

NCSP Activities and Accomplishments in FY17 for Q1 through Q3

Analytical Methods (AM)

LANL AM

NJOY21 Progress

- Reported on NJOY status at annual CSEWG meeting.
- Provided onsite two-day NJOY class on creating MCNP ACE files and visualizing nuclear data.
- Finalized source code for initial NJOY2016 release.
- Finalized the NJOY2016 manual.
- V&V checks are continually being implemented in ACETk as code is written.
- Work is progressing on resonance reconstruction in NJOY21—on track for completion by end of year.
- Taught NJOY class at LANL. This is a complete update of the NJOY class that includes many exercises. Class was well received by all participants.
- Processed the ENDF/B-VIII.0 Beta4 evaluations and performed benchmark testing.
- Paper presented at ANS Annual Meeting on Open Source availability of NJOY. It was well received and people are excited about the ease with which they can get NJOY.
- V&V checking has been implemented in ACETk. More will be added as additional capabilities are implemented.

GND Supporting Activities

- Co-chair of WPEC Subgroup-43 tasked with implementing an API for GND

MCNP Code Work

Whisper

- Established ACE covariance data files, based on BLO “low-fi” data.
- Whisper modifications for ACE covariance files.
- Documentation for upcoming release.
- LA-UR-17-20098, Covariance Data File Formats for Whisper-1.0 & Whisper-1.1.
- LA-UR-17-20567, User Manual for Whisper-1.1.
- LA-UR-17-23504, Release Notes for Whisper-1.1.
- LA-UR-17-22018, Using Whisper to Support NCS Validation ANSI/ANS-8.24 Requirements.

Assisting with preparation for the release of MCNP6.2

- Continued testing for criticality safety V&V suites using MCNP6.2.
- Updated MCNP Reference Collection.
- Completed testing with latest versions of Intel & gcc/gfortran compilers.
- Examined changes needed for nuclear data to be included with MCNP6.2 release.
- LA-UR-17- 23822, Verification of MCNP6.2 for Nuclear Criticality Safety Applications.
- Updated MCNP & Whisper Reference Collection.
- Testing of latest versions on Mac, Linux, Windows systems.
- Updated nuclear data to be included with MCNP6.2 release.

Fission neutron multiplicity

- Improved & consolidated the fission neutron multiplicity capabilities in MCNP6 (CGMF, Freya).
- LA-UR-16-27710, CGMF & FREYA Verification in MCNP6.
- LA-UR-17-20972, Correlated Prompt Fission Particle Emission Models in the Next Release of MCNP6.

- LA-UR-17-21962, MCNP6.2 Status & Developments: FY16 and early FY17.

MCNP User Support and Training

- Monte Carlo Techniques for Nuclear Systems, UNM Monte Carlo class.
- Continued to provide training & assistance to LANL NCS division. Lectures, consultations, assistance with validation & reviews, etc.
- Criticality user support by web site, MCNP Forum email, user email, & direct assistance.
- Ongoing investigation of improved method for modeling plutonium solution, including considerations for oxidation state, complexation (speciation), and density.
- Reproducing LA-UR-07-0160 to compare k-effective results for a moderated cubic array of plutonium pieces with Whisper USL.
- Collaborating with SNL criticality safety on the use of Whisper. Compared results for ICSBEP benchmark models - 1101 from LANL vs. 866 from SNL.
- MCNP criticality class at LANL – April 2017.
- MCNP criticality class at PNNL – scheduled for July.
- MCNP-Whisper collaboration with ORNL – scheduled for August.
- Monte Carlo Techniques for Nuclear Systems, UNM Monte Carlo class
- Continued to provide training & assistance to LANL NCS division. Lectures, consultations, assistance with validation & reviews, etc.
- Continued support & updating of MCNP Reference Collection, with over 800 reference reports.
- Continued support for MCNP website.
- Continued support for MCNP classes.
- Continued support to NCS users via MCNP Forum, email, & hands-on assistance division. Lectures, consultations, assistance with validation & reviews, etc.

MCNP6.2 Release Support

- Wrote installer scripts for MCNP6.2, nuclear data, documentation, and utilities (including Whisper-1.1)
- Continued testing of MCNP6.2 & Whisper-1.1 for NCS applications. Numerous documents issued, including guidance for NCS practitioners.
- MCNP6.2 code finalized and transmitted to RSICC.

MCNP International Collaboration:

- Visited IRSN in Paris, France, June 29 – July 4. Exchanged technical information on MCNP-Whisper, sensitivity-uncertainty methods, MCNP calculations, etc.
- Participated in OECD-NEA Expert Group Meetings in Paris, France, July 5-7: Expert Group on Advanced Monte Carlo Techniques, and Expert Group on Uncertainty Analysis for Criticality Safety. Continued interchange & analysis of benchmark collections with Sandia NCS.
- Sandia independent testing of upcoming release of MCNP6.2 & Whisper-1.1
- Gave IRSN the results for 1101 ICSBEP benchmarks run with MCNP6 for Whisper. This is the initial phase of IRSN-LANLORNL- LLNL inter-comparison of ICSBEP benchmark results.
- Technical interchange with IRSN, focused on sensitivity uncertainty methods & Pu solution chemistry.
- Participated in OECD-NEA-WPNCS Expert Group meetings on "Advanced Monte Carlo Techniques" & "Uncertainty Analysis for Criticality Safety Analysis."
- Teaching & graduate student mentoring at University of New Mexico.
- Mentored 3 summer student interns at LANL.

MCNP R&D Progress

- Ongoing investigation of improved method for modeling plutonium solution, including considerations for oxidation state, complexation (speciation), and density.
- Reproducing LA-UR-07-0160 to compare k-effective results for a moderated cubic array of plutonium pieces with Whisper USL.
- Ongoing investigation of improved method for modeling plutonium solution, including considerations for oxidation state, complexation (speciation), and density.
- Fission neutron multiplicity & NCS calculations (with UNM grad student).
- Fission matrix applications (with UNM grad student).
 - Acceleration of source convergence.
 - Automated detection of source convergence.
- Review & revision to the 10-year old "Best practices for MC criticality calculations" guidance for NCS practitioners. Additional guidance on clustering rolled out at MCNP workshop at Carlsbad NCSD-2017.
- Continued investigation of Pu solution chemistry & effects on NCS calculations.
- Investigate application of MCNP-Whisper methodology to identify & support nuclear data improvements

MCNP Papers and Talks

- ANS ANNTPC 2016, Santa Fe NM
 - LA-UR-16-23341, Correlated Fission Multiplicity Model Verification Efforts in MCNP6
- NECDC 2016, Livermore CA
 - LA-UR-16-27172, Sensitivity-Uncertainty Based Nuclear Criticality Safety Validation
 - LA-UR-16-27724, Fission Neutron Multiplicity In Monte Carlo Criticality Calculations
- ANS Winter 2016, Las Vegas NV
 - LA-UR-16-23968, MCNP Progress for the Nuclear Criticality Safety Program
 - LA-UR-16-24254, New Version of the MCNP Analytic Criticality Benchmark Suite
 - LA-UR-16-24308, Verification of MCNP6.1, MCNP6.1.1, and MCNP6.2-pre for Criticality Safety Applications
 - LA-UR-16-28482, The Impact of Chemistry in Criticality Safety Analysis (tutorial session)
 - NCSP Analytic Methods Working Group, Las Vegas NV
 - LA-UR-16-28473, LANL Analytic Methods Work for the Nuclear Criticality Safety Program
 - DOE-NNSA-NCSP Technical Program Review
 - LA-UR-17-21889, LANL-SNL Collaboration on NCS Validation
 - LA-UR-17-21840, MCNP Progress for NCSP
 - LA-UR-17-22018, Using Whisper to Support NCS Validation ANSI/ANS-8.24 Requirements
- ANS Summer 2017, San Francisco, CA (submitted)
 - LA-UR-17-21889, LANL-SNL Collaboration on NCS Validation.
 - LA-UR-17-20799, Using the MCNP6.2 Correlated Fission Multiplicity Models, CGMF and FREYA.
 - LA-UR-17-20668, Semi-Analytical Benchmarks for MCNP6
- ANS Nuclear Criticality Safety Division – 2017, Carlsbad, NM (submitted)
 - LA-UR-17-22713, Release of MCNP6.2 & Whisper – Guidance for NCS Users.
 - LA-UR-17-22805, Investigations into Validation of Plutonium Solutions for Criticality Safety Analysis.

