity. If a team submits final ratings that differ by two levels or more, there should be a note from the team lead describing in brief the difference in opinion.

Relevance Criterion

The **relevance** criterion is intended to evaluate how relevant the work is to this particular call. This rating should not include consideration of the risk. For example, a high rating could be given despite cost and timeline being far too low. **Relevance** is intended to be independent of the execution team—it is a rating given to the idea. **Relevance** for the same idea could change in the future based on new data sources or new industry directions. **Relevance** is always relative to what exists at that point in time.

Risk Criterion

The **risk** criterion is intended to evaluate how possible it is that the work will be completed as described. The **risk** rating should not include consideration of timeliness relative to the DNCSH timeline. That is, the **risk** rating would be valid in the future, e.g. for future calls. It is also independent of the **relevance**.

Timeliness Criteria

The **timeliness** criterion is intended to gauge how possible it is that the work fits in the current DNCSH project timeline. It is a simpler criterion than the others. These questions are designed to help rate higher those proposed EAWs which may be performed sooner than later, knowing there will be additional calls within this project.

The rating and review matrix in Table 3 shows the ratings which will be collected from each reviewer. The technical reviewers will work as a team but provide individual ratings with notes. The targeted reviewers will work individually and evaluate only risk and timeliness for their respective focus. The final DOE review will have access to all ratings listed in Table 3 (R1,R2, ..., KP, TP, ...) and work with the NRC to determine a final yes/no for each proposal. Ratings and feedback will not be delivered to the applicants.

Table 3. Rating Criteria and Reviewer Matrix

		Relevance	Risk	Timeliness
Technical	Reviewer 1 (lead)	R1	K1	-
	Reviewer 2	R2	K2	-
	Reviewer 3	R3	K3	-
Targeted	Procurement Reviewer	-	KP*	TP*
	Experiment Reviewer	-	KE**	TE**
	ICSBEP Reviewer	-	KI	-
DOE Final		yes/no		

* If procurement of HALEU is not necessary, gets max Excellent (3) rating.

** If experiment has already been performed, gets max Excellent (3) rating.

A rubric is provided in Appendix IX.B to reviewers containing the above information formulated specifically to help them assign their scores.

V.B. REVIEW AND SELECTION PROCESS

The award sequence is as follows:

1. Applications submitted in response to Call.
2. Technical review teams will be assigned by the DOE PM and comprised of experts and may include participants from DOE National Laboratories, NRC and DOE federal employees, and other industry experts.
3. The technical review team lead may reach out to the applicant's POC for additional details which become part of an addendum to the proposal, ensuring a proposal is not rejected based on a small, unclear point.
4. Each reviewer assigns ratings, as described in the previous section. Those ratings and brief reasons for those ratings are recorded in a central database accessible only to the core management team, none of whom are submitting proposals or reviewing them.
5. Once all proposal ratings have been accumulated, all information is sent to DOE for the final ranking.

6. DOE-NE will make the final yes/no assessment based on all information and with consultation with NRC.
7. Awardees are notified and funding is transferred to the laboratory awardee's POC as a work package in DOE-NE's Program Information Collection System: Nuclear Energy (PICS:NE).

Note that the funding will be distributed in a PICS-NE work package to the lab point of contact from the proposal. It is up to the team to decide how funding is distributed among members. Subcontracts may be placed with non-laboratory partners. Although one or more industry partners on a proposal is highly desired, the industry partner should not receive a significant amount of the funding. As a guideline, no more than 10% of funding should go to the industry partner. An exception could be if an industry team member is performing a key role, for example, is responsible for creating the benchmark document.

V.C. ANTICIPATED NOTICE OF SELECTION AND AWARD DATES

The awards are anticipated to be announced on July 1, 2024. If more proposals are received than expected, a delay may be necessary to allow for proper review. This delay will be announced via the mailing list and posted the www.ornl.gov/dncsh website.

V.D. MITIGATION OF ORGANIZATIONAL CONFLICT OF INTEREST

The following sources of organizational conflict of interest (OCOI) exist.

- a) ORNL is the lead lab for managing the DNCSH, but ORNL will also submit proposals to this call.
- b) The pool of qualified technical reviewers is small and using them in a review capacity should not preclude them from submitting proposals to the call.

