NCSP
NUCLEAR CRITICALITY SAFETY PROGRAM

NEWSLETTER

SUMMER 2023

IN THIS ISSUE

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DATES TO REMEMBER

Hands-On Training & Education Course Dates:
Two-week Practitioner Course Dates:
Aug 7-18,2023

One-week Manager's Course Dates:
NCERC – December11 – 15, 2023

T&E Page: https://ncsp.llnl.gov/training-education

LINKS TO REMEMBER

NCSP Website
NCSP Program Management
NCSP Mission and Vision
NCSP Five-Year Execution Plan
NCSP Planning Calendar
Previous NCSP Newsletters
CSSG Taskings
Nondestructive Assay Program

A Message from the NCSP Manager

I hope everyone is enjoying their summer. We are wrapping up the 3rd quarter of FY23 with the annual ANS meeting in Indianapolis, a special Integral Experiments Meeting (TEX 2.0) hosted by LLNL, as well as the Five-year Mission and Vision Meeting also hosted by LLNL. Following the Mission and Vision Meeting, we were able to take a tour of LLNL's Superblock facilities, the Intrinsically Safe Subcritical Assembly Facility, and the National Ignition Facility. The NCSP annual Budget Execution Meeting is scheduled for July 19-20 in Nevada. As an enterprise, NNSA continues to focus on its pit production mission, and the NCSP should be attuned to opportunities to continue to enable and support that mission, as appropriate, while continuing to support our other missions within DOE and NNSA.

Angela L. Chambers

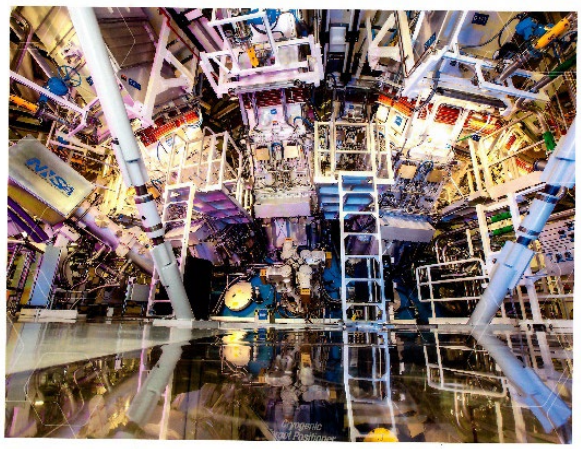


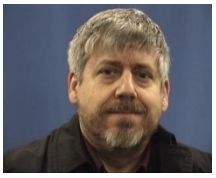
Figure 1 A external view of the NIF ignition chamber

Figure 2 NCSP tour of NIF

National Nuclear Security Administration

U.S. DEPARTMENT OF ENERGY

Welcome Scott Finfrock, Savannah River Site



Scott Finfrock is the new NCSP Site Program Manager for Savannah River Site (SRS), taking over for David Erickson who retired on April 27, 2023. Scott is a senior criticality safety engineer at the Savannah River Site where he has served for the last 10 years. Before that he was at Hanford for nearly 30 years, starting in reactor load design before moving into criticality safety. For the last 20 years, he has developed and maintained the CritView digital handbook for NCSP.

Congratulations Jennifer Alwin and David Hayes

Jennifer Alwin and David Hayes have accepted new positions at Los Alamos National Lab (LANL).

Jennifer Alwin is the Division Leader for Nuclear Criticality Safety at LANL. In her role as the LANL NCS Manager she is the responsible line authority. She is working to structure the NCS Division with groups centered around operational areas for customer focus and interaction. She is committed to providing career growth and development opportunities for NCS Division staff and an inclusive environment that values continuous learning and improvement.

David Hayes in the Chief Engineer for Nuclear Criticality Safety at LANL. In this role he serves as the technical authority for NCS. He serves as a resource for technical consistency and adjudication for analysts, is a champion for NCS philosophy of practice and vision, Dave spends time in the field with operations and NCSD staff and continues to teach the DOE NCSP Hands-on classes for operators, analysts, and managers.

Current career opportunities within NCS Division include Group Leader for NCS-Weapons Support, Deputy Group Leader for NCS-Weapons Support focused on Plutonium Infrastructure, Deputy Group Leader for NCS-Weapons Support focused on Aqueous/Pyrochemical Operations, Group Leader for NCS-Actinide Material Operations, Group Leader for NCS-Materials Management Area, Group Leader for NCS-Balance of Programs.

CSSG Happenings

The CSSG will be meeting after the ANS Annual Meeting in Indianapolis. Currently, the CSSG is working on drafting a Tasking related to criticality infraction reporting as a follow-up to Tasking 2009-002, *Development and Recommendation of a Uniform Criticality Incident Categorization Scheme.* As always, the CSSG is available to support resolving any questions or concerns you may have regarding criticality safety.