- LA-UR-17-22714, Four Decades of Nuclear Criticality Education.
- LA-UR-17-22892, Using Whisper-1.1 to Guide Improvements to Nuclear Data Evaluations
- LA-UR-17-25009, Brown, "Investigation of Clustering in MCNP6 Monte Carlo Criticality Calculations"
- LA-UR-17-24260, Brown, Rising, Alwin, "Release of MCNP6.2& Whisper-1.1 - Guidance for CS users".
- LA-UR-17-22892, Rising, Brown, Alwin, "Using Whisper-1.1 to Guide Improvements to Nuclear Data Evaluations".
- LA-UR-17-20668, Grechanuk, Rising, Brown, Palmer, "Semi-Analytical Benchmarks for MCNP6".
- LA-UR-17-21889, Brown, Miller, Henderson, Rising, Alwin, "LANL-SNL Collaboration on NCS Validation".
- LA-UR-17-23822, Brown, Rising, Alwin, " Verification of MCNP6.2 for Nuclear Criticality Safety Applications ".
- LA-UR-17-24406, Brown, Rising, Alwin, " Verification of MCNP6.2 for Nuclear Criticality Safety Applications ".
- LA-UR-17-25040, Brown, Rising, Alwin, " Verification of MCNP6.2 for Nuclear Criticality Safety Applications ".
- LA-UR-17-24321, Alwin, Brown, Rising, Salazar-Crockett, "Investigations Into Validation of Plutonium Solutions for Criticality Safety Analysis".
- LA-UR-17-24966, Alwin, "Using Whisper to Support Nuclear Criticality Safety Validation - Pu Process Chemistry Considerations".

LLNL AM

- Attended a meeting of the Analytical Methods Working Group at Caesars Palace on November 10, 2016 which included a presentation by Barry Ganapol (University of Arizona) on his compendium* of analytical benchmarks.
- Ganapol corrected LLNL-identified errors revising published results for benchmarks 5.1.3a, b. COG results are now in excellent agreement except minor discrepancies remain for benchmarks: 2.1.2 (at high lethargy), 3.1.1 ($x \approx 0$), 5.1.3a ($\rho < 3$). Ganapol reviewing these cases.
- Presented *Combinatorial Geometry Performance Analysis using COG11.1 and MCNP6.1 for Nuclear Criticality Safety Applications* at the Nuclear Explosives Code Developers Conference (NECDC 2016) at LLNL on October 19, 2016.
- Attended CSEWG and NDAG meetings at BNL on November 14-18, 2016. Provided the latest version of the COG LibMaker to BNL for implementation in ADVANCE. Also provided a β -test version of COG12 to the Naval Nuclear Laboratory (Bettis).
- Reported numerous "NaN" errors in ENDF/B-VIII.0 β 3 ACE files created by ADVANCE (using NJOY) to BNL.
- LLNL approved external release of TART 2016 as Export Controlled Information and provided it to RSICC for distribution.
- Installed COG11.1 on the DNFSB Windows 7 server and confirmed proper installation via successful execution of verification test cases in both serial and parallel (MPI) processing. Provided an introductory lecture to DNFSB users based on CSG-TM-016, *Training Module: COG Software*.
- Hosted a meeting of the NCSP Analytical Methods Working Group at the UC Washington Center on March 13, 2017 with 24 participants from AWE, IRSN, LANL, LLNL, NNL, OECD and

ORNL. Presented LLNLPRES- 726259, *Corrections to Ganapol Benchmarks 3.1.5 and 5.1.3*, which concludes all major discrepancies identified by LLNL in previous meetings are now resolved. LLNL is continuing work with Ganapol (U. Arizona) to discover the cause of the remaining minor discrepancies.

- Assisted NNL by providing COG (a,n) results for comparison to their MC21 results, which NNL will present at M&C 2017. Significant differences in interpreting JEFF3.1.1 decay data for α -emission line spectra were observed; however, calculated neutron thick target yield (in UO₂) and neutron spectra (for UO₂, PuO₂ and Am-Be) were in excellent agreement. LLNL and NNL concur that calculations based on 2-body kinematics are superior to those based on Kalbach-Mann systematics in reproducing experimental data.
- LLNL-TR-726839, *A Pulsed Sphere Tutorial*, by Dermott E. “Red” Cullen, approved on March 14, 2017 for unlimited distribution. Implemented the latest International Reactor Dosimetry and Fusion File, IRDFF v.1.05a, in COG as library file IRDFF1.05, and updated the ENDF6toCOG ‘libmaker’ routines to handle the new dosimetry data.
- Provided COG ²⁵²Cf spectrum-average cross-section calculational results for the Mini-CSEWG meeting at LANL on May 4-5, 2017, which demonstrated significantly improved results for ²³⁹Pu(n,f) using ENDF/BVIII.0β3 with C/E = 0.995 ± 0.014 resolving a long-standing (~5%) discrepancy.
- Revised the COG thermal scattering law data library, T.HZIce, for ice replacing the original Naval Nuclear Laboratory data (dated December 22, 2015) with their latest data (dated August 10, 2016) to resolve observed discrepancies between COG and MC21 integral testing results using pulse die-away experimental data.
- Reviewing first principles bremsstrahlung simulation from prompt photon emission from fission with subsequent photo-atomic electron production as well as delayed beta emission from fission products for comparison to approximate methods employed in other codes.
- Implementing thermal scattering law data for Lucite in ACE format for use with MCNP6.1 (on LLNL machines) for comparison to COG.

Multiphysics

- LLNL-TR-730661, *Severe Excess Reactivity Insertion Accident Analysis for the Krusty Reactor Experiment (U)*, completed on May 1, 2017.

Criticality Slide Rule

- Attended the Criticality Slide Rule Task Collaboration Meeting at IRSN on October 7, 2016. In collaboration with AWE, IRSN and ORNL, determined actions to complete the first phase of the task as described in *Update of the Nuclear Criticality Slide Rule for the Emergency Response to a Nuclear Criticality Accident*, which is accepted for publication in the proceedings of the ICRS13-RPSD2016 conference by the European Physics Journal – Web of Conferences.
- Implemented the latest International Reactor Dosimetry and Fusion File, IRDFF v.1.05a, in COG as library file IRDFF1.05, and updated the ENDF6toCOG ‘libmaker’ routines to handle the new dosimetry data.
- Reviewing first principles bremsstrahlung simulation from prompt photon emission from fission with subsequent photo-atomic electron production as well as delayed beta emission from fission products for comparison to approximate methods employed in other codes.
- Implementing thermal scattering law data for Lucite in ACE format for use with MCNP6.1 (on LLNL machines) for comparison to COG.
- IRSN presented *Status of the Slide Rule Update* as part of the NCSP Analytical Methods Working Group meeting on March 13, 2017.

- A Criticality Slide Rule Task Collaboration Meeting was convened following the NCSP TPR at UC Washington Center on March 15, 2017 with participants from AWE, IRSN, LLNL and ORNL to discuss finalizing the second phase of the project including the detailed specifications for *Plutonium Configurations* and *Sensitivity Studies*. The specification was revised and issued on March 24, 2017.
- LLNL provided COG calculational results for the second phase of the Criticality Slide Rule project, which have been included in *Introduction of Plutonium Systems to the Nuclear Criticality Slide Rule* for submission to the 2017 ANS Criticality Safety Topical Meeting in Carlsbad, NM, September 10-15, 2017.

ORNL AM

AM1-RSICC activities: See rsicc.ornl.gov for monthly newsletters.

- Distributed 3142 software packages and updated 9 software packages.
- 985 SCALE, 1216 MCNP, and 2 COG packages distributed.
- RSICC quarterly reports issued.

