NCSP NEWS

2018 DATES TO REMEMBER

- Jul 21- Aug 2, 2018 Budget Execution Meeting at NATM

Hands-On Training & Education Course Dates

Two-week Practitioner Course Dates:

Aug 13 – 24, 2018

One-week Manager's Course Dates:

Jun 11 – 15, 2018

Course Registration: http://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 ACCOMPLISHMENTS
- NCSP PLANNING CALENDAR
- PREVIOUS NCSP NEWSLETTERS

Dr. Angela Chambers
NCSP Manager

IN THIS ISSUE

A Message from the CSSG

The last CSSG input for this newsletter was about a year ago. Since then we have been addressing a number of Taskings. These will be statused in the following paragraphs.

Two 2016 Taskings that were discussed in our previous update (2016-04: Position of the CSSG on Natural Phenomena, and Other Extreme Events and 2016-05: Regulatory Impediments to Effective Operational Nuclear Criticality Safety) were both completed. 2016-04 was a significant effort and took much thoughtful consideration to bring to fruition. However, it has since been transmitted to ANS, along with two ANS Inquiries, to hopefully help add clarifications to some ANS-8 Standards.

For 2017, Tasking 2017-03 to support the comment resolution on DOE-STD-3007-20XX was a significant effort (in addition to developing the draft standard). To celebrate completion, the STD was issued in December as an early Christmas present.

The CSSG has also performed two important site assessments. The first was Tasking 2017-04, where we reviewed the status of the LANL Criticality Safety Program. The second was Tasking 2017-05, where we reviewed the SRNS criticality safety program. This helped SRNS address a DOE required independent review due to some criticality safety related issues in 2015.

Finally, as we do almost every year, the CSSG just completed a review of the annual FY19 NCSP proposals. This year was similar, however, we started with ~50 proposals (significantly more than in prior years) to review and provide a first ranking on. This culminated in an all-day face-to-face review with the CSSG, the NCSP, and half-a-dozen proposal presenters, at the recent Technical Program Review and finally recommendations to the NCSP Manager about which proposals to consider for FY19 funding.

Looking forward we are developing a Tasking to provide input to the NCSP to help develop training for CSO and possibly FMHs.

As always, we look to additional opportunities to support the NCSP and the DOE Criticality Safety Community. Just let the NCSP Manager, or any CSSG member, know if you see something/somewhere where you think we can assist.

David Erickson, CSSG Chair

ANALYTICAL METHODS

Release of MCNP version 6.2
(Article submitted by Avneet Sood, LANL)

Overview

MCNP® version 6.2 has been finalized by Los Alamos National Laboratory and released by RSICC. This version has been released in order to provide the radiation transport community with the latest feature developments and bug fixes. Since the last release, significant work has been conducted to improve the code base, add features, and provide tools to facilitate ease of use as well as the analysis of results. MCNP version 6.2 contains 39 new features in addition to 172 bug fixes and code enhancements. Details on our improvements can be found in our updated manual and reference documents at: http://mcnp.lanl.gov. Note that our updated manual is not restricted as in the past.

New Tools

In addition to the physics, source, nuclear data, tally, unstructured mesh improvements, this release also contains new tools to assist the user in analysis of their results. This includes (1) Whisper – for validation and sensitivity/uncertainty quantification of upper subcritical limits for nuclear criticality safety, (2) MCNPTools to facilitate common tasks or interrogate output files, (3) ISC – for constructing source definitions, and (4) Unstructured mesh utilities.

Training and Education

The MCNP code development team provides multiple opportunities for training and education. In addition to our introductory classes on using MCNP, we provide specific training for NCS applications. We provide training on using sensitivity-uncertainty methods for NCS validation using Whisper and classes on nuclear criticality calculations using MCNP. Please see our website for upcoming classes. If you require specific on-site training, please contact the MCNP code development team at: mcnp_help@lanl.gov.

Performance

MCNP version 6.2 has the same or better performance than version 6.1.1 and 1.5 to 2 times faster than version 6.1 for Nuclear Criticality Safety (NCS) applications. Significant improvements were made in the energy and cross-section treatment for neutron calculations, the parallel threading performance, and efficient treatment of the checking for the multitude of options available in MCNP .

The code has been extensively tested through our verification and validation test suites. MCNP version 6.2 results for several NCS validation suites were compared to our previous version 6.1.1 and 6.1 releases. The principal conclusion from this testing is that MCNP version 6.2 performs correctly with results exactly matching previous results. Any differences were due to known fixes or compiler differences. MCNP version 6.2 is as correct, robust, and reliable for NCS applications as version 5, version 6.1, and version 6.1.1. Detailed results on our testing can be found on our website.

