NCSP ◆ NEWS

DATES TO REMEMBER

- Mar 25 - 29, 2019 — Technical Program Review at PANTEX
- Jul 29 - Aug 2, 2019 — Budget Execution Meeting at NATM

Hands-On Training & Education Course Dates

Two-week Practitioner Course Dates:

Jan 28 – Feb 8, 2019 Aug 12 – 23, 2019

One-week Manager's Course Dates:

Apr 15 – 19, 2019 Jun 3 – 7, 2019

Course Registration: https://ncsp.llnl.gov/trng_apply.php

LINKS TO REMEMBER

- NCSP WEBSITE CSSG TASKINGS
- NCSP HISTORY & PROGRAM OVERVIEW
- NCSP ORGANIZATION CHART
- NCSP MISSION AND VISION
- NCSP FIVE-YEAR EXECUTION PLAN
- NCSP PLANNING CALANDER
- PREVIOUS NCSP NEWSLETTERS

Dr. Angela Chambers
NCSP Manager

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A Message from the NCSP Manager

FY18 was a tremendously successful year. The completion of KRUSTY and the first two TEX experiments are two shining examples of the accomplishments of the NCSP. We successfully met 38 Integral Experiment milestones in FY18 (a record for recent years). In addition to conducting our IE mission, we trained 71 students in our NCSP courses, 130 students in our MCNP criticality courses, 94 in our SCALE KENO courses, and revised our 10 year mission and vision document. We significantly revised our Five Year Plan, secured our isotope leasing plan for nuclear data, and strengthened our international collaborations. We continue to face and overcome challenges such as the NCERC lead-in-line installation, the TSR issue and the Sandia SCX facility, and the consolidation and movement of our NCERC materials. We have added additional detail to our Five Year Plan and task spreadsheets in order to better track our deliverables and provide more program transparency. We've moved our IE database over into NA-50's G2 system. We continue to partner with NR and RPI to investigate nuclear data and refurbish the RPI accelerator for NCSP use. Thank you and keep making the NCSP one of DOE's greatest programs.

ANALYTICAL METHODS

State-of-the-Art Advances in Monte Carlo Criticality Methods (Forrest Brown, Michael Rising, Jennifer Alwin, Colin Josey (XCP-3, LANL))

Over the past few years, NCSP code and methods developers have delved deeply into the traditional computational methods used by NCS analysts, characterizing potential problems such as bias in k-effective, errors in the shape of the fission source, convergence of the iterations, loosely-coupled problems, undersampling, clustering, and more. Developers from LANL, ORNL, IRSN, CEA, University of Michigan, University of New Mexico, and the OECD-NEA-WPNCS Expert Groups have collaborated to achieve significant advances in understanding those problems. With the problems and their causes understood, attention has shifted to solving the problems with a variety of improved computational methods.

LANL has recently made significant breakthroughs in completing a milestone for "automated convergence checking." A local version of *mcnp®6.2.1* was modified to:

- automatically generate an initial fission source,
- use physics-based problem data to create a mesh for convergence analysis,
- accelerate convergence of the iterations,
- perform statistical tests for convergence,
- automatically activate the tallies, and
- assess whether sufficient neutrons per generation were used.

Six different statistical checks are made to assess convergence, and 2 novel statistical tests are made to assess population size. The convergence acceleration typically reduces the number of initial inactive cycles by factors of 2-10, and the use of many statistical checks for convergence has proven to be extremely robust and reliable. In the future, *mcnp6* users will not need the *kcode*, *ksrc*, *sdef*, or *hsrc* cards, and will not have to make trial runs or plot Shannon entropy. Common user pitfalls and annoyances have been removed by the automated convergence and statistical testing methods, and quantitative proof of convergence is provided.

Over the next year, the new *mcnp6.2.1* methods will be thoroughly tested, documented, and explained to the NCS community. Coding upgrades will target guaranteed convergence results, and external field testing of *mcnp6.2.1* by NCS analysts will be used to improve ease-of-use. The overall goal is to provide NCS analysts with robust, reliable, state-of-the-art predictive tools for NCS criticality calculations.