AM2-SCALE activities:

- Completed initial documentation of 186 ²³³U experiments to the VALID benchmark library. Qualification and comment resolution ongoing.
- Initiated project to update and expand capabilities in the USLSTATS trending program.
- Completed and distributed SCALE Annual Report.
- Review of the initial 186 ²³³U experiments was completed, identifying 4 additional experiments to be included. Technical review of all 190 experiments is complete.
- Developed 6 abstracts for submittal to the ANS NCSD conference on SCALE and AMPX testing and validation—5 full papers submitted for publication at ANS NCSD conference.
- Since 2004, there have been over 12,000 distributions of SCALE to 8,000 unique users in 56 nations.
- Since April 2016, SCALE 6.2 has been distributed to 2467 users in over 30 nations.
- Released SCALE 6.2.2 update providing enhanced features for criticality safety and sensitivity/uncertainty analysis.
- Participated in the OECD/NEA Working Party on Nuclear Criticality Safety meeting in Paris, including chairing the Expert Group on Uncertainty Analysis for Criticality Safety Assessment.
- Completed new SCALE website: <http://scale.ornl.gov>.
- Scheduled 4 weeks of SCALE training for October 2017.
- Answered 973 requests for user assistance through scalehelp@ornl.gov.

AM3-AMPX Maintenance and Modernization:

- Processed ENDF/VIII-Beta 4 data into MG and CE and ran valid cases to assess impact of updated release on NCS benchmarks.
- Attended CSEWG working group meeting and presented the AMPX status report and chaired the Formats and Processing Session.
- Started modernization of JAMAICAN module used to produce CDFs and PDFs—updates to process discrete energies and Bragg data and use new CE in-memory library structure to store CDF and PDF data.
- Processed ENDF/VIII-Beta 4 data into MG and CE and ran valid cases to assess impact of updated release on NCS benchmarks.
- Added a class that calculates redundant cross section data in the CE AMPX resource.
- Processed the preliminary ENDF/VIII-β4 covariance data and checked data—results presented at the 2017 Mini-CSEWG, May 2017.

- At WPEC meeting in Paris (travel paid by NRC), changes for the new Generalized Nuclear Data (GND) format were discussed. Some of the changes to the low-level data containers were implemented in AMPX.

AM6 – Slide Rule activities:

- Most of the KENO-VI and MAVRIC/Monaco Simulations for the FY17 contribution to the Slide Rule update are complete—full paper documenting work submitted to the NCSD topical meeting.

Integral Experiments (IE)

LANL IE

- Tumbleweed Support
- Godiva Ops
- Planet Ops
- ANS Workshop
- NDSE Measurements
- Comet JAEA
- RTO Build
- Material Receipt
- ER Class
- Planet testing in preparation for TEX
- Material moves to support facility maintenance
- Critical Assembly Maintenance
- NPod Certifications
- Flattop Irradiation
- NCSP Class
- Detector Calibration
- Comet Ops
- 2 weeks of NDSE Support
- ZPPR Receipt
- NDSE Support
- Began Planet TEX with a handstack. A failure within the Planet drive mechanism precluded the transfer of the stack to the critical assembly.
- Supported facility inventory
- ZPPR Verification and Repack
- DNDO Operations
- University Measurements
- Godiva Burst
- NASA Training for KRD
- Funds were successfully transferred to RPI University to support a measurement campaign at the RPI Reactor to occur in Q4.
- Operator training occurred for new operators and proficiency was maintained for current operators when evolutions were executed using the NNSS assemblies.
- New candidate operators performed OJT as part of their initial certification.
- Biennial operator training occurred in April as part of the recertification/certification process for current and future operator candidates.
- Two new operators were certified as Planet crew members.

KRUSTY Support and Collaboration with NASA:

- Participated in regularly scheduled KRUSTY project conference calls hosted by NASA.
- Participated in the comment resolution process for the KRUSTY safety basis addendum 90% and 100% review.
- Worked with different safety management program SMEs to generate documentation to successfully execute KRUSTY experimental work in a safe and compliant manner.

- Worked with NSTec/DAF facility personnel to coordinate execution of necessary facility modifications to successfully execute KRUSTY experimental work.
- Participated in the assembly of KRUSTY electrical heated system tests using a depleted uranium core. These tests were conducted at NASA Glenn Research Center.
- Provided as needed feedback and support to NCERC safety basis team wrt KRUSTY project.
- KRUSTY final design document (CED-2) was approved.
- Experiment plans for KRUSTY were revised and sent out for review. The LANL CESC reviewed the experiment plan to be used for the cold/warm critical experiments and provided comments to the PI for resolution.

Papers of interest presented at the 2016 ANS Winter Meeting hosted in Las Vegas, NV:

- J. Hutchinson, et. al., “Subcritical Benchmark of the BeRP Ball Reflected by Tungsten” Various Correlated Fission Multiplicity Monte Carlo Codes”
- R. Bahran, et. al, “Development of a Research Reactor Protocol for Neutron Multiplication Measurements”
- J. Hutchinson, T. Cutler, “Use of Criticality Eigenvalue Simulations for Subcritical Benchmark Evaluations”
- Poster: J. Arthur, et. al., “Advanced Critical and Subcritical Neutron Multiplication Measurements for Nuclear Data and Computational Methods Validation”
- R. Sanchez, et.al., ““Prompt Neutron Decay Constants in a Highly Enriched Uranium-Lead Copper Reflected System”
- T. Cutler, et. al. “Measurements of the Fission Neutron Spectrum using Threshold Activation Detectors Final Design”
- J. Goda, et. al., “Evaluation of Engineering Controls Implemented to Mitigate Godiva Contamination”

Papers of interest presented at the NCSP TPR Meeting hosted in Washington, DC:

- J. Hutchinson, et. al., “Subcritical Copper-Reflected α -phase Plutonium (SCR α P) Measurements and Simulations”
- R. Bahran, et. al, “Progress on the Development of a Neutron Multiplication Measurement Protocol at a Reactor Critical Facility”
- R. Sanchez, et.al., ““Kilowatt Reactor Using Stirling Technology (KRUSTY) Experiment Update”
- T. Cutler, et. al. “Experimental Design to Study Criticality Effects of Plutonium Aging”
- D. Hayes, “Flatop Startup at NCERC”
- Participated in regularly scheduled project conference calls hosted by NASA.
- Participated and presented in the integrated project meeting that occurred in Washington, DC in November.

Additional Publications of Interest:

- 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 (2017).
- Jesson Hutchinson presented two papers at the International Conference on Mathematics and Computational Methods Applied to Nuclear Science & Engineering (M&C 2017) held in Jeju, Korea:
- J. Hutchinson, et. al., “Subcritical Copper-Reflected α - phase Plutonium (SCR α P) Measurements and Simulations”

- J. Hutchinson, et al., “A Study of Measured, Experimental, and Nuclear Data Uncertainties for Subcritical Benchmark Experiments.”
- Kim Klain successfully defended her Ph.D. Thesis defense at UNLV, “Temporal Analysis of Asymmetrical Zero-Power Loosely-Coupled Subcritical Bare Metal Reactor Systems”. This work was supported using NCSP succession planning funding.