Reaffirmation of DOE-STD-3007

The NNSA Office of Safety (NA-ESH-20) has issued a letter reaffirming DOE-STD-3007, Preparing Criticality Safety Evaluations at the Department of Energy Nonreactor Nuclear Facilities. This standard can be found on the DOE standards website.
https://www.standards.doe.gov/

Prompt Fission Neutron Spectrum (PFNS) Measurements for Neutron-induced Fission of ^{240}Pu at LANSCE

LA-UR-23-25986

Matthew Devlin, Keegan Kelly, John O'Donnell, Eames Bennett
Los Alamos National Laboratory

Ching-Yen Wu, Roger Henderson
Lawrence Livermore National Laboratory

Prompt Fission Neutron energy Spectra (PFNS) are an important component to criticality and to criticality safety, and considerable effort has been directed at improving these data with both new evaluations and new measurements internationally. As a continuation of the Los Alamos National Laboratory (LANL) and Lawrence Livermore National Laboratory (LLNL) effort on such new measurements, the spectra of prompt fission neutrons produced in the neutron-induced fission of ^{240}Pu has been measured at the Los Alamos Neutron Science Center (LANSCE) using the Weapons Neutron Research (WNR) facility and the Chi-Nu neutron detector array for the National Criticality Safety Program.

LANSCE is a designated NNSA National User Facility comprised of programs in nuclear science, material science, isotope production and other applications. See Figure 1. It uses an 800 MeV proton beam either directly or to produce neutrons through spallation reactions. The WNR facility at LANSCE has an unmoderated tungsten neutron-production target, producing a continuous spectrum of neutrons from below 1 MeV to over 700 MeV, and has six beamlines, each of which can accommodate measurements whenever beam is on. WNR is primarily used for nuclear science.

Figure 2 An aerial view of the LANSCE accelerator, looking east.

Fission events were identified using a Parallel-Plate Avalanche Counter (PPAC) with twelve cells, each with a high purity ^{240}Pu deposit. The PPAC and ^{240}Pu foils were made at LLNL, despite some pandemic issues and delays, and shipped to LANSCE for the in-beam measurement. At LANSCE, the PPAC was installed in the center of the Chi-Nu 54-detector liquid scintillator array on flightpath 15 Left, 21.5 m from the WNR neutron production target. Incident neutron energies were determined on an event-by-event basis using their time of flight: the timing difference between the proton pulses striking the WNR target and the measured fission time in the PPAC is used to determine the velocity (hence energy) of the incident neutron. Figure 2 shows both the Chi-Nu array and the PPAC.

Prompt neutrons emitted in fission were detected in the Chi-Nu detectors, each roughly 1 m from the PPAC. The energies of these outgoing neutrons, the prompt fission neutrons, are also determined by their time of flight, using the fission time and

the neutron detection time. The Chi-Nu detectors also distinguish neutrons from γ-rays, based on the shape of the electronic pulses generated by each type of interaction. PFNS neutrons are identified by their pulse shape and their kinematics – that is, they are required to have a time of flight consistent with their pulse height signal in the detector. All of the electronic signals are digitized, and randomly coincident signals are determined using the individual channel data rates. These random events are subtracted from the total PFNS events to produce the PFNS result. Neutrons from the spontaneous fission of ^{240}Pu are also a small background to these measurements, so separate out-of-beam PFNS measurements are also taken to correct for these neutrons.