Radiation Safety Information Computational Center (RSICC) (Tim Valentine, ORNL – report by Doug Bowen, ORNL)

There is a monthly RSICC newsletter that gets distributed each month that describes changes to the RSICC code and data collection, information about RSICC distribution fees and user agreements, registration requirements, information about conferences, training courses, and symposia, and SCALE/MCNP training schedules.

The NCSP 5-year plan outlines the scope, funding and milestones that allow RSICC to use NCSP funds to distribute code packages that NCS engineers typically use to support their work, e.g., SCALE, MCNP, COG, NJOY, SAMMY, etc. DOE/NNSA employees, M&O contractors, and University nuclear engineering students can request code packages with the registration and distribution fees waived. Consulting companies and NRC-regulated facilities are not covered by NCSP funds and will have to pay the distribution fees.

RSICC distributes many code packages to support NCS work in the DOE complex:

NCSP Task ORNL-AM1: Distribution of available and newly packaged software
- Distributed 937 software packages including 156 SCALE and 472 MCNP® packages in the fourth quarter of FY2018.

The RSICC monthly newsletters can be accessed from this website: http://rsicc.ornl.gov/RSICCNewsLetters.aspx

Release of ENDF/B-VIII.0-Based ACE Application Files for MCNP® (Jeremy Conlin, Wim Haeck (XCP-5, LANL))

ENDF/B-VIII.0

ENDF/B-VIII.0 was released in February of 2018. It represents the culmination of many years of collaboration from institutions around the world to improve nuclear data evaluations with a specific effort to remove unphysical compensating errors. Several Labs supported by NCSP contributed to ENDF/B-VIII.0, including BNL, LANL, LLNL, ORNL, and RPI.

NJOY2016 Updates

NJOY2016 was modified to be able to handle new format changes that came with ENDF/B-VIII.0. In addition to these changes, a number of other changes were made to correct and improve the data processing in NJOY2016, including:

- Updates to ACER for plot generation and thermal scattering data formatting.
- Updates to ERRORR for covariance processing.
- Updates to LEAPR for generating thermal scattering data.
- Updates to PURR for unresolved resonance probability tables.
- Updates to THERMR for thermal scattering data.

Distribution of ACE Application Files

The Nuclear Data Team at Los Alamos National Laboratory has processed the ENDF/B-VIII.0 library and has made available a library of ACE data tables at several temperatures for each of the incident neutron materials. The library is called Lib80x, and is completely compatible with the recent release of MCNP6.2.

Lib80x is distributed as a free download from: https://nucleardata.lanl.gov. This website is a new way of distributing application libraries that have been processed by NJOY. It makes it possible for the Nuclear Data Team to release and distribute the data more quickly than we have been able to do in the past. If you have any questions about Lib80x please contact nucldata@lanl.gov.

References

W. Haeck et al. *NJOY2016 Updates for ENDF/B-VIII.0,* LA-UR-18-22676. Los Alamos National Laboratory, 2018.
J. L. Conlin, W. Haeck, D. Neudecker, D. K. Parsons, and M. C. White. *Release of ENDF/B-VIII.0-based ACE data files,* LA-UR-18-24034, Los Alamos National Laboratory, 2018.

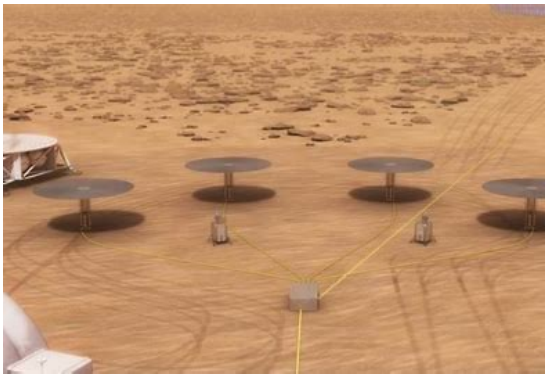
INTEGRAL EXPERIMENTS

KRUSTy – MISSION COMPLETE!!!
(Kilopower **R**eactor **U**sing **S**tirling **T**echnolog**Y)**
A Joint NCSP/NASA Project

NNSA, along with the National Aeronautics and Space Administration (NASA), has recently completed testing a prototype fission reactor coupled to a Stirling engine in an experiment entitled KRUSTY (Kilowatt Reactor Using Stirling TechnologY).