LLNL IE

- Completed LLNL-TR-715817, “International Inter-comparison Exercise for Nuclear Accident Dosimetry at the DAF Using Godiva-IV:.”
- LLNL submitted a BCR for TEX extending the CED-3a completion date to Q3 (IE3) – see Issues/Path Forward.
- AWE completed report no. 775/16, “Final Design for the Characterization of the leakage radiation field from the Flattop critical assembly machine at NCRC: Report.” This report, while not required as CED-3b initiation is approved, provides a detailed roadmap for experiment execution.
- NCSP Manager approved CED-1 and initiated CED-2 for [International Inter-comparison Exercise for Nuclear Accident Dosimetry using Flattop].
- Completed [foil irradiations] as an add-on to [NCT #2] in June 2016. A draft report is available on request and NCSP Manager approval of CED3b and 4a has been requested.
- The (draft) CED-2 report Final Design for Thermal/Epithermal experiments with Jemima Plates with Polyethylene and Hafnium” was completed and uploaded for CEdT review on December 19, 2016.
- Provided review comments on (draft) report, “SNL Preliminary Design for Experiments Involving Molybdenum,” to the author, Nicolas Leclaire (IRSN), and Gary Harms (SNL) (IE3).
- LLNL-TR-715677, “ISSA Subcritical Multiplicity Benchmark, CED-2 Report,” completed and NCSP Manager approved CED-2/3a and initiated CED-3b on December 22, 2016.
- NCSP Manager approved completion of [Reference values of the Godiva radiation field] CED-4a on March 9, 2017.
- NCSP Manager approved completion of [International Inter-comparison of Nuclear Accident Dosimetry Using Godiva] CED-4a on February 10, 2017.
- LLNL reported completion of [TEX] CED-3a on March 24, 2017, based on the following:
 - LANL Critical Experiment Safety Committee approval of the TEX experiment plan on January 26, 2017
 - Facility Operational Review Committee (FORC) approval of the experiment plan on March 21, 2017, and the revised plan on March 27, 2017.
 - LLNL fabricated diaphragm and platen provided to LANL on March 27, 2017
 - Initial hand-stacking completed for the first 2 (of 10) TEX experiments
- LLNL provided 9975 shipping containers enabling shipment of PANN ZPPR fuel from INL to NCERC. Sufficient PANN fuel is now at NCERC for all 10 [TEX] experiments.
- [BeRP/Composite] on hold pending experiment plan completion/approval.
- [LEMC], [LLNL NCT/AWE] and [liquid scintillators] setup on February 8-9 and measurements on February 13-16, 2017.
- NCSP Manager approved completion of [Cf-252 (ICSBEP) Benchmark] CED-2 on April 4, 2017. LLNL published and uploaded LLNL-TR-728214, *252Cf Reference Radiation Field Benchmark*.
- LLNL hosted a JOWOG-22.9 packaging and transportation AWE-NNSA technical exchange meeting on January 30 - February 2, 2017. Detailed plans for aquisition and transfer of additional AWE assets were discussed and POCs identified.

NNSS IE

- Continued the development of the 90% SB document for KRUSTY-DAF DSA CN 2. SBRT 90% comments resolved. Completed 100% document goes to NFO early July. SER expected early August. No Readiness Review required.
- Managed engineering, procurement and construction tasks via an IPT to support KRUSTY. Provided input to the NASA/KRUSTY schedule. Finished 2 weeks early.
- Continued development of the 90% SB document for DAF DSA CN 3- MAR/TEX/Small Quantity. NFO comments resolved. Received a Technical Direction Letter from NFO which added scope to this CN. Completed 100% document, to include scope of TDL. No Readiness Review required. Need by date remains November 2017 to support final TEX experiments.
- Provided monthly input for non-NCSP (WFO) work products
- Initiated planning for the Vault Modification Project for NCERC with LANL for inclusion in upcoming programming.
- Formed an IPT for the Vault Modification Project for NCERC. Planning, a facility walk-down and engineering has started.

Provided support to the following NCSP/NCERC experiment activities in the 1st quarter:

- Misc. Program Support
- Godiva Operator Training
- Material move, ANS Workshop
- RTO build
- ER Class

Provided support to the following NCSP/NCERC experiment activities in the 2nd quarter:

- Misc. Program Support
 - NCSP Class Support
 - Detector Calibrations
 - NCSP Class
 - NCSP Class
- Flattop Operations
LEMC Measurements
Godiva Operations
Godiva Operations

Provided support to the following NCSP/NCERC experiment activities in the 3rd quarter:

- Program Support
- Manager's course
- Planet Operations
- NCSP Class

NCSP/NCERC Experiment Support:

- Planet Ops.
- Comet Ops.
- Godiva Ops.
- Instrument Set up.
- Comet Maintenance.
- Material Moves.
- NCT/TACS

Non-NCSP (WFO) Support:

- Planet Operations
- DTRA Support
- Flattop setup and operations (including Global Security)
- NDSE Measurements

- ER Class
- (Godiva SLFPY, LLNL Hot Operations)
- Comet Operations
- NPOD Certs
- Instrument setup, LEMC experiments:

ORNL IE

Investigation of new critical epi-thermal experiment capability at SNL

- The CE_dT Team traveled to SNL to visit with Harms/Ford the end of February 2017 to tour SNL TA-V and Critical Assembly.
- Initial analysis shows such a capability is problematic to develop as a traditional critical experiment sensitive to NCSP structural materials of interest in the epithermal range. Concepts include rods, blocks, solutions, and foils.
- Initiated efforts to explore reactivity experiments that would be able to spotlight minor constituents at epi-thermal energies. Such experiment would involve placement of test material in central cavity and comparison to voided central cavity—potential limitation of test materials to high worth materials with lower lying resonances.
- Potential investigation of flux perturbation calculations around a central detector. This concept has only been discussed at this stage.
- The investigation of new critical epi-thermal experiment capability at SNL. CED-1 report is being reviewed by IER team.

SILENE benchmark:

- Final evaluations of pulses 2 and 3 accepted by ICSBEP for publication.
- The pulse 1 evaluation was revised, to be more consistent with pulses 2 and 3, and was also accepted for publication by the ICSBEP.

SNL IE

- The capability and authorization of the Sandia Critical Experiments was maintained.
- Staff proficiencies were maintained by performing critical operations. The critical experiments were started at the end of the third quarter.
- Two staff members travelled to Las Vegas to attend an SBRT meeting and to NASA GRC to review progress on the DU KRUSTY demonstration.
- Staff participated in the review of the KRUSTY 90% DSA submission and attended two SBRT meetings in Las Vegas.
- Staff participated in experiment reviews with the LANL CESC.
- BCRs to harmonize the NCSP schedule with the way work is proceeding were filed with the NCSP after the end of the quarter. All affected FY17Q2 milestones are marked as late.
- A benchmark evaluation, LEU-COMP-THERM-097 was prepared and submitted for ICSBEP review.
- Performed rod-replacement experiments.
- Provided support the NFO SBRT for KRUSTY.

Information Preservation and Dissemination (IPD)

LLNL IP&D

ICSBEP Accomplishmentss (IP&D1)

- LLNL received 90 copies of the December 2016 Edition of the ICSBEP Handbook from OECD NEA and distributed 78 copies to NCSP users. ICSBEP (CED-4b) evaluations in progress for completion in FY-2017 include:
 - NCT/NTNF Material #2 (Bill Myers, LANL); which includes:
 - LLNL Foil Irradiation Add-On to NCT #2 (Jo Ressler, LLNL).
 - Reestablish 4.3% (BUCCX) Capability (Gary Harms, SNL).
 - Titanium Cross Sections in a Thermal Application (BUCCX Hardware) (Gary Harms, SNL).
- Meeting rooms reserved at George Washington University (GWU) in Washington, DC for the NCSP Manager to host the 2017 ICSBEP/IRPhEP meetings on October 23-27, 2017 with official “sponsorship” from the GWU Department of Physics.

Website and Red Net Accomplishments(IP&D2)

- Held meeting with CEdT Manager at LLNL November 11, 2016 to discuss in detail of the NCSP classified CEdT process and its linkage to unclassified CEdT process.
- Modified 20 Integral Experiment Request Form programs and logic to transition to new NCSP Manager.
- Archived and copied the unclassified NCSP website content to the classified ESN NCSP website.
- Implemented Multi-Factor Authentication on both classified and unclassified NCSP webservers, and 19 computers at NCERC as mandated by the Committee on National Security Systems (CNSS).
- Updated the NCERC classified network images to ensure the latest Microsoft patches were installed as required to avoid vulnerabilities found and published by Microsoft.
- Supported NCERC programs with equipment inspections for visiting students and class attendees.
- Performed penetration testing on LANL classified network at NCERC as required by DOE Cyber Security Plan. Completed a prototype for a new top-level T&E page and added content for CSSG and NDAG subpages on <https://ncsp-new-dev.llnl.gov>. Initial designs were also completed for new top-level IE and IP&D pages, which are in development. A live demonstration of the modernized website design was presented at the TPR on March 14, 2017.
- Created a new NCSP Newsletter web section to publish the NCSP Quarterly Newsletter.
- Converted 152 Adobe Flash videos to modern mp4 format.
- Migrated ncspl.llnl.gov, cog.llnl.gov, and ncspl-beta.llnl.gov servers’ Operating System from RHEL 5 to RHEL 6.9 as mandated by the LLNL Cyber Security Program.
- Provided IT support for the 2017 NCSP Technical Program Review (TPR) meeting.
- Upgraded NTS-LAN/NCERC provisioning server and backup software to latest versions.
- Updated the NTS-LAN/NCERC classified network images and servers to ensure the latest Microsoft patches were installed as required by LANL Cyber Security Plan.
- Supported NCERC with equipment inspections for (T&E courses).
- Repaired a corrupted NCSP website DNS name record, which caused the NCSP website to be temporarily inaccessible from outside of LLNL.
- Upgraded ncspl.llnl.gov and ncspl-beta.llnl.gov to SSL to provide the strongest privacy and integrity protection in conformance with White House Office of Management and Budget policy memorandum M-15-13.