OCOI source a), related to ORNL management of DNCSH, will be mitigated by the following measures:

- a.1) As ORNL staff, the National Technical Director (NTD) will not submit proposals, review proposals, or provide any ratings for proposals. The NTD will act as an observer and coordinator for the review and award processes.
- a.2) This call follows the U.S. DOE Nuclear Criticality Safety Program (NCSP) process, which is an established multi-lab effort. Key labs involved in NCSP critical experiment execution have been involved in the project and in creating this proposal call.
- a.3) Activities to publicize the DNCSH project and this call have been made to relevant parties outside of ORNL. A public workshop has been held with over 200 attendees from labs, academia, and industry making them aware of this opportunity. A talk was given at the recent NCSP technical program review meeting about this project. A public meeting will be held following the call's release to answer questions.
- a.4) DOE-NE has the final decision for which projects to fund and will have access to all information and all ratings.

OCOI source b), related to reviewers also submitting proposals, will be mitigated by the

following measures:

- b.1) Each technical review team will be led by an independent expert, i.e. external to the national laboratory system and not involved in the proposal call. The lead will be responsible for getting additional information from the proposal team, if needed, and resolving disagreements of more than one level (e.g. Excellent vs. Poor) within the team.
- b.2) There are three technical review members on each team, thus diluting any potential source of OCOI.
- b.3) The review questions are framed in a way to limit subjectivity, typically requiring evidence in the proposal to support the rating.
- b.4) The review process described in this section has been reviewed and approved by the multi-laboratory DNCSH team.
- b.5) Ratings will not be shared among the review teams or returned to proposal teams. This is primarily to reduce opportunity for retaliatory behaviors on future calls, which will most likely involve most of the same people.
- b.6) DOE-NE has the final decision for which projects to fund. The ratings and reviews are provided to DOE as concise, summarized information to use in their decision-making process.

Note that it is the individual's responsibility to request a change in assignment if they are asked for a review where their bias creates an unfair review.

VI AWARD ADMINISTRATION INFORMATION

VI.A. AWARD NOTICES

DOE will notify applicants selected for award. This notice of selection is not an authorization to begin performance. A work package based on the award is anticipated to be created in PICCS:NE shortly after the awards are announced and funding will be distributed shortly thereafter. The DNCSH project has a funding source which is not based on fiscal year allocations and therefore has additional flexibility to fund packages outside of the typical fiscal year-based budget cycles.

Organizations whose proposals have not been selected will be advised as promptly as possible.

VI.B. REPORTING

The main mechanisms for reporting progress will be a minimum of quarterly within the DNCSH project management plan (PMP) and monthly within PICCS:NE.

VII QUESTIONS/AGENCY CONTACTS

VII.A. QUESTIONS

General questions regarding this call can be sent to the DNCSH project management team at dncsh@ornl.gov.

VII.B. DOE CONTACTS

The DOE contacts for this project and call are given below.

DOE Federal Manager	Mr. Don Algama <u>Don.Algama@nuclear.energy.gov</u>
DOE Call Manager	Mr. Bob Rova <u>Robert.Rova@nuclear.energy.gov</u>

VIII APPENDIX A: EAW PROPOSAL TEMPLATE

DOE/NRC Collaboration for Criticality Safety Support for Commercial-Scale HALEU Fuel Cycle and Transportation (DNCSH) Proposal Template for Experiment and Analysis Work Packages

1.0 Proposal Information

PI Name	
PI Email	
PI Institution	
Primary Topic Area	
Experimental Facility (if applicable)	
Title	
Team Member Names and Institutions	
Length of proposed work (# of years)	
Total Budget (all years and all collaborators)	

2.0 Short Description – 2 – 3 sentences describing your proposal, specifying the validation gap it fills in terms of topic area descriptions in the call.

3.0 Long Description – no more than 2 pages (*concise description of work, including whether it's a benchmark of a new experiment or benchmark of an existing experiment, or other measurement; the gap that it fills in criticality safety validation basis for commercial-scale HALEU operations; the facility in which it will be executed; supporting calculations; industry partner(s) that will specifically benefit; and major expected risks*).

4.0 Milestones and Deliverables for each year, as applicable (*include specific, measurable milestones and deliverables, when the experiment will be executed and when it will go to the ICSBEP technical review group. Note, the ICSBEP technical review group meets in March/April of each year, meaning the majority of the benchmark work needs to be completed and through internal and external review by February*).

5.0 Preliminary Procurement Plan with materials/equipment broken down by year, not including new HALEU fuel cost (*part of the review process will be to assess the ability of the DNCSH project to provide new fuel required, in the form required. Therefore, list in the procurement plan when the fuel would ideally be available, but do not include any fuel costs*

(in the estimate. Any other materials must be procured by the project team and should be listed with approximate costs in this procurement plan.)