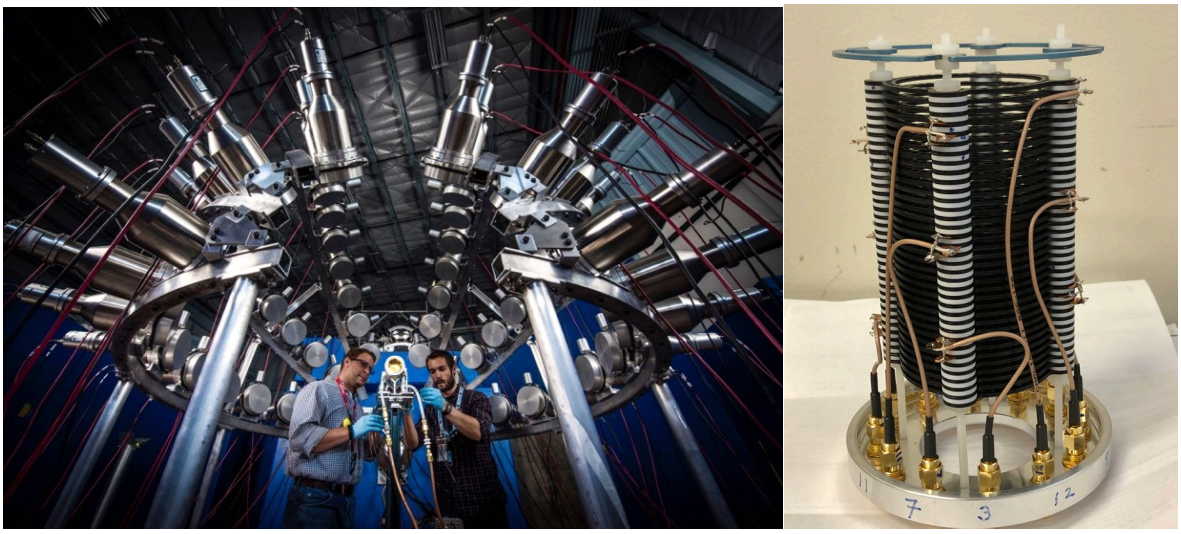


Figure 2 (Left) The Chi-Nu liquid scintillator array at LANSCE/WNR, with Jaime Gomez (now LANL XTD-PRI) and Keegan Kelly, and (right) an internal view of the LLNL built ^{240}Pu Parallel-Plate Avalanche Counter used in the ^{240}Pu(n,f) measurements at LANSCE.

For these ^{240}Pu PFNS measurements each Chi-Nu liquid scintillator signal was split and digitized twice, with two different gain settings. This arrangement allows the outgoing energy range of the PFNS to be extended to lower energy. Figure 3 shows the preliminary measured PFNS for ^{240}Pu(n,f) for two incident energy bins, compared to various evaluations, with the two gain setting shown separately. Data was taken at LANSCE over a 2.5 month period, and the data analysis is almost complete: remaining tasks include combining the two datasets (low and high gain), folding in the appropriate uncertainties in that applying that combination, applying the correction for the spontaneous fission in the data, and finalizing the uncertainties and covariances from the data.

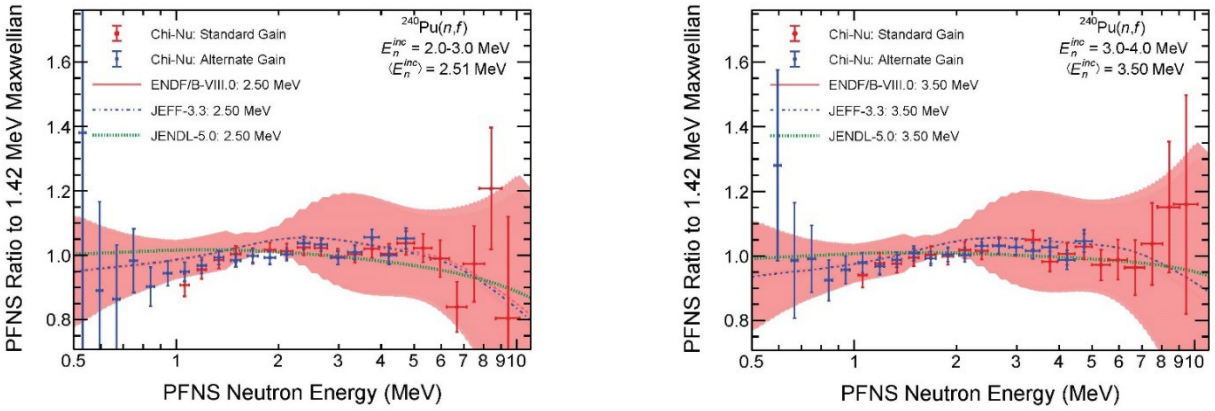


Figure 3 Preliminary Chi-Nu results for the PFNS of neutron-induced fission of ^{240}Pu for two incident neutron energy ranges, using both gain settings of the digitized liquid scintillator array.

These data are the first reported PFNS data for ^{240}Pu(n,f), and are expected to considerably reduce the uncertainty in the evaluated nuclear data for ^{240}Pu and reduce the uncertainty in criticality calculations in which ^{240}Pu is present. Sharing the final data with nuclear data evaluators and publication of the final results will complete this project.

Acknowledgements
LANSCE is a National User Facility, operated by Los Alamos National Laboratory for the National Nuclear Security Administration of the US Department of Energy.

WANDA

Jesse Brown, ORNL

The Workshop for Applied Nuclear Data Activities (WANDA) is designed to increase communication among nuclear data (ND) users in multi-disciplinary federal programs and ND experts. It also presents an opportunity to cross-pollinate ideas and introduce ND gaps identified by federal programs to ND experts and ND capabilities to the various federal ND users. WANDA 2023 focused on fission yields (FY), isotope science and production, gamma-ray strength functions (gSF) and nuclear level densities (NLD), nuclear data processing and preservation, and the activities and applications that rely on these data.