- Archived the classified NCSP website and IER database in preparation of imminent shutdown and deletion of classified NCSP content on the Enterprise Secure Network.
- Added 14 new data fields to the IER database capturing the 'Approved' status and time stamps for all CEdT phase gates. Updated 22 CGI programs to automatically store the IER time stamp going forward. Manually 844 CEdT phase gates with times stamps for "Approved status" for 211 IERs based on the automated IER email notifications.
- Installed 812 Microsoft security patches to fix security vulnerabilities on NTS-LAN/
- NCERC classified network images and servers.
- Updated the NTS-LAN/NCERC Computer Security Plan to include mandated monthly authenticated network scans for vulnerabilities. Risk Assessment (performed monthly via authenticated network scans).
- Supported NCERC with equipment inspections

SRS IP&D

- Prepared revised FY16 Plan.
- Prepared documentation: Software Evaluation Package, requirements Specification, Requirements Traceability Matrix, and Test Case Package to support design/development of CritView.
- Began modification of the CritView code to speed up database reading to support the identified upgrades.

Nuclear Data (ND)

BNL ND

- Added 2 new reports to ADVANCE in response to CSEWG requests:
- New ACE file summary report, containing the NJOY inputs, outputs and NJOY generated cross section and heating data plots.
- New covariance summary report, containing covariance plots generated by NJOY.
- Released ENDF/B-VIII.β3 on 2 Dec. 2016.
- 8 new charged particle evaluations.
- 5 new thermal scattering law evaluations (all NCSP funded) evaluations of NCSP interest).
- Released ENDF/B-VIII.β3.1 on 19 Jan. 2017.
- Revised CIELO evaluations.
- Released, ENDF/B-VIII.β4 on 28 Feb. 2017—contains new 2 new NCSP-funded TSL evaluations from NCSU (UN).
- Revised Neutron Standards and CIELO evaluations.
- Major revisions to NCSP-funded evaluations (^{35}Cl , ^{37}Cl , ^{63}Cu , ^{65}Cu , ^{240}Pu).
- GForge & ADVANCE machines received OS upgrades in Feb. 2017 and GForge received a version upgrade in Feb. 2017.
- New data validation enabled by sharing of LEAPR inputs by members of NCSP.
- Now use NJOY2016 in product, simplifying NJOY build & deploy as well as resolving issues with generated ACE files.
- Upgraded ADVANCE to use PREPRO17 and FUDGE-4.2.2.
- FUDGE can now translate Decay files into GNDS, so add to ADVANCE.
- Add PREPRO's LEGEND into list of codes to run on neutrons Coordinating bug-fixes and repairs to ENDF library.
- TSL – LEAPR decks for all files; working with CAB, CNL & NNL on light.
- H2O; work with NNL on D2O; correct ZAID's.
- Neutrons – 18 files updated with format corrections.
- Deuterons – 2 files updated with format corrections.
- Decay – 14 files updated with format corrections.
- Protons – small fixes to headers in 2 files.
- New version of FUDGE (version 4.2.2) includes BNL implementation of Blatt-Biedenharn formalism for computing angular distributions from resonance parameters. FUDGE-4.2.2 released June 21, 2017. Work on this task “officially” began July 10, in Q4, summer student arrived July 10, 2017.
- Atlas of Neutron Resonances submitted to publisher July 10, 2017.

LANL ND

- Evaluated the gamma-ray multiplicity dependent prompt fission gamma-ray spectra (PFGS) for n+U-235, n+U-238 and n+Pu-239 from thermal up to 20 MeV incident neutron energies.
- Monte Carlo Hauser-Feshbach CGMF code was used to calculate those spectra at several incident neutron energies (thermal, 5, 10, 15 and 20 MeV). At the highest outgoing gamma energies and for the highest multiplicities where low Monte Carlo statistics becomes a problem, we have fitted a parametrized model, originally developed by Jandel to represent his DANCE measured data. The fits are excellent for most multiplicities and energies, demonstrating the very good agreement between the CGMF results and DANCE experimental data.

- The multiplicity-dependent spectra are much harder for low multiplicities and soften with increasing multiplicity—multiplicity distribution has been calculated with CGMF up to $M_g=24$.
- Below ~ 1 MeV, clear structures are predicted with CGMF, in very good qualitative agreement with recent experimental data from JRC, Geel, Belgium, and with older experiments by Verbinski (with much poorer energy resolution though). DANCE data could not resolve those structures, which correspond to discrete transitions in the fission fragments.
- New ENDF-formatted files produced for all three nuclei, using a new format recently adopted for multiplicity-dependent PFNS. Only one set of multiplicity-dependent PFGS was adopted for all incident energies. The energy dependence appears in the multiplicity distribution $P(N_g)$ instead, stored in MF12,MT18.
- Working to include those new evaluations into the ENDF/B-VIII.0 library, to be released later this year.
- A Generalized Least Squares evaluation of the U-235 PFNS (prompt fission neutron spectrum) was undertaken for 21 incident neutron energies ranging from thermal to 20 MeV. An extended Los Alamos model and the exciton model were used to calculate prompt fission neutrons emitted from compound nucleus and pre-equilibrium processes. Experimental data of 11 data sets spanning incident neutron energies from thermal to 20 MeV were included and covariance's for each experimental data set and between all data sets were estimated in detail. This evaluation was updated end of December 2016 with recently measured data by the Chi-Nu team. Chi-Nu provided data for 20 incident neutron energies from 0.7 MeV to 20 MeV and for outgoing neutron energies from 0.04 to 2.4 MeV. These new data have a non-negligible impact on the evaluated mean energies compared to an evaluation with Chi-Nu data from September 2016. Analysis for the high-energy data is still ongoing. [1] D.
- Neudecker et al., Nuclear Instruments and Methods A, Vol. 791, p. 80 (2015).
- Evaluated the average gamma-ray multiplicity based on the latest data from Geel (Oberstedt et. al) and older data from Drake for both Pu239(n,f) and U235(n,f) as a function of incident neutron energy. The new evaluations reproduce well the total gamma production and the gamma production spectrum as compared to data by Drake, at all available incident energies.
- Removed an artifact from ENDF-B/VII.1 at 14 MeV incident neutron energy, where the gamma production spectrum was showing an unphysical drop around 4 MeV outgoing gamma-ray energy.
- The prompt fission gammas contributions below 100 keV, the current threshold for gamma detection, were estimated based on CGMF simulations. A similar procedure will be used for a new evaluation of U238(n,f).
- Created evaluated files for testing using the new format accepted for multiplicity-dependent prompt fission neutrons and gammas.
- Data Testing for ENDF/B-VIII.0 and CIELO
- All beta versions of ENDF/B-VIII.0 processed via NJOY2016
- Resulting ACE files are used in 1151 MCNP criticality Benchmarks
- Prompt fission gamma-ray spectra for U235, U238 and Pu239
- PFGS evaluations updated to include in the ENDF/B-VIII.0 beta5 release. They are based on CGMF (Monte Carlo Hauser-Feshbach) calculations, recent experimental data from JRC-Geel, CEA and LANSCE, as well as older experimental data from Drake on the total gamma production for several incident neutron energies.
- The CGMF calculations reproduce nicely most of the complicated structures observed in the spectra below 1.5 MeV gamma-ray energy.