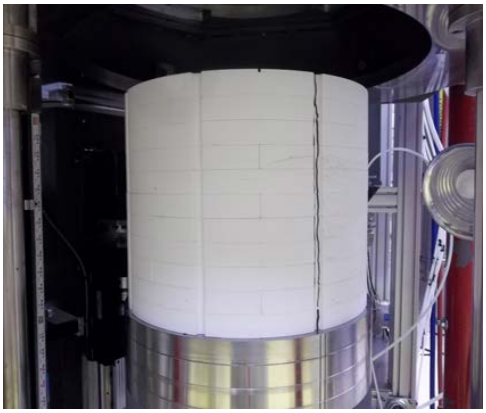
INTEGRAL EXPERIMENTS

KRUSTy – Final Operation a Success!
(Kilopower Reactor Using Stirling TechnologY)
A Joint NCSP/NASA Project
(Article submitted by Dave Hayes, LANL)

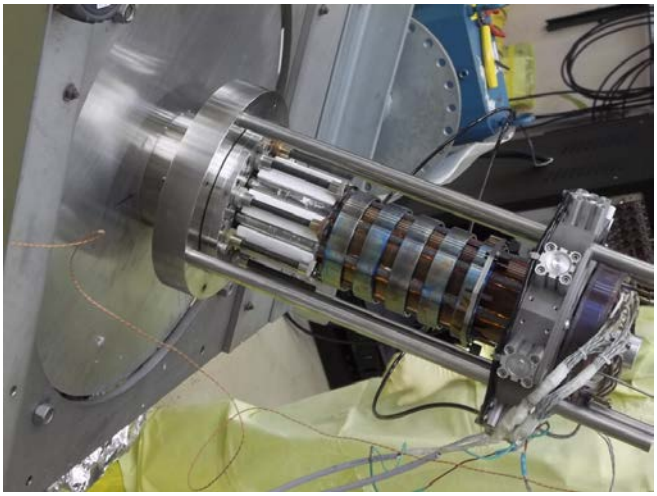
KRUSTy component criticals, warm criticals, and the full power 28 hour continuous operation were conducted in the second quarter at NCERC. The final operation was a complete success! En route to the full power test, more than 90 distinct configurations were operated at critical or above providing a data bank for the forthcoming benchmark evaluation. From a dynamics perspective, the modeling matched the reactor performance exceptionally well, providing NASA with a validation for future designs.

Data is still being crunched and will be reported in a future edition.

Operating Crew just after 28 Hours of Operation



BeO Reflector on Platen



KRUSTy Core Assembled

KRUSTy Mounted on Comet

Please contact **Lori Scott** for information or contributions:
Lori.Scott@nnsa.doe.gov

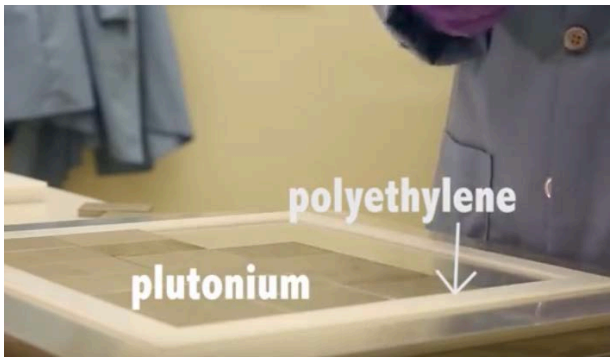
National Nuclear Security Administration

INTEGRAL EXPERIMENTS (cont'd)

The Thermal/Epithermal eXperiments (TEX) is an ongoing critical experiment campaign being conducted by Lawrence Livermore National Laboratory (LLNL) and Los Alamos National Laboratory (LANL) (Article submitted by Catherine Percher, LLNL)

The Thermal Epithermal eXperiments (TEX) are back underway at the National Critical Experiments Research Center (NCERC). The goal of the TEX experiments is to create test bed critical assemblies that span multiple neutron energy regimes to test neutron cross sections of importance to the Nuclear Data and nuclear Criticality safety communities. Last summer, LLNL and LANL completed two of the first plutonium TEX experiments, which used surplus Zero Power Physics Reactor (ZPPR) plutonium plates moderated by polyethylene. For the current campaign, the labs hope to complete three additional plutonium baseline configurations and five experiments diluted with tantalum plates. All configurations will be evaluated to be included in the International Criticality Safety Benchmark Evaluation Project (ICSBEP) Handbook. The week of April 2, 2018, the labs achieved criticality on the third plutonium baseline configuration. LLNL and LANL are also working on a similar highly enriched uranium (HEU) and U-233 TEX test bed.