In the years leading up to WANDA 2023 there has been an increased number of FY measurements, and therefore evaluation of those FY data is in progress. This, in turn, indicates that the ND community also needs to ensure that there are experimental data that can be used to validate these new higher-fidelity evaluations. The NCSP program indicated capabilities and facilities that could be employed to validate these data. New evaluated FY data impacts a broad spectrum of federal programs and applications, including (among others) reactors, isotope production, and criticality safety. Federal program managers indicated that

higher-fidelity neutron capture gamma data was needed, including fission product capture cross sections and actinide capture cross sections. It was also indicated that more data was needed to model and predict correlated neutron-gamma emissions. It was also expressed that the community needed increased resolution for neutron-induced fission-yields as a function of incident neutron energy and the corresponding energy-energy covariances.

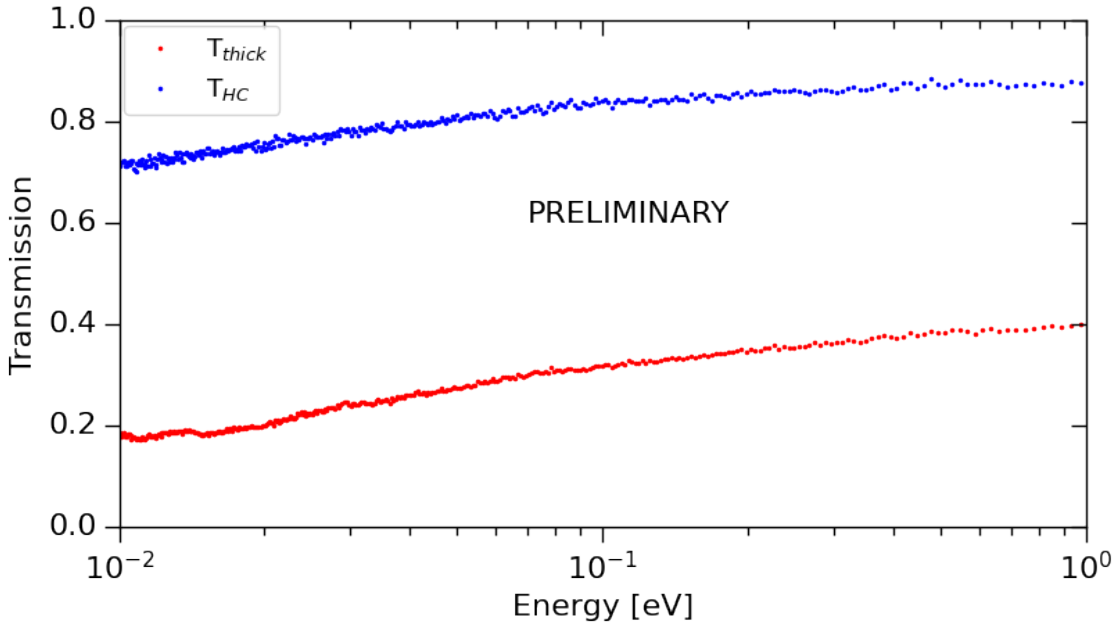
New capabilities for measuring gSF and NLDs were communicated to federal program managers, matching the call for better gamma production data. Several evaluation efforts are underway to disentangle the best way to deliver evaluations of these new experimental data. There was also discussion on how to best deliver the evaluated data to ND users, whether ENDF and ENSDF were appropriate or whether new libraries were needed.

ND processing and preservation was scheduled for only a comparatively small amount of time but ended up requiring a lengthy discussion. Processing experts discussed strategy and current capabilities with a look to the future in how those processed data would be used. In that vein, perspectives were given from high-performance computing (HPC) experts on how processed data can be optimized for modern HPC radiation transport software (e.g. flattening data structures, reducing memory, and shifting greater computing burden on transport software). ND preservation is important to nearly every federal program, and the DOE has recently introduced requirements for all funded work that it must plan for data preservation. Due to the importance of this topic, WANDA participants were very engaged in the discussion, which focused on best practices, how and where these practices should be employed, and a lack of increased funding to support those practices. Experimental ND experts which produce data seemed to indicate that more discussion was needed, and more nuanced guidance should be crafted by the ND community to ensure that ND preservation efforts efficiently deliver data that downstream researchers can use.

Thermal Neutron Transmission Measurements of Concrete and Hydrated Cement

Chris Chapman, Jesse Brown, ORNL

Thermal transmission measurements of two samples of concrete and one sample of hydrated cement were conducted at the RPI LINAC. Several samples (with different configurations of water, cement, and aggregate) were made to determine both: which samples would be the most stable after curing, as well as which ones would be the easiest to computationally simulate. Once a mixture was decided upon, two sample thicknesses of concrete (water + cement + binder) and one sample of hydrated cement (water + cement, no binder) were mixed and allowed to cure for one month. These samples were then measured over the span of 5 days using the new ETTC sub-thermal moderator setup in place at the RPI LINAC. Preliminary results of the thick concrete (T_{thick}) and hydrated cement (T_{HC}) transmission are shown below.