- At the highest energies, above ~8 MeV, deterministic CGMF calculations have to be used due to poor statistics.
- Recent experimental data by Nishio were used to guide the U235 PFGS evaluation.
- The same PFGS obtained at thermal is used up to 20 MeV, as only limited evidence shows little to no dependence of the spectrum on the incident neutron energy.
- Prompt fission gamma-ray multiplicity distributions P(Ng) obtained from CGMF calculations, reproducing very well the limited experimental data.
- Prompt fission neutron spectra
- The PFNS for U235 and Pu239 have been re-evaluated based on an extended Los Alamos model, and a review of past experimental data.
- Chi-Nu data are yet to be finalized, and only preliminary data for U235 were used to compare with the new evaluation. Pu239 Chi-Nu data are very preliminary but show good consistency with the current evaluation.
- Improvements at higher incident energy compared to BVII. are being incorporated into ENDF/B-VIII.0.
- Incident energy-dependent covariance matrices have been evaluated for both isotopes, but only limited information can be incorporated into ENDF/B-VIII.0, due to format limitations.

NDAG Chair Activities

- Organized and led the annual NDAG meeting during Nuclear Data week at BNL
- Reviewed IER proposals

CSEWG Meeting

- Reported on evaluation and data testing efforts in preparation for ENDF/B-VIII.0

LLNL ND

Thermal Scattering Cross Sections (ND2)

- NCSU contributed the following thermal scattering laws (TSLs) to ENDF/B-VIII.0^{β3} in File 7 format:
 - Beryllium metal (Be)
 - Single crystal graphite (C)
 - Nuclear graphite (with porosity)
 - Uranium and oxygen in uranium dioxide (UO₂)
- Previous NCSU evaluations contributed to ENDF/B-VIII.0^{β3} include:
 - Beryllium and oxygen in beryllia (BeO)
 - Polyethylene (CH₂)
 - Lucite (C₅H₈O₂)
 - Silicon carbide (SiC)
 - Silicon dioxide (SiO₂)
- NCSU continued development of a thermal scattering law for heavy paraffinic oils. Verification of the diffusional behavior of the system is currently underway.
- NCSU, NNL (Bettis) and LLNL attended Nuclear Data Week at Brookhaven National Laboratory (BNL), November 14-18, 2016, and presented the following papers:
 - *Progress of Thermal Scattering Data Research at NCSU*, A. Hawari
 - *Progress on the Evaluation of the Thermal Scattering Law for Heavy Paraffinic Molecular Materials*, C. Manring and A. Hawari
 - *Analysis of a TREAT Benchmark including Graphite Thermal Scattering Effects*, N. Sorrell and A. Hawari

- *NNL TSL Evaluations for Yttrium Hydride and Hexagonal Ice*, M. Zerkle and J. Holmes
- NCSU made a major contribution to the TSL section in the upcoming ENDF/B-VIII.0 paper. This included a description of the analysis and TSL production for the following materials: (1) beryllium metal, (2) beryllium oxide, (3) crystalline graphite, (4) nuclear/reactor graphite, (5) silicon carbide, (6) silicon dioxide, (7) uranium dioxide, (8) uranium mononitride, (9) polymethyl methacrylate (aka as Lucite), and (10) polyethylene. The TSL data for silicon carbide, silicon dioxide, nuclear/reactor graphite, uranium mononitride and polymethyl methacrylate are first-of-a-kind materials in the ENDF database. The remainder of the materials are reevaluations using fundamental data generated with modern atomistic simulation techniques.
- NCSU generated, using classical MD modeling, the TSL for hydrogen in heavy paraffinic oil. This version of the TSL treats the highly viscous oil as a weakly diffusing system that can be approximated as a solid-like material (e.g., similar to amorphous polymers). Work is ongoing to examine various models for a “liquid” treatment for the oil and to compare the results to the current solid-like treatment.
- NCSU attended the International Conference on Mathematics & Computational Methods Applied to Science & Engineering (M&C 2017) meeting on April 16-20, 2017 in Jeju, Korea and presented the paper “Thermal Neutron Scattering Law Data Evaluations for Nuclear Technology Applications”.
- NCSU continued work on the ten thermal scattering laws (Be, BeO, C (crystalline), C(nuclear), SiC, SiO₂, UO₂, UN, C₅H₈O₂, CH₂) which were contributed to ENDF/B-VIII.beta4. This work included updates and corrections in support of the ENDF/B-VIII.beta5 (test) and ENDF/B-VIII.0 (production) releases. Additionally, a modified version of NJOY is under development to enable independent testing and QA of the contributed TSL libraries.
- NCSU modified a version of NJOY/LEAPR to include the capability to treat highly viscous materials using a Langevin representation of the diffusional component of the TSL. This is needed to complete the TSL generation process of heavy paraffinic oil materials.
- NCSU submitted a summary paper entitled “Evaluation of The Thermal Neutron Scattering Law for a Heavy Paraffinic Molecular Material” for presentation at the upcoming 2017 ANS Winter Meeting in Washington, DC.
- Next Generation Codes (ND3)
- NCSU continued development of the “next generation” TSL code. All modules (incoherent approximation, generalized coherent elastic scattering, and coherent inelastic (1-phonon) scattering) are integrated and a GUI developed. V&V of the code using Be, C, BeO is underway.
- NCSU presented *Status of TSL Code Development at NCSU*, Y. Zhu, J. Pashby and A. Hawari, during Nuclear Data Week at BNL.
- NCSU completed the initial version of a modern platform for analyzing thermal neutron scattering in matter and producing the TSL and the related thermal scattering cross sections. This platform is known as the “Full Law Analysis Scattering System Hub” (*FLASSH*).
- The beta1 version of *FLASSH* has been delivered to LLNL and NNL. It includes all capabilities discussed previously (e.g., incoherent approximation, generalized coherent elastic scattering, and coherent inelastic (1-phonon) scattering).
- NCSU presented the paper “Full Law Analysis Scattering System Hub (*FLASSH*)” at the ANS 2017 Annual Meeting in San Francisco in June 2017.
- NCSU completed the initial version of a modern platform for analyzing thermal neutron scattering in matter and producing the TSL and the related thermal scattering cross sections. This platform is known as the “Full Law Analysis Scattering System Hub” (*FLASSH*). The beta1 version of

FLASSH has been delivered to LLNL and NNL. It includes all capabilities discussed previously (e.g., incoherent approximation, generalized coherent elastic scattering, and coherent inelastic (1-phonon) scattering).

ORNL ND

- ORNL experiments at JRC-Geel for the NCSP:
- Traveled to JRC-Geel to initiate new zirconium (Zr) measurements, continue vanadium (V) measurements, and perform data reduction tasks for previously measured V data.
- Data sorting for thick V-sample neutron capture experiments were continued and thick V sample transmission factors produced.
- Performed data testing with SAMMY for V capture and transmission data.
- Performed transmission experiment on natural Zr.
- Performed gamma activation calculations for an enriched ^{142}Ce -oxide sample in collaboration with RPI and JRC-Geel.
- Presented ORNL measurements at the CSEWG meeting at BNL in November.
- At request of KAPL and RPI, ORNL provided 3-day workshop on nuclear data resonance evaluation theory.
- Participated in NR/NCSP program review of the RPI accelerator modernization on December 14, 2016.
- Resonance Evaluation for the Isotopes of Cerium.
- Continued progress on the resolved resonance region evaluation of the isotopes of Cerium.
- Simultaneous analysis of experimental transmission and capture data from Guber, as well as 2 sets of historical transmission data from Hacken and 2 sets of transmission data from Ohkuba.
- Abstract submitted to 2017 ANS Annual Meeting entitled, "Status of a New Resonance Evaluation for Cerium to Support Nuclear Criticality Safety Applications."
- ORNL experiments at JRC-Geel for the NCSP:
- Thick V sample transmission factors were produced.
- Thick V sample capture data reduction.
- Investigation of data normalization for neutron capture data.
- Continue data testing with SAMMY for V data.
- Initiated activation calculations for the enriched Zr samples.
- Presented ORNL measurements at the NCSP Technical Program Review meeting in Washington in March.
- Work on NCSP data/publication for the new ENDF-VIII nuclear data library.
- ^{239}Pu evaluation (leading evaluator) Work on the covariance matrix related to the resonance parameter evaluation is in progress.
- ^{40}Ca evaluation
- Work on the paper related to the release of ENDF/BVIII. 0 nuclear data library. The manuscript was prepared and submitted for external review.
- Resonance Evaluation for the Isotopes of Gadolinium in collaboration with IRSN.
- Resonance re-evaluation of the 27 experimental data sets from RPI.
- A detailed model has been obtained for the integral experiment performed at the ZED-II reactor at CNL.
- A first study of the feasibility and the consequences of reporting cross-isotope covariance matrices has been completed.
- Travel to JRC-Geel in April and May to perform cross section measurements and data reductions.