6.0 Budget for each year, provide realistic out year budget projections.

Example Format per Proposal

Task List	2024	2025	2026	2027	Total Cost by Task
Task #1	\$100k 0.2 FTE	\$200k 0.3 FTE			\$300k
Task #2		\$700k 1.2 FTE			\$700k
Task #3			\$250k 0.4 FTE	\$50k 0.2 FTE	\$300k
Total Cost by Year	\$100k	\$200k	\$250k	\$50k	\$1,300k

7.0 References (if applicable)

8.0 Industry Letters (if applicable)

9.0 CV of all Team Members

IX APPENDIX B: REVIEWER'S RUBRIC

This section provides a simple rubric to follow for reviewers. A spreadsheet will be provided to each review team with the template. Please see Section V for details.

Technical Reviewers

Each member of the technical review team is responsible for providing two ratings with reasons: a **relevance** and **risk** rating. First, read the proposal and make the ratings without consulting anyone. Then meet with the team to discuss and potentially modify. The technical review ratings should be delivered as a set. You have been chosen as a technical reviewer based on your current experience, but it is okay to change your mind after discussing with teammates, especially when a teammate has more experience in a particular area. Keeping that in mind, rely on the proposal itself as the primary source of information.

	Relevance	Reason	Risk	Reason
Reviewer 1 (lead)	R1		K1	
Reviewer 2	R2		K2	
Reviewer 3	R3		K3	

To determine the **relevance** rating (R1,R2,R3), start with an Excellent (3) rating and reduce by one for each “no” to the following questions. When you answer a question with “no”, add a sentence to the **reason** column.

- Does the proposal clearly identify a gap and align with a topic area for this call?
- Is there an analysis (referenced or included in proposal) that shows the existence and severity of the gap?
- Is there published, referenceable support (e.g. industry, regulatory) for filling this data gap?
- Are the described measurements technically sound and likely to fill/partially fill the gap?

To determine the **risk** rating (K1,K2,K3), start with an Excellent (3) rating and reduce by one for each “no” to the following questions. When you answer a question with “no”, add a sentence to the **reason** column.

- Does the proposal team have the skills and experience necessary?
- Are the costs proposed reasonable?
- Will this work most likely result in a high-quality benchmark data set?

Procurement Reviewer

The procurement reviewer is charged with estimating **risk** and **timeliness** for the procurement of HALEU fuel.

	Risk	Reason	Timeliness
Procurement Reviewer	KP		TP

To determine the **risk** rating (KP), first, if no new fuel material is required then give an Excellent (3). If material must be procured, start at a Good (2) and reduce by one for each no answer. Add a sentence to the reason column for each “no”.

- Is HALEU of this quantity and quality available by end of FY26?
- Is there a known fabricator for the fuel form of interest (e.g. oxide or metallic)?
- Is this a well-exercised pathway?

To determine the **timeliness** rating (TP), start at Excellent (3) if the fuel is not required or could be delivered to the experiment site by end of FY24. Good (2) if end of FY25. Fair (1) if end of FY26. Poor (0) if end of FY27 or beyond. Because of the simplicity of this rating, no reason is required.

Experiment Reviewer

The experiment reviewer is charged with estimating **risk** and **timeliness** for the experiment to be completed.

	Risk	Reason	Timeliness
Experiment Reviewer	KE		TE

To determine the **risk** rating (KE), first, if no experiment is required then give an Excellent (3). If an experiment will be performed, start at Excellent (3) and reduce by one for each “no” answer. Add a sentence to the reason column for each “no”.

- Is this a follow-on to an existing, planned experiment?
- Are you confident the experiment can be completed as described in the proposal?
- Does the facility have experience successfully performing experiments like this?
- Consider that measurement cost and uncertainty are inversely proportional. Compared to other recent experiments, does this experiment have a favorable cost vs. uncertainty tradeoff (i.e., if the cost is high, it produces a low uncertainty, and vice versa)?

To determine the **timeliness** rating (TE), start at Excellent (3) if the experiment is not required or could be done by end of FY24. Good (2) if by end of FY25. Fair (1) if end of FY26. Poor (0) if end of FY27 or beyond. Because of the simplicity of this rating, no reason is required.

ICSBEP Reviewer

The ICSBEP reviewer is charged with estimating **risk** for the ICSBEP benchmark to be completed.

Risk	Reason
ICSBEP Reviewer	KI

To determine the **risk** rating (KI), start at Excellent (3) and reduce by one for each “no” answer. Add a sentence to the reason column for each “no”.

- Will this measurement most likely result in a high-quality ICSBEP benchmark by today’s standards?
- Will this measurement most likely result in a medium-quality ICSBEP benchmark by today’s standards?
- Does the facility where the experiment will be/has been conducted have a track record of producing ICSBEP benchmarks?