These measurements will be combined with inelastic thermal neutron scattering measurements at the Spallation Neutron Source and theoretical models of concrete being developed at ORNL to create a first-of-its kind thermal neutron scattering file for concrete.

Integral Experiments to Address Nuclear Criticality Safety Needs (TEX 2.0) Meeting Held at LLNL

Catherine Percher, LLNL

In July of 2011, the NCSP convened a meeting at Sandia National Laboratories (SNL) in Albuquerque, NM which brought together nuclear criticality safety (NCS) practitioners, critical experimenters, and nuclear data experts to discuss experimental needs relevant to criticality safety. The meeting was called the Thermal Epithermal eXperiments (TEX) meeting and a large focus of the meeting was the lack of experimental data in the intermediate energy range. A prioritization of data needs was published after that meeting, and those identified needs have helped inform the experimental work of the NCSP's Integral Experiment (IE) element for the last decade. As it had been more than a decade since that original meeting, the NCSP decided to host another meeting to solicit input and update the integral experiment needs for criticality safety. The "TEX 2.0" meeting took place at Lawrence Livermore National Laboratory (LLNL) on May 1-2, 2023, with 45 in-person and 10 virtual attendees.

The first day of the two-day meeting was largely focused on U.S. experimental capabilities, ongoing experimental campaigns, and recently completed and planned benchmark experiments relevant to criticality safety, with presentations from Los Alamos National Laboratory (LANL), LLNL, Oak Ridge National Laboratory (ORNL), and SNL. Brookhaven National Laboratory (BNL) also provided a presentation about the importance of integral experiments in nuclear data validation. The presentations highlighted the significant progress that has been made in the decade since the first TEX meeting toward providing integral experiments to meet the needs of NCS programs.

The second day focused on current integral experiment needs from NCS practitioners, with presentations from DOE Environmental Management (EM), Idaho National Laboratory (INL), LANL, LLNL, Naval Nuclear Laboratories (NNL), Savannah River Site (SRS), Y-12 National Security Complex, and the French Institut de Radioprotection et de Sûreté Nucléaire (IRSN). After the presentations, the group discussed the relative priorities of needs, grouping them into high, medium, and low categories, with high priority needs generally impacting multiple sites or addressing a crucial deficiency in validation. High priority needs agreed upon were 239Pu and 235U in an intermediate spectrum, mixed oxide (MOX) and high assay low enriched uranium (HALEU) fuels at all energies, reflection by tantalum (fast) and beryllium (thermal), chlorine and lithium absorption, and pulsed neutron die-away experiments with polyethylene and Lucite.

Attendees at the TEX 2.0 Meeting, LLNL, May 1, 2023

Mission and Vision Meeting at LLNL

Doug Bowen, NCSP Execution Manager

The NCSP Management Team held a meeting at LLNL after the TEX 2.0 meetings to review and update the NCSP Mission and Vision (M&V) Document (https://ncsp.llnl.gov/sites/ncsp/files/2021-04/ncsp_mission_vision.pdf) that provides baseline 5- and 10-year attributes and goals for the NCSP. Five teams, corresponding to the NCSP technical program elements, Analytical Methods, Information Preservation and Dissemination, Integral Experiments, Nuclear Data, and Training and Education, held review meetings to decide the status of the current goals and to discuss new needs for the NCSP. The updated M&V document will be published in early 2024.

Plutonium Verification Team Measurements and Training

LA-UR-23-25798

Garrett McMath, LANL

During the week of April 10th, 2023, a subset of NNSA's Office of Nonproliferation and Arms Control's (NPAC/NA-24) Plutonium Verification Team (PVT) performed a measurement campaign and training event at the National Criticality Experiments Research Center (NCERC). The PVT is a deployable team under the Nuclear Compliance Verification Program within NPAC's Office of Nuclear Verification (NA-243). The team is comprised of a diverse group of scientists and engineers from across the DOE complex. Their mission is to implement negotiated agreements for on-site nuclear verification and monitoring activities at nuclear material production and processing facilities. As part of that mission, the team needs highly specialized equipment to measure plutonium mass. In order for the equipment to be used to its full potential, calibration curves must be measured with relevant material. NCERC provided a unique facility for just these types of measurements.

The PVT shipped three specialized measurement systems to NCERC where they were used to measure a large range of Pu metal and oxide masses. The data from these measurements will allow the team to build more accurate and comprehensive calibration curves for these instruments. In the two days of measurements, 48 unique configurations were measured. These were split across the three instruments and encompassed four different material types. Data from these measurements were collected both with a traditional shift register and with the latest list-mode technology available at NCERC. The calibration curves obtained have greatly increased the capabilities of the team's instruments for their mission.