- ORNL experiments at JRC-Geel for the NCSP:
- Initiated thick natural Ce sample (^{140}Ce) neutron capture experiment. This is necessary to obtain better data above 50 keV. Previous experiments with a thin sample show insufficient statistics after complete data reduction. ^{140}Ce has a closed neutron shell and thus a very small capture cross section. The aim is to achieve better statistics with a thicker sample.
- Data sorting of transmission for natural Zr samples of different thickness.
- Initiated data sorting for Zr neutron capture samples.
- Determination of data normalization for neutron capture data.
- Work on NCSP data/publication within the CIELO collaboration for the release of ENDF-VIII.0 nuclear data library.
- Work on the covariance matrix related to the resonance parameter evaluation was presented at the mini-CSEWG at LANL.
- **^{235}U evaluation**
- Work on ^{235}U resonance parameters performed in collaboration with IAEA—produced updated set of resonance parameters that showed improved performance in benchmark calculations. The file is currently adopted by the ENDF/VIII.0 beta-3.1 release (December 2016/ January 2017).
- Paper about the n+ ^{235}U resonance evaluation work was completed and submitted to the ND2016 conference proceedings.
- Evaluation work on ^{235}U evaluation was presented at the nuclear data week at Brookhaven National Laboratory (BNL) in November 2016.
- Work on ^{235}U resonance parameters performed in collaboration with IAEA. The file is currently adopted by the ENDF/VIII.0 beta-4 release (February/March 2017).
- Paper about the n+ ^{235}U resonance evaluation work was peer-reviewed and accepted to be part of the ND2016 conference proceedings.
- Evaluation work on ^{235}U evaluation was presented at the Nuclear Criticality Safety Program Technical Program Review in Washington DC in March 2017.
- Work on the covariance matrix related to the resonance parameter evaluation presented at the mini-CSWEG at LANL.
- Tungsten evaluations—paper about the validation work on the tungsten evaluations was completed and submitted to be part of the ND2016 conference proceedings.
- Prepared paper related to the release of ENDF/BVIII.0 nuclear data library. The manuscript was prepared (currently in PTS) and submitted for external review.
- **^{16}O evaluation**
- ORNL presentation about the n+ ^{16}O evaluation presented at CSEWG Meeting. Particular emphasis was devoted to describe the longstanding problem related to the normalization of the (n, α) reaction chain.
- Prepared paper related to the CIELO collaboration for the n+ ^{16}O evaluation.
- Current status of the evaluation work was presented at the Nuclear Criticality Safety Program Technical Program Review in Washington DC in March 2017.
- **Ce and Gd evaluations**
- Continued progress on the resolved resonance region evaluation of the isotopes of Cerium
- Completed collaborative visit to IRSN (Dr. Leal) to work on the joint evaluation of the resolved and unresolved resonance regions of the five isotopes of Gadolinium (Gd-155,156,157,158,160).
- **ND4- Thermal Neutron Scattering work**
- Thermal neutron scattering kernel evaluation framework.

- Christopher Chapman has received the Best Paper Award for the University Tasks at the Nuclear Criticality Safety Program, Technical Program Review Meeting, Washington D.C., March 14-15, 2017, and has been invited to present this work at the 2017 ANS Winter Meeting. In the presentation "Thermal Energy Scattering Evaluation Framework" Christopher Chapman has outlined the ORNL evaluation and uncertainty quantification framework for the thermal neutron scattering kernel, $S(a,b)$, that couples Spallation Neutron Source data, Molecular Dynamics simulations, and Universal Monte-Carlo method, and has presented results for light water. This ORNL-based project will culminate in Christopher Chapman's Ph.D. Thesis at the Georgia Institute of Technology in 2017. Christopher Chapman has defended his Ph.D. Thesis titled "Thermal Neutron Scattering Evaluation Framework" at the Georgia Institute of Technology on June 23, 2017. This is a product of research on thermal neutron scattering evaluation and uncertainty quantification using Monte Carlo methods with application to water performed by Chris at the ORNL for the past 2 years.

ND6-SAMMY Modernization:

- Released SAMMY 8.1 Beta to RSICC and RPI for testing. New features in this release include:
- Informing R-matrix resonance parameter evaluation by coupling to the integral benchmark experiments in the new
- SAMMY module SAMINT, Modernized build and test procedure following the SQA practices recently implemented in AMPX and SCALE.
- Visited Prof. Yaron Danon's group at the RPI on November 4, 2016, to ensure that SAMMY modernization would enable analysis of new kinds of data anticipated after completion of an ongoing upgrade of experimental facilities in the Gaertner Electron Linear Accelerator (LINAC) Center.
- Invited presentation at the ND2016, Brugge, Belgium, September 9-16, 2016, titled "Generalized Reich-Moore R-matrix Approximation" laying down R-matrix theory relevant to the SAMMY modernization project.
- Invited presentation at the IAEA Consultants' Meeting on "R-Matrix Codes for Charged-particle Induced Reactions in the Resolved Resonance Region", Vienna, December 5-7, 2016, titled "SAMMY Modernization" to an international group of R-matrix experts and code developers.
- ORNL official release of SAMMY 8.1 via RSICC (rsicc.ornl.gov) was announced in RSICC March 2017 Newsletter. New features in this release include: Informing R-matrix resonance parameter evaluation by coupling to the integral benchmark experiments in the new SAMMY module SAMINT.
- Modernized install, build and test procedure following the SQA practices recently implemented in AMPX and SCALE.
- Software License Agreement for use and distribution of code CWFCOMPLEX in SAMMY/AMPX/SCALE was negotiated and signed by the author, Dr. Nicolas Michel, and by the ORNL. CWFCOMPLEX computes precise Coulomb wave function used by SAMMY and AMPX for a much greater range of input parameters. Code CWFCOMPLEX has resolved a problem encountered in reconstructing cross section in a recent data evaluation.
- Identified a potential solution for a longstanding issue caused by unrealistically small uncertainties calculated by SAMMY. The proposed solution uses correlation matrix calculated using R-matrix formalism to populate off-diagonal data covariance matrix.
- A collaboration with Prof. Dean W. Halderson of Western Michigan University was started in Q3 to enable accurate calculation of relativistic effects that may be useful for resonant cross section evaluations of light nuclides whose resolved resonance range extends into 10's of MeV where

relativistic effects may be tangible. This constitutes the first attempt to use consistent Dirac relativistic R-matrix formalism in nuclear data evaluation framework for improved precision and accuracy. This R-matrix formalism is considered for potential utilization by the modernized version of SAMMY.

- ORNL summer student Jinghua Feng has implemented a prototype generalized least squares fitting program that will be augmented for fitting of resonance parameters in a modernized version of the SAMMY code. Novel strategies for more accurate estimation of uncertainties and covariance matrices are being pursued in the context of this project. The fitting capability being developed in the context of SAMMY modernization will become available to AMPX and SCALE developers via a generic application programming interface.