This design of this experiment was dual purposed: NNSA needed beryllium oxide experimental benchmark nuclear data, and NASA was looking for a small power source to provide approximately one kilowatt of power from nuclear fission energy.

The experiment is part of the NASA Kilopower project aimed at developing small fission reactors as a potential power source for manned missions to the moon and Mars as well as deep space missions where power sources currently used may not be adequate.



Conceptual drawing of 4 Kilopower reactors on Mars' surface

For NNSA, the DOE Nuclear Criticality Safety Program partnered with NASA's Space Technology Mission Directorate in 2016 to develop and test the KRUSTY reactor at NNSA's National Criticality Experiments Research Center (NCERC) in the Device Assembly Facility (DAF) at the Nevada National Security Site (NNSS).

Engineers from NASA and LANL in the KRUSTY control room

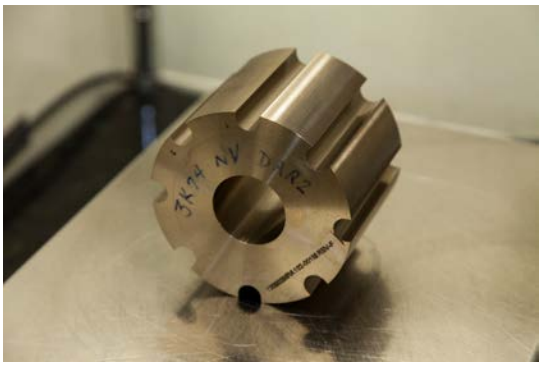
Los Alamos National Laboratory (LANL), along with NASA's Glenn Research Center in Cleveland, Ohio, designed and performed initial testing of the KRUSTY reactor design with contributions from NASA's Marshall Space Flight Center in Huntsville, Alabama. Initial testing was conducted in December 2016 using a surrogate (non-fissile) reactor core and resistive heating elements at the NASA Glenn Research Center.

The KRUSTY Experimental Assembly

NNSS, the Nevada Field Office, the NNSA Production Office, the Y-12 National Security Complex, LANL, Lawrence Livermore National Laboratory, and Sandia National Laboratories all contributed to completion of the design, safety analysis, fabrication, and final testing of the KRUSTY experiment.

LANL's Advanced Nuclear Technology Group and Advanced Nuclear Experiments Group, along with support from NNSS Mission Support and Test Services staff, conducted the KRUSTY experiments at NCERC.

The Y-12 National Security Complex in Oak Ridge, Tennessee, cast and machined the reactor core, which was delivered to the DAF early in the fall of 2017.



Y-12 Manufactured Uranium Core Piece for KRUSTY experiment

INTEGRAL EXPERIMENTS (cont'd)

KRUSTy – MISSION COMPLETE!!! (continued)

Assembly of the KRUSTY experiment began at DAF shortly after the arrival of the Y-12 fabricated core and the NASA components, including the Stirling converters, shielding materials, sodium heat pipes, and beryllium oxide reflector. The uranium core is subcritical in air, but once surrounded by the beryllium oxide (BeO) reflector, it becomes critical, which means it maintains a self-sustaining reaction of splitting uranium atoms until the reflector is removed.

LANL experimenters at NCERC achieved initial criticality on November 16, 2017. In the following months, a series of critical experiments to characterize the assembly and obtain BeO experimental benchmark data were completed, culminating in a 28 hour continuous full power demonstration in March of this year. The full power run demonstrated the feasibility of small fission reactors for deep space and manned Mars missions.

The KRUSTY team completes the final assembly steps

LANL Press Release on KRUSTY

'Game changing' space-mission power system passes tests with flying colors.

https://www.lanl.gov/museum/news/newsletter/2018/06/krusty-nr.php

NASA shared the successful completion of the experiment during a press conference at the NASA Glenn Research Center on May 2, 2018.