The PVT also took advantage of the criticality safety training available at NCERC. The team regularly encounters criticality safety issues in their mission space, and throughout the training, the MC-15 neutron detector was demonstrated as a potential tool for the team. During their final two days, they performed a hand stack and remote approach to critical using the class foils, handled kg quantities of special nuclear material during the BeRP/Np demonstration, observed high multiplication Radiation Test Objects (RTOs) being assembled, and practiced safe approaches to unknown objects using the MC-15. The criticality safety training and unique RTOs the team were able to measure led to excellent discussions and presented a variety of future opportunities for the team.

Training and Education

April 17-21, 2023, One-week Sandia CSO/Manager Course

Doug Bowen, NCSP Training and Education Coordinator

A One-week NCSP hands-on NCS training course was successfully executed at Sandia National Laboratory (SNL) from April 17, 2023. A total of 15 students attended the course from Pantex, INL, BWXT, DOE, US Army, NNL (UK), Danish Decommissioning, LANL, Y-12, Curio, and Portsmouth. The following SNL staff provided instructor support: John Miller, Gary Harms, David Ames, Rafe Campbell, Jason Soares, Beth Hanson, Patrick Ward, Walt Gilmore, Bob Busch, and Mac Cook. Doug Bowen and Marsha Henley from ORNL provided course coordination/logistics support and NDA instruction support, respectively. Loretta Rankin, Mary Silva, Isabel Madrid-Roybal, Nancy Ford, and Evangeline Clemena provide student registration and logistics support for the course.

Two-week Practitioner Course Dates:

- August 7 – 18, 2023
- January 22 – February 2, 2024
- August 5 – 16, 2024

Registration is open (courses to be held in person)

The first week (lectures and workshops) will be held at the National Atomic Testing Museum (NATM) while the second week (hands-on portion) will be held at the National Criticality Experiments Research Center (NCERC) and Sandia National Laboratories. The courses are designed to meet the ANSI/ANS-8.26, "Criticality Safety Engineer Training and Qualification Program," requirement for hands-on experimental training. The NATM portion of the course involves virtual classroom lectures and workshops for NCS Evaluation development and the NCERC and SNL portions of the course involve hands-on experiments with the critical assemblies. MSTS, LANL, ORNL, LLNL, SNL, Y12, and NFO staff participate in the course execution.

One-week CSO/Manager's Course Dates:

- NCERC CSO/Manager Course – December 11 – 15, 2023
- NCERC CSO/Manager Course – March 18 – 22, 2024
- Sandia CSO/Manager Course – April 29 – May 3, 2024
- Sandia CSO/Manager Course – September 9 - 13, 2024
- NCERC CSO/Manager Course – December 9 - 13, 2024

Registration is open (courses to be held in person)

The courses are designed for fissile material handlers, process supervisors, line managers, and regulators with criticality safety responsibilities. Mission Support and Test Services (MSTS), LANL, ORNL, LLNL, SNL, Y12, and Nuclear Facility Operator (NFO) staff participate in the course execution.

One-week Generalized Holdup Measurement Fundamentals Course

ORNL will offer the second Hands-on Generalized Geometry Holdup Measurement Fundamentals Course the week of September 11, 2023. A registration link will be provided on the NCSP NDA website (https://nda.llnl.gov/). The course is free of charge to participants – the course is funded by the NCSP Non-Destructive Assay (NDA) program.

MCNP® Courses

Class Information: https://mcnp.lanl.gov/classes.html

Fees and Registration Information: https://mcnp.lanl.gov/class_registration.html

Jun 5 – 9, 2023	Introduction to MCNP6 (online)
Jun 19 – 23, 2023	Criticality Calculations with MCNP6
Jun 26 – 30, 2023	MCNP6 for Nuclear Safeguards Practitioners
Aug 21 – 25, 2023	Introduction to MCNP6
Aug 28 – Sep 1, 2023	Using NJOY to Create MCNP ACE Files and Visualize Nuclear Data
Oct 2 – 6, 2023	Intermediate MCNP6
Oct 23 – 27, 2023	Introduction to MCNP6 (online)
Dec 4 – 8, 2023	Variance Reduction with MCNP6

MCNP User Symposium

The 2023 MCNP® User Symposium (hosted by Los Alamos National Laboratory) will be held from **September 18 - 21** as a hybrid event. The in-person option will take place at the Los Alamos J.R. Oppenheimer Center while the virtual option will use the Cvent platform. We hope to have a session dedicated to Nuclear Criticality Safety.