LLNL produced a short video describing the design of the plutonium-fueled TEX configurations and explaining the approach to critical methodology, which can be viewed here: https://www.youtube.com/watch?v=D46aPz6d9-I



Catherine Percher
Lawrence Livermore National Laboratory
Nuclear Criticality Safety Division

INFORMATION PRESERVATION & DISSEMINATION

NCSP Annual Technical Program Review (TPR)

The NCSP TPR was recently held at Oak Ridge National Laboratory, on March 27-28, 2018.

The review was a great success, with just under 100 participants from AECOM, ANL, AWE, BNL, Boston Government Services, CNS, CS Engineering, DNFSB, DOE, FTE/UCOR, INL, IRSN, LANL, LLNL, NCSU, NNL, NNSS, ORNL, RPI, Sigma Science, SNL, Spectra Tech, SRS and UoF.

The full TPR agenda, with links to all presentations can be found at:

https://ncsp.llnl.gov/TPRAgendas/2018/NCSP_2018_TPR_Agenda.html

Thanks to everyone who participated and to those who made it all happen.

Please contact **Lori Scott** for information or contributions:
Lori.Scott@nnsa.doe.gov

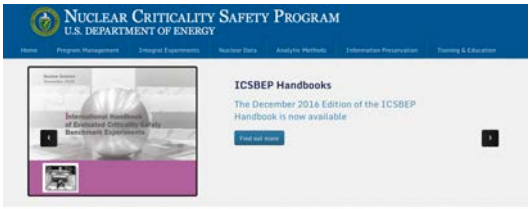
National Nuclear Security Administration

INFORMATION PRESERVATION & DISSEMINATION (cont'd)

If you haven't already…
Check out our new website!!!

https://ncsp.llnl.gov/

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



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National Nuclear Security Administration

NUCLEAR DATA

50 Years of Nuclear Data: Cross Section Evaluation Working Group (CSEWG) announces the release of the ENDF/B-VIII.0 evaluated nuclear reaction data library (Article submitted by Dave Brown, BNL)

The U.S.'s Evaluated Nuclear Data File (ENDF) is the default low energy nuclear data library in particle transport codes such as MCNP, SCALE and even GEANT4. ENDF/B provides:

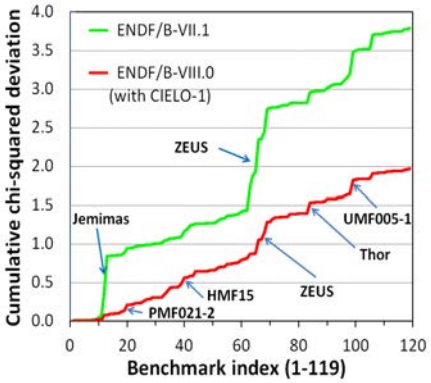
- the neutron reaction data needed for simulating nuclear systems, the particle transport data and decay data used for health physics shielding calculations
- the activation and decay data needed for spent fuel modeling
- the charged-particle reaction data for fusion applications

What's even more surprising is that the ENDF library has been under continuous improvement since 1968, the year the Cross Section Evaluation Working Group (CSEWG) released ENDF/B-I. CSEWG is a long-running collaboration between members of several DOE and other programs (Criticality Safety, Office of Science, Defense Programs, Naval Reactors, Nuclear Energy, NIST, & others), industry and international partners. 2018 marks the 50th anniversary of the ENDF library.

On February 2, 2018, CSEWG released its latest revision of the ENDF/B library, ENDF/B-VIII.0.

ENDF/B-VIII.0 fully incorporates the new Neutron Data Standards, includes improved thermal neutron scattering data and uses new evaluated data from the Coordinated International Evaluation Library Organization (CIELO) pilot project for neutron reactions on ^{16}O, ^{56}Fe, ^{235}U, ^{238}U and ^{239}Pu. The evaluations benefit from recent experimental data obtained in the U.S. and Europe, and improvements in theory and simulation. Notable advances include updated evaluated data for light nuclei, structural materials, actinides, fission energy release, prompt fission neutron and gamma-ray spectra, thermal neutron scattering data, and charged-particle reactions.

CSEWG has performed integral validation testing on a wide range of criticality, reaction rate and neutron transmission benchmarks. In general, our integral validation demonstrates that performance of the library is a noticeable improvement over the previous ENDF/B-VII.1 library.