As stated by Patrick Cahalane, NNSA's Principal Deputy Associate Administrator for Safety, Infrastructure and Operations, "The relationship between NNSA and NASA is 'win-win' because NASA gets a prototype demonstration for a kilowatt range fission power source, and NNSA obtained a benchmark-quality experiment that provided new nuclear data in support of our Nuclear Criticality Safety Program."

LANL is currently using the nuclear data obtained to develop experimental benchmarks which can then be used for a variety of applications including those in nuclear criticality safety, emergency response, and non-proliferation.

To learn more, you can visit NASA's media release at the following link: https://www.nasa.gov/press-release/demonstration-proves-nuclear-fission-system-can-provide-space-exploration-power

Patrick Cahalane (seated on the right of picture), the NNSA Principal Deputy Associate Administrator for Safety, Infrastructure and Operations, NA-50, along with NASA and LANL staff, participate in a media conference on May 2 at NASA's Glenn Research Center to announce the successful completion of the KRUSTY Experiment

INTEGRAL EXPERIMENTS (cont'd)

Relocation of the Integral Experiment Request Database from LLNL to the NNSA's G2 Management Information System (Doug Bowen, ORNL)

A meeting was held Aug. 6-10, 2018 that included ORNL and LLNL staff to relocate the NCSP IER database developed, maintained, and managed by Chuck Lee at LLNL to ORNL. Chuck worked with Tim Wynn, group leader of the Nonproliferation Systems Group, and his staff to transfer the LLNL IER database to be incorporated into the NNSA G2 system. This was completed in mid-August. Chuck's preparations and advice ensured a smooth transition to the new location of the website. With Thomas Miller and Doug Bowen's assistance, this transition also allows the G2 programmers and support staff to learn how the IER database functions to ensure comparable functionality once a new G2 IER database is developed. A prototype of the new IER database in the G2 system will be completed by FY19Q3 for testing and necessary enhancements.

For those persons who currently support IER teams, you will need to register to use the IER database in the G2 system. The following information is from Tim Wynn at ORNL:

Registration

New and existing users must register through NNCAMS for access to the site at https://nncams.doe.gov

Follow the onscreen instructions and select CEDT for the requested application (detailed instructions are in the attached Word document)

Web Application Firewall

To address cyber security concerns, the site has been placed behind a Web Application Firewall (WAF), requiring an extra layer of authentication (login) Authentication to the WAF can be done via

1) RSA Token - supplied by NNCAMS or ORNL or
2) DOE HSPD-12 badge (this is the same authentication method used by our other NNSA-hosted systems such as G2 so the same credentials will work for both)

Authentication to the CEDT site remains unchanged – once authenticated through the WAF, users will continue to use their existing CEDT username and password that was used on the LLNL site.

Network access to the site requires an approved IP address/subnet. All Lab and HQ networks have been "whitelisted," but no foreign national or public networks (including home, hotel, and airport networks) will have access to the server. Users can VPN (a.k.a cisco) or VDI (a.k.a. Citrix) through their home organization's network to access the site.

New URL

The new site URL is https://cedt.nn.ornl.gov

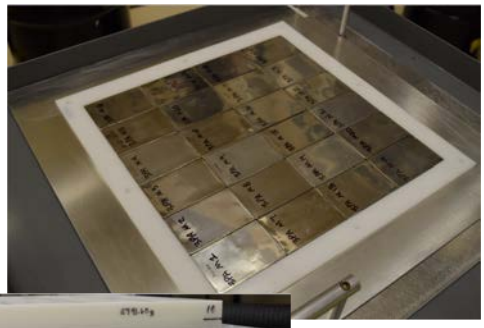
Note: links to specific resources inside the website (a.k.a. "deep links" such as those contained in emails) may not translate through the WAF. Users may be able to cut-and-paste links into the browser after authenticating with the WAF. We are currently looking into a solution for this.

Please contact Doug Bowen, bowendg@ornl.gov or 865-576-0315 for more information.