Registration is open and we are now soliciting abstracts for presentations. Information on both topics is available at www.lanl.gov/mcnp2023 and below. There are several important deadlines indicated below to be aware of as well.

Registration

Everyone who wishes to participate in the symposium must register at **www.lanl.gov/mcnp2023.** This includes both in-person and virtual attendees.

The fee for in-person registration is $200.00. There are a variety of ways provided to pay this registration fee. Note the following:

- In-person attendees will have access to events and sessions not available virtually. We will post an overview agenda soon that will indicate what will only be available for in-person attendees.

- **Early registration for in-person is encouraged**, as we could be subjected to numerical limits.
- There is a reduced fee for students.
- Travel information, including room blocks, is available on the website.

There is no registration fee for virtual attendees, but registration is still required.

Registration Deadlines

Non-US Citizens:

- **Non-US citizens must register and provide the required information no later than July 12, 2023.**
- **Please note additional information is required from non-US citizens.** This information is required for all non-US citizens, whether attending in-person or virtually. It is very important to provide all of the information requested. Failure to do so will risk a delay in approval or result in denial to attend.
- Non-US citizens working at LANL do not need to provide the additional information but must have their hosts ensure that their FVTS includes MCNP in their approved work scope.

US Citizens:

- **The deadline for US citizen registration is September 12, 2023**

Call for Abstracts

To be considered for a presentation, please submit an abstract. An abstract template is available on the website. The information requested is fairly minimal: name(s), institution, proposed title, a short abstract, suggested session topic(s), and presentation time requested. The information below is also available by clicking the “Presenter Information” link at the top of the landing page.

We expect to incorporate presentations that range from 15 minutes to 30 minutes, depending on the type of content. For example, a presentation focusing on a large and complex MCNP application having unique requirements and challenges that had to be overcome (or may still remain) could require 30 minutes. A presentation suggesting a new MCNP capability motivated by a specific application might require less time. A similar comment could be made about a presentation that in effect concludes by asking the entire community (developers and other users) for advice on solving a problem. The audience would be particularly interested in clever uses of the code (sharing tricks – user presentations are not just for developers but for other users as well), whether the focus be related to physics, variance reduction, parallel computing, set-up or visualization, etc. Presentations that include input on MCNP nuclear data libraries and adjacent software tools such as Whisper, MCNPTools, ISC, MAKXSF, and mcnp_pstudy are also welcome.

The past Symposia have included sessions on the following topics:

- Fusion Applications
- Reactors and Criticality
- Unstructured Mesh and CAD
- Accelerators
- Experimental Design
- Data and Physics
- Shielding
- Transport Methods and Statistics
- Space and Earth Science Applications

- Tools

We anticipate similar but not necessarily identical topics for the 2023 MCNP User Symposium. **Do not feel limited by the above topic list. Feel free to suggest others with your abstracts.**

Abstracts should be submitted to mcnp2023abstracts@lanl.gov. The deadline for submitting abstracts is August 14, 2023. While we will strive to incorporate all submissions into the agenda, we cannot guarantee that will be possible. We will notify all submitters by **August 28, 2023,** as to the disposition of their proposed presentations.

SCALE Courses

The next training block will be held in person at Oak Ridge National Laboratory October 2 – November 3, 2023. There will be no virtual or hybrid option for the courses. Registration fee information is available here. **Registration will open by the end of July.** More information about the courses is found at https://www.ornl.gov/scale/training.

Oct 2 - 6, 2023	Source Terms for Advanced Reactor Spent Fuel Applications
Oct 9 – 13, 2023	SCALE/ORIGEN Standalone Fuel Depletion, Activation, and Source Term Analysis
Oct 16 – 20, 2023	Source Terms and Radiation Shielding for Spent Fuel Transportation and Storage Applications
Oct 23 – 27, 2023	SCALE Criticality Safety Calculations
Oct 30 – Nov 3, 2023	SCALE Modeling and Simulation for Nuclide Inventory and Decay Heat in LWR Spent Nuclear Fuel

SCALE Users' Group Meeting

The 7th annual SCALE Users' Group Workshop (https://scalemeetings.ornl.gov/) was successfully held as a hybrid event, April 26–28, 2023. A total of 174 participants from 133 organizations in 22 countries attended the meeting, with 79% of them external to ORNL (see Fig. 1).