Cumulative chi-squared of k_{eff} results of critical assembly simulations, showing the dramatic improvement of ENDF/B-VIII.0 over the previous ENDF release. Plot taken from MB Chadwick et al, Nuclear Data Sheets 148, 189 (2018)

There are two download URL's available at the National Nuclear Data Center:

- https://ndclx4.bnl.gov/gf/project/endf/scmsvn/?action=browse&path=%2Ftags%2FENDF-B-VIII.0%2F to browse the subversion repository
- https://ndclx4.bnl.gov/gf/project/endf/frs/?action=FrsReleaseBrowse&frs_package_id=30 to download archives of the various ENDF/B sublibraries

Cover of the ENDF/B-VIII.0 special issue of Nuclear Data Sheets

The ENDF/B-VIII.0, CIELO and Neutron Standards evaluations are also detailed in a series of Nuclear Data Sheets articles, soon to be published:

- D. 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," Nuclear Data Sheets 148, 1 (2018).
- A.D. Carlson, *et al.,* "Evaluation of the Neutron Data Standards" Nuclear Data Sheets 148, 143 (2018).
- M.B. Chadwick, *et al.,* "CIELO Collaboration Summary Results: International Evaluations of Neutron Reactions on Uranium, Plutonium, Iron, Oxygen and Hydrogen," Nuclear Data Sheets 148, 189 (2018).
- M. Herman, *et al.,* "Evaluation of Neutron Reactions on Iron Isotopes for CIELO and ENDF/B-VIII.0," Nuclear Data Sheets 148, 214 (2018).
- R. Capote, *et al.,* "IAEA CIELO Evaluation of Neutron-Induced Reactions on ^{235}U and ^{238}U Targets for Incident Energies up to 30 MeV," Nuclear Data Sheets 148, 254 (2018).
- D. Neudecker, *et al.,* "Evaluations of Energy Spectra of Neutrons Emitted Promptly in Neutron-induced Fission of ^{235}U and ^{239}Pu," Nuclear Data Sheets 148, 293 (2018).

TRAINING & EDUCATION

NCSP Hands-on Training and Education Courses
(Article submitted by Doug Bowen)

2-Week CSE Course – January 29 – February 9, 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

Students handling the BeRP Ball at NCERC

Students handling the BeRP Ball at NCERC

FY2018 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

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, submitted to Nuclear Data Sheets, LA-UR-17-30870

P.A. Grechanuk, Semi-Analytic Benchmarks for MCNP6, LA-UR-16-28568

P. Grechanuk, et al., Semi-Analytical Benchmarks for MCNP6, Trans. Am. Nuc. Soc., Vol.116, p.709-711, LA-UR-17-20668

P.A. Grechanuk, Using Machine Learning to Predict MCNP Bias, LA-UR-18-20175

Ed Lent, A Comparative Study of the COG Thermal Libraries II, including the latest thermal scattering law data from NCSU, LLNL-TR-743341

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, Nuclear Data Sheets 148, 1 (2018)

D. Heinrichs, Integral Experiment Needs, showing discrepancies for Cd radiative capture gamma lines in EGAF, CapGam, and JEFF3.2 libraries, LLNL-PRES-740584

Conferences

International Conference on Transport Theory, Monterey CA

F.B. Brown, Investigation of Clustering in Monte Carlo Criticality Calculations, abstract LA-UR-17-27093, presentation LA-UR-17-2926

P Grechanuk, et al., Using Machine Learning Methods to Predict Bias in Nuclear Criticality Safety Simulations, abstract LA-UR-17-27855, presentation LA-UR-17-29317

IEEE Nuclear Science Symposium, Atlanta GA

C.R. Bates, et. al., Verification and Validation of MCNP6.2, LA-UR-17-29540

ANS Winter Meeting, Washington, DC

J. Arthur, et. al., Improved Figure of Merit for Feynman Histograms

T. Cutler, et al., Experimental Design To Study Criticality Effects of Plutonium Aging

R. Bahran, et. al., Neptunium Subcritical Observation (NeSO) Integral Benchmark Experiment Design

V. Hagopian, et. al., Design of a Highly-Enriched Uranium (HEU) Metal Fast Burst Supercritical Assembly

D.K. Hayes, Flat-top Startup at the National Criticality Experiments Research Center

J. Hutchinson, et. al., Prompt Neutron Decay Constant Fitting Using the Rossi-alpha and Feynman Variance-to-Mean Methods

J. Hutchinson, et. al., Measurements on a Subcritical Copper-Reflected **α**-Phase Plutonium (SCR**α**P) Sphere

K.L. Klain, Determination of the Optimal Time Bin Width for the Rossi-Alpha Analysis of Highly Subcritical Fast Metal Systems