Thermal Epithermal eXperiments (TEX) with Plutonium at the NCERC (Catherine Percher, LLNL)

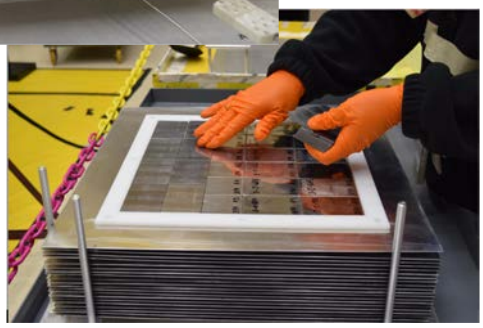
In September 2018, LLNL and LANL completed the last of ten experiments for IER 184, Thermal Epithermal eXperiments (TEX) with Plutonium at the NCERC. The ten configurations were fueled with plutonium plates that were excessed from the Zero Power Physics Reactor (ZPPR) project and saved by the NCSP for use in critical experiments. Five of the experiments were designed to be baseline experiments and used only plutonium ZPPR plates, arranged in layers, and varying thicknesses of polyethylene layers for moderation, which tuned the fission neutron spectrum from fast to thermal. The data is currently being analyzed for the experiments, but it is clear that there is significant (1-2% in keff) over-prediction by the radiation transport codes for the more intermediate energy baseline configurations. The other five experiments were like the baseline configurations but included a tantalum layer on top of each plutonium layer, providing a test of the tantalum cross sections in different energy regimes. Tantalum is a common material used in high temperature operations with fissile materials, and yet there are no experimental benchmarks for tantalum validation in the International Criticality Safety Benchmark Evaluation Project (ICSBEP) handbook. The last three experiments completed in FY18 with tantalum showed large differences between prediction and experiment- an additional 2.5-7.5 kg more Pu than predicted was required to achieve criticality. This result points to an issue with the intermediate and fast underlying neutron scattering cross sections for tantalum. An ICSBEP evaluation of the experiments is being prepared for inclusion in the 2019 edition of the Handbook, and LLNL has already engaged the nuclear data community on the preliminary results of the experiments.

To support the benchmark for the TEX experiments, LLNL took samples from one of the 60 year old ZPPR plates, also in September of 2018. Inside of a glovebox, a machinist carefully cut open the stainless steel jacket and removed the plutonium plate. Detailed measurements of the weights and dimensions of each component part were made, and they appear to be in good agreement with the historical ZPPR data. The two metal samples from the plate (one from the center and one from the edge) will be sent back to LLNL for metallographic and chemical analysis in FY19.



Experimental tray loaded with 24 Pu/Al ZPPR plates

Thermal configuration using 1" polyethylene sheets interspersed between layers of Pu and tantalum, showing temperature probe placement



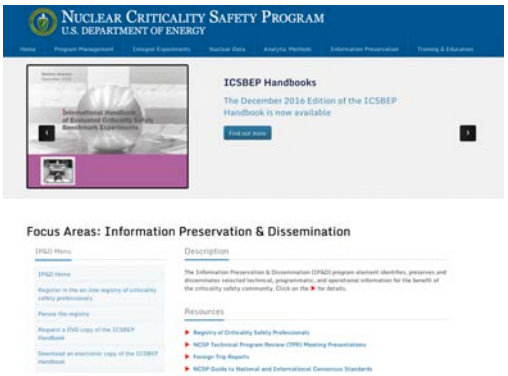
Tantalum is added on top of a Pu layer during handstacking of a fast experiment containing no interstitial polyethylene

INFORMATION PRESERVATION & DISSEMINATION

Check out our website!!!

https://ncsp.llnl.gov/

Thanks to Lawrence Livermore National Laboratory, we have a new and recently designed NCSP website.