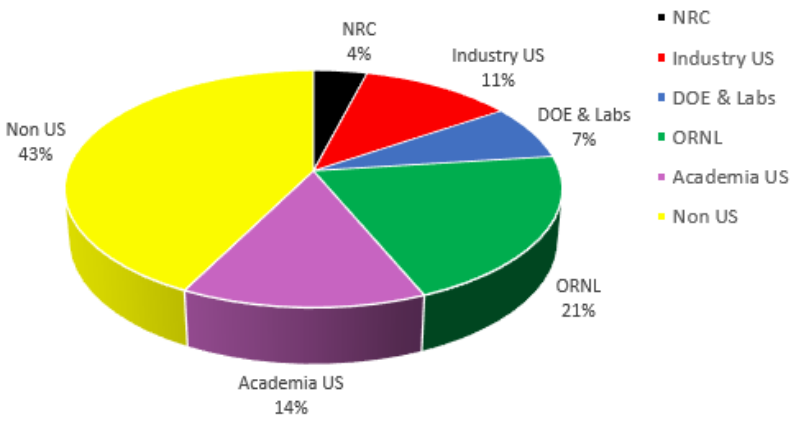


Fig. 1. Summary of participation (174 total attendees).

The meeting included 28 presentations and 11 hands-on tutorials on impactful and innovative applications of SCALE. This year the Special Session of invited talks included speakers from the US Nuclear Regulatory Commission, Orano NCS (Germany), Purdue University, Georgia Institute of Technology, and Pacific Northwest National Laboratory.

Thirteen entries were contributed to the Best SCALE Model Contest. The top three winners of the "Best SCALE Model Contest" are Mario Redondo Morales (Universidad Politecnica de Madrid, Spain), Rabab Elzohery (ORNL), and Jonathan Faulkner (Georgia Tech). The winning models are illustrated in Fig. 2.

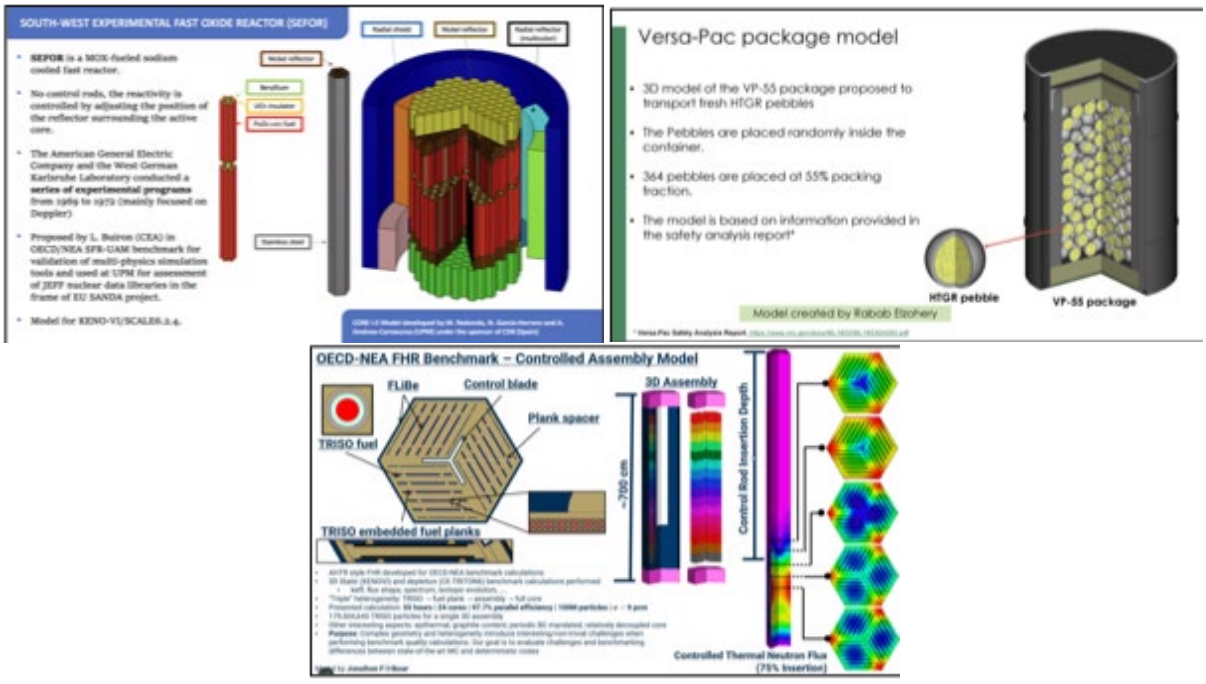


Fig. 2. Winners of the Best SCALE Model contest in 2023

All technical and tutorial presentations made at this meeting will be made publicly available on the SCALE website, https://www.ornl.gov/content/scale-users-group-annual-workshop and on the meeting website at https://scalemeetings.ornl.gov/previous-workshops/.

Nuclear Energy Agency (NEA) Courses and Workshops

Information about Nuclear Energy Agency (NEA) courses is found at https://www.oecd-nea.org/dbcps/training-courses/.

19 – 23 June 2023	PHITS Beginner
20 – 22 June 2023	FISPACT-II
3 – 7 July 2023	PENELOPE-2022
9-13 October 2023	PHITS Advanced