G. McKenzie, et. al., Prompt Neutron Decay Constant Measurements on a Polyethylene-Reflected Sphere of Highly Enriched Uranium

A. McSpaden, et. al., Eliminating Detector Response in Neutron Multiplicity Measurements for Model Evaluation

W. Myers, et. al., Using Fast Burst Assembly Designs to Demonstrate Safe Assembly of KRUSTY Core Components
R. Sanchez et al, Kilowatt Reactor Using Stirling TechnologY (KRUSTY) Experiment Update

FY2018 PUBLICATIONS (cont'd)

Internal Reports and Journals

Conferences

ANS Winter Meeting, Washington, DC

K. Smith, et al., Cold Critical Pre-Experiment Simulations of KRUSTy

D. Heinrichs, DOE Nuclear Criticality Safety Program Website Modernization

Cole Manring, NCSU presented Evaluation of the Thermal Neutron Scattering Law for a Heavy Paraffinic Molecular Material

FY2017 PUBLICATIONS

Internal Reports and Journals

J. Favorite, et. al., Adjoint-Based Sensitivity and Uncertainty Analysis for Density and Composition: A User's Guide, Nuclear Science and Engineering, vol. 185, no. 3, article in press.

D. Cullen, A Pulsed Sphere Tutorial, LLNL-TR-726839.

Severe Excess Reactivity Insertion Accident Analysis for the Krusty Reactor Experiment (U), LLNL-TR-730661.

J. Hutchinson, et. al., Subcritical Copper-Reflected α-phase Plutonium (SCRαP) Measurements and Simulations.

J. Hutchinson, et al., A Study of Measured, Experimental, and Nuclear Data Uncertainties for Subcritical Benchmark Experiments.

F. Brown, Investigation of Clustering in MCNP6 Monte Carlo Criticality Calculations, LA-UR-17-25009.

F Brown, et. al., Release of MCNP6.2 & Whisper-1.1 - Guidance for NCS Users, LA-UR-17-24260.

M. Rising, et. al., Using Whisper-1.1 to Guide Improvements to Nuclear Data Evaluations, LA-UR-17-22892.

M. Rising, et. al., Semi-Analytical Benchmarks for MCNP6, LA-UR-17-20668.

F. Brown, et. al., LANL-SNL Collaboration on NCS Validation, LA-UR-17-21889.

F. Brown, et. al., Verification of MCNP6.2 for Nuclear Criticality Safety Applications, LA-UR-17-23822.

F. Brown, et. al., Verification of MCNP6.2 for Nuclear Criticality Safety Applications, LA-UR-17-24406.

F. Brown, et. al., Verification of MCNP6.2 for Nuclear Criticality Safety Applications, LA-UR-17-25040.

J. Alwin, et. al., Investigations Into Validation of Plutonium Solutions for Criticality Safety Analysis, LA-UR-17-24321.

J. Alwin, Using Whisper to Support Nuclear Criticality Safety Validation - Pu Process Chemistry Considerations, LA-UR-17-24966.

D. Brown et. al., Scattering Angular Distributions in the ENDF/B Nuclear Data Library, Brookhaven National Laboratory Report BNL-114446-2017-IR.

Conferences

ANS Summer 2017, San Francisco, CA

LANL-SNL Collaboration on NCS Validation, LA-UR-17-21889.

Using the MCNP6.2 Correlated Fission Multiplicity Models, CGMF and FREYA, LA-UR-17-20799.

Semi-Analytical Benchmarks for MCNP6, LA-UR-17-20668.

ANS Nuclear Criticality Safety Division – 2017, Carlsbad, NM

Release of MCNP6.2 & Whisper-1.1 – Guidance for NCS Users, LA-UR-17-22713.

Investigations into Validation of Plutonium Solutions for Criticality Safety Analysis, LA-UR-17-22805.

Four Decades of Nuclear Criticality Education, LA-UR-17-22714.

Using Whisper-1.1 to Guide Improvements to Nuclear Data Evaluations, LA-UR-17-22892.

K. Klain, Simulated Rossi-Alpha Analysis of an Asymmetrically Coupled Bare Metal HEU Reactor System.

IRSN-LLNL-ORNL status report, Introduction of Plutonium Systems to the Nuclear Criticality Slide Rule.

D. Bowen, Current Status of the DOE/NNSA Nuclear Criticality Safety Program Hands-On Criticality Safety Training Courses.

D. Bowen, Overview and Status of Domestic and International Standards for Nuclear Criticality Safety.