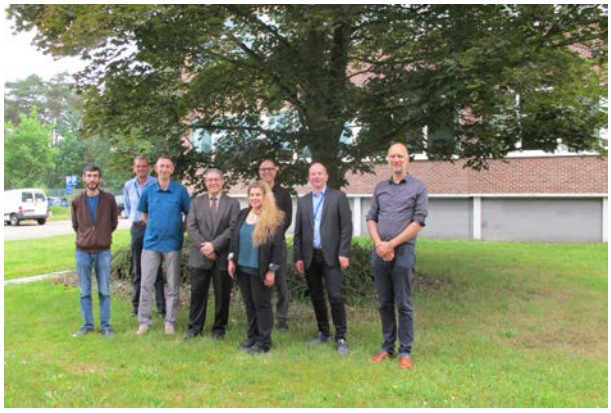


NUCLEAR DATA

DOE/NNSA–Euratom Agreement In Progress for Formal Nuclear Data Collaborations with the European Union's Joint Research Center in Geel, Belgium (Doug Bowen, ORNL)

Angela Chambers (NCSP Manager) and Doug Bowen (NCSP Execution Manager) visited the JRC GELINA facility in Geel, Belgium, in June 2018. One of the objectives of the visit was to discuss a new formal collaboration to ensure the long viability of the NCSP nuclear data program. The NCSP will collaborate through an existing NNSA NA-24, Office of International Nuclear Safeguards, DOE/NNSA-Euratom agreement. This collaboration will allow the NCSP to prepare nuclear data measurement statements of work via NA-24 to the JRC Directorate G.2, Standards for Nuclear Safety, Security, and Safeguards (JRC-G2), for consideration each year. This formal agreement will permit NCSP nuclear data measurements for years to come. NCSP nuclear data measurement priorities are documented in the NCSP 5 year plan (Appendix B).

Klaus Guber (ORNL, Nuclear Data and Criticality Safety Group) travels to Geel several times each year to perform neutron scattering measurements to support NCSP nuclear data measurement priorities. These measurements ultimately support the generation of new Evaluated Nuclear Data Files that are used to generate neutron cross sections for use in radiation transport codes for NCS applications.



Angela Chambers, NCSP Manager, Doug Bowen, and JRC-Geel Hosts

A Scale Model of the JRC-Geel Neutron Production Target

Angela Chambers, NCSP Manager, Doug Bowen in Front of the Monnet Van de Graaff Generator at JRC-Geel

Resolution of Stable Isotope Leases with DOE/SC – Nuclear Physics to Support NCSP Nuclear Data Priorities (Doug Bowen, ORNL)

In 2014, Jefferson Lab returned stable isotope samples to the National Isotope Development Center (NIDC) at ORNL that were activated after some experimental activity. As a result, Jefferson Lab had to purchase the sample at great cost. In order to return stable isotopes to the NIDC the samples must have a specific activity less than 0.6 Bq per gram of material. This is a requirement that has been included in NIDC lease agreements since the beginning to ensure the returned samples are stable enough to be offered to end users as stable isotopes. The issue at Jefferson Lab resulted in the DOE/SC-Nuclear Physics office to rearrange lease agreements to include the specific activity threshold to a conspicuous location. Sponsor approval for the lease agreements was also required to ensure it was understood that stable isotopes returned above the specific activity threshold may have to be purchased at great cost (likely hundreds of thousands of dollars).

In July 2018, Angela Chambers and Doug Bowen communicated with Dr. Jehanne Gillo, Director, Facilities and Project Management Division, DOE Office of Nuclear Physics, SC-26.2, to introduce the NCSP and to discuss the leasing issues that have impacted the NCSP nuclear data program due to potential activation issues with some stable isotopes. Dr. Gillo offered to allow the NCSP to negotiate lease agreements on a case-by-case basis. Doug Bowen visited Dr. Gillo and several staff on September 11, 2018, at her office in Germantown, MD, to provide an overview of the NCSP nuclear data program and to discuss the importance of continuing stable isotope sample leases to support NCSP goals. Again, Dr. Gillo agreed to support our program as needed. Subsequent discussions were held with the NIDC at ORNL and all parties are now aware of the NCSP nuclear data program and NCSP priorities as described in the 5-year plan, Appendix B.

In November 2018, Klaus Guber, ORNL Nuclear Data and Criticality Safety Group, will begin differential nuclear data measurements on Ce-142 (neutron capture and transmission). Activation analysis performed by ORNL and destructive analysis indicate there will be no activation issues for this stable isotope. The NCSP 5-year plan provides the measurement plan for the NCSP over the next five years.