RPI ND

Accelerator Modernization with Naval Reactors

- Hosted NR/NCSP technical review meeting on December 12, 2016.
- Factory acceptance tests all klystrons was completed.
- Modulator order was submitted to vendor and work began.
- RPI and NR final section-design review meeting was held at SLAC.
- Modulator production started at vendor site.
- Accelerator sections design purchase recommendation was submitted to NNL (KAPL).
- SLAC delivered accelerator sections design drawing to RPI.
- NR/BMPC approved purchase of additional (6th) klystron.

Measurement and Analysis Accomplishments

- Journal publication on Ta URR capture was submitted to Phys Rev C.
- Hosted a SAMMY analysis workshop in collaboration with ORNL and NR during November 1-3.
- Presented results during CSEWG and participated in NDAG meeting at BNL during November 14-16.
- Working with IAEA and BNL evaluators on incorporation on the Fe and Fe-56 capture (and scattering) into ENDF/B-VIII.
- Presented at ANS Winter Conference in Las Vegas on the topic: "Improvements to Thermal Neutron Scattering Law of CH₂".
- Developing a new method of producing thermal libraries using ab-initio simulations and VISION instrument at SNS Oak Ridge.
- Created a process to compare the VISION data with current phonon spectrums.
- Converted H₂O experimental data into an ACE file that runs in MCNP with promising results.
- Prepared experimental plan for Ta RRR and URR measurements and obtained sample quotes.
- Worked with CSEWG on the benchmarking the evaluation of Fe and Fe-56, against RPI capture and scattering experimental data.
- Completed neutron scattering measurements at SNS for samples of Lucite, Teflon, and Concrete.
- Compared the Lucite experiment to new ENDF/B-VIII.b4 evaluations and observed noticeable disagreement.
- Finished developing a new method for producing thermal libraries using DFT simulations and VISION instrument at SNS. At a test created a polyethylene library using new method.
- Presented US experimental program in WPEC meeting and results of thermal scattering in SG-42. Contributed to discussion in other SG meetings.
- Completed Ta experimental plan.
- Purchased Ta samples.

- Confirmed total scattering cross sections of ENDF/B-VIII.b4 for H₂O at raised temperatures are lower compared to ENDF/B-VII.1. The double differential scattering cross section for the two files agree relatively well with RPI experimental data (at 450 and 550K).
- Found total cross section of ice in ENDF/B-VIII.b4 to be approximately half of what was expected; comparison with experimental $S(Q,\omega)$ from SNS show good agreement with elastic peak but poorly in the inelastic region.
- Updated criticality benchmarks to test evaluations for CH₂a nd SiO₂, H₂O and Lucite, but found no usable benchmarks for Teflon in the desired energy range.

Training and Education (T&E)

LANL T&E

- Participated in regularly scheduled NCSP T&E conference calls.
- Support the ANS Young Members Group's organized DAF tour as part of the ANS 2017 Winter Conference held in Las Vegas, NV.
- Began responding to and resolving comments from observers from the NCSP's CSSG that attended different training classes in FY2016.
- Supported execution of the second week (NCERC) of the two week training for Criticality Safety Analysts.
- Preparations complete for ½-day, 1-day, & 2-day training on SU methods & Whisper, including hands-on computer use of MCNP6 & Whisper.
- The MCNP Criticality Class now includes ½-day session on SU methods & Whisper. Presented in August 2016 & April 2017.
- Scheduled MCNP Criticality class at PNNL in July, including SU methods & Whisper.
- Scheduled 1-day training at ORNL in August for SU methods & Whisper.
- Supported execution of the manager's class (NCERC).
- 1-day SU & Whisper training at ORNL on August 7 and at Y-12 on August 8 (collaboration with ORNL).

LLNL T&E

- Participated in regularly scheduled NCSP T&E conference calls.
- Support the ANS Young Members Group's organized DAF tour as part of the ANS 2017 Winter Conference held in Las Vegas, NV.
- Began responding to and resolving comments from observers from the NCSP's CSSG that attended different training classes in FY2016.
- Provided registration and logistics support for:
 - 1-week Managers course on Jan. 9-13 at SNL
 - 2-week CSE course on Jan. 3-Feb. 10 at NFO & NCERC/SNL
 - 1-week Managers course on June 19-23 at NCERC
 - 2-week CSE course on Aug. 14-25 at NATM & NCERC/SNL
 - 1-week Managers course on June 19-23, 2017 at NFO/NCERC
 - 2-week CSE course on Aug. 14-25, 2017
 - 2-week CSE course on Jan. 29-Feb. 9, 2018
 - 1-week Managers course on June 11-15, 2018 at NFO/NCERC
 - 2-week CSE course on Aug. 13-24, 2018
- Provided academic and hands-on instruction for the 2-week NCSE course at NFO/NCERC on Jan. 3-Feb. 10 including the following modules:
 - NCS Fundamentals
 - NCS Evaluations
 - NCSE Workshops 1-5
 - Introduction to Experimental Methods
 - TACS
- Provided academic and hands-on instruction for the 1-week Managers course at NFO/NCERC on June 19-23, 2017 including the following modules:
 - NCS Fundamentals

- NCS Evaluation
- Introduction to Experimental Methods
- TACS
- Demonstrated a simplified T&E subpage prototype under development at <https://ncsp-new-dev.llnl.gov> at the NCSP TPR on March 14, 2017.
- Created a new Emergency Response training module for the 2-week CSE course, which has been provided to Chris Haught (CNS) and Doug Bowen (NCSP) for review.
- Updated the Managers course materials for consistency with CSSG comments.
- Participated in all T&E teleconferences.

ORNL T&E

- Updated Student Information Booklets for the FY17 2-week hands-on course to include information about the National Atomic Testing Museum.
- NCSP T&EP coordinator executed the plan to resolve comments from the CSSG Tasking 2016-01 for a Review of the US DOE NCSP T&EP Hands-on Training and Education Course for Criticality Safety Professionals. Significant progress was made on the NFO course but limited progress made on NCERC and Sandia portions of the course.
- Developed draft NCSP T&E Course Procedure to standardize course registration, course materials/changes, logistics, and execution—feedback from CSSG Tasking 2016-01 will be incorporated into draft procedure prior to issuing procedure. The T&EP coordinator will be working with Becka Hudson (LLNL) to find a DAF and NFO badging coordinator to assist with student paperwork for these portions of the 2-week hands-on course.
- Initiated efforts to include two new instructors for the T&E courses: Bob Busch (UNM) and Chris Haught (Y-12) will support the Manager and Practitioner courses, respectively. Busch will teach two modules (Fundamentals and Process Accident Lessons learned) at the Sandia Manager Course. Haught will attend the 2-week Hands-on course as an observer in Feb. 2017 and will begin to teach/assist for the August Hands-on course.
- Coordinated execution of the Sandia Manager Course in Jan. 9-13, 2017 and 2-week Hands-on Course Jan. 30-Feb. 10, 2017.
- Participated as student, observer and instructor for the 1-week Manager Course in Jan. 2017.
- Continued execution on CSSG assessment report comment resolution plan (CSSG tasking 2016-01). (% CSSG 2016-01 comments resolved: NFO –75%, NCERC–47%, Sandia–29%, Overall–60%).
- Performed work on the NCSP T&E Course Procedure based on lessons learned from the Jan/Feb MGR and Hands-on courses, respectively, to standardize course registration, course materials/changes, logistics, and execution—feedback from CSSG Tasking 2016-01 incorporated into draft procedure prior to issuing procedure.
- Bob Busch and Chris Haught as T&EP instructors supported the Manager and Practitioner courses, respectively. Bob taught two modules (Fundamentals and Process Accident Lessons learned) at the Sandia Manager Course. Chris attended the 2-week Hands-on course as an observer in Feb. 2017 and will begin to teach/assist for the August 2017 Hands-on course.
- Completed the Sandia Manager Course in Jan. 9-13, 2017
- Completed the 2-week Hands-on Course Jan. 30-Feb. 10, 2017.
- Continued execution on CSSG assessment report comment resolution plan (CSSG tasking 2016-01). (% CSSG 2016-01 comments resolved: NFO –75%, NCERC–47