TRAINING & EDUCATION

NCSP Hands-on Training and Education Courses

2-Week CSE Course – August 13 – 24, 2018

The NCS Practitioners Course was held at the National Atomic Testing Museum (NATM), the National Criticality Experiments Research Center (NCERC) and Sandia National Laboratories in Las Vegas, Nevada. The courses are designed to meet the ANSI/ANS-8.26, "Criticality Safety Engineer Training and Qualification Program", requirement for hands-on experimental training.

Then NATM portion of the course involves classroom lectures and workshops for NCS Evaluation development and the NCERC and SNL portions of the course involve experiments with the critical assemblies.

NNSS, LANL, ORNL, LLNL, SNL and NFO staff participated in the course execution.

Class Photo

Our Instructors

1-day Sensitivity/Uncertainty (S/U) Course at the Savannah River Site on April 23, 2018

A 1-day S/U training class at Savannah River Site, April 23, 2018. Fourteen NCS personnel attended. B. J. Marshall (ORNL) worked with Forrest Brown (LANL) to coordinate and execute for a 1-day S/U introductory training course. This is a collaborative task with LANL (Brown, Alwin, Rising). B.J. Marshall, A. Holcomb, and C. Perfetti provided ORNL support. The purpose of the course is to encourage use of the S/U tools that exist with the SCALE and MCNP code packages to support NCS validation efforts in NCS programs in the DOE complex. Additional course opportunities are being explored in FY2019.

MCNP Class Schedule for 2018

Nov 27-29, 2018
Using NJOY to Create MCNP ACE Files & Visualize Nuclear Data

Dec 3-7, 2018
Introduction to MCNP6

https://laws.lanl.gov/vhosts/mcnp.lanl.gov/classes/classinformation.shtml

SCALE Class Schedule for 2018

October 15-19, 2018
Sensitivity and Uncertainty Analysis for Criticality Safety Assessment and Validation

October 22-26, 2018
SCALE/TRITON Lattice Physics and Depletion

October 29 - November 2, 2018
SCALE/ORIGEN Standalone Fuel Depletion, Activation, and Source Term Analysis

November 5 – 9, 2018
SCALE Criticality Safety and Radiation Shielding

https://www.ornl.gov/scale/scale-training

INTERNATIONAL COLLABORATIONS

NCSP Management Visits AWE, IRSN and JRC

International collaborations in scientific research and development are becoming more important in solving global issues.

Similar collaborations in the area of nuclear safety can profit from information sharing as well as distributing tasks to achieve goals while conserving resources.

The Nuclear Criticality Safety Program (NCSP) currently has ongoing international collaborations with three countries: the UK, Belgium, and France.

Angela Chambers, NA-511 staff member and Nuclear Criticality Safety Program Manager, recently travelled to Europe as part of these ongoing nuclear criticality safety international collaborations.

First stop was to the United Kingdom Atomic Weapons Establishment's (AWE's) Aldermaston site touring their plutonium facility. The A-90 plutonium facility is AWE's equivalent of the PF-4 Facility at Los Alamos National Laboratory.

AWE collaborates with the NNSA M&O Partners and the NCSP under the US-UK Mutual Defense Agreement and as part of the JOWOG-30 Joint Working Group.

One recent accomplishment of the AWE/NCSP collaboration was Criticality Accident Alarm System (CAAS) testing of Y-12's and AWE's CAAS detectors using the Godiva fast burst assembly at the NCSP's National Criticality Experiments Research Center (NCERC). This test was one of several integral experiments conducted this year at NCERC.

Second stop was the L'Institut de Radioprotection et de Sûreté Nucléaire (IRSN) in Paris.

Angela Chambers (2nd from right in front) of NA-511 and Doug Bowen (4th from right in front) of ORNL with IRSN nuclear criticality safety and nuclear accident dosimetry staff

Similar to the US, France has two nuclear regulatory bodies: one for defense and one for commercial nuclear power. The IRSN, however, is the technical and safety institution that serves both of these. Therefore, IRSN's nuclear criticality safety organization serves both France's defense and commercial nuclear sites.

IRSN staff provided two tours: one of their dosimetry laboratory and one of their emergency operations center. In addition to performing measurements with traditional dosimetry, IRSN's lab is able to take biological samples, like fingernails and hair, and perform dose estimates from radiological accidents. These results can guide medical staff in treating personnel involved in accidents.

IRSN is involved in a number of NCSP tasks including updating the nuclear accident slide rule which helps provide dose estimates to personnel involved in a nuclear criticality accident and participating in the nuclear accident dosimetry exercise recently held at the NNSS.

IRSN flew the US flag alongside the French flag and the European Union flag during the NCSP Manager's visit to IRSN's site

Because France no longer has a criticality experiments facility, they rely on their foreign collaborations, primarily with the US and Japan, for critical experiments benchmarks. In return, they provide a multitude of experience and knowledge and well as an in roads to information sharing within the European Union related to nuclear data, nuclear accident dosimetry, and nuclear criticality safety.

Continued →

INTERNATIONAL COLLABORATIONS (cont'd)

The third and final stop of the trip was to the European Commission's Joint Research Centre (JRC) in Gelina, Belgium.

The JRC is the European Commission's science and knowledge service, which employs scientists to carry out research in order to provide independent scientific advice and support to EU policy.

JRC staff member Peter Schillebeeckx demonstrates how the beam line of the MONNET target can be spatially adjusted

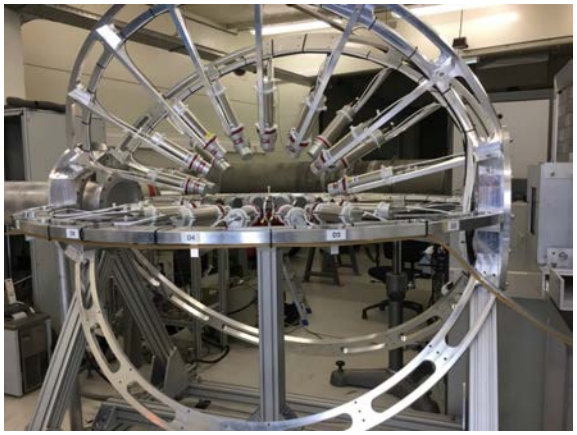
The JRC has two accelerators at its Geel, Belgium site: Gelina and MONNET. These two accelerators complement each other in their capabilities for measuring neutron cross sections at various energies. The NCSP is currently utilizing the Gelina accelerator to conduct some of its nuclear data measurements necessitated by DOE's shutdown of the ORELA accelerator at ORNL.

The MONNET accelerator uses an ion beam source of protons, deuterons or helium atoms to generate quasi-monoenergetic neutrons by putting lithium, deuterium or tritium targets in the beam line. High purity isotopic samples can then be put in line with the neutron beam to measure neutron transmission rates which in turn can be used to generate neutron cross section data. This neutron cross section data is then put into data libraries. These data libraries are used by computer codes such as MCNP or SCALE to calculate k-effective which is a value used by nuclear criticality safety engineers to estimate the margin of safety of a fissile material system.

The MONNET accelerator is the newest addition to Geel and has not yet been used for neutron productions, as it was only recently built as a replacement for their decommissioned Van de Graaff accelerator.

The Gelina accelerator produces neutrons via a high energy electron beam striking a depleted uranium target. The NCSP is completing neutron cross section data measurements using Gelina to help fill in some of the unresolved resonances in a number of isotopes important to criticality safety.

These International collaborations are an important part of the DOE's Nuclear Criticality Safety Program.



An experimental station along the Gelina neutron beam line. Small, circular, very pure isotopic samples are placed in the beam line while the neutron beam is on. Radiation detectors are placed around the sample to measure neutron beam interactions with the sample to measure data used for nuclear criticality safety calculations.

2018 PUBLICATIONS

Internal Reports and Journals

F.B. Brown, Monte Carlo Techniques for Nuclear Systems, LA-UR-16-29043

F. B. Brown, Advanced Computational Methods for Monte Carlo Calculations, LA-UR-18-20247

C.J. Werner, et al., MCNP User's Manual - Code Version 6.2, LA-UR-17-29981

F.B. Brown, et al., Status Report on the MCNP 2020 Initiative, LA-UR-17-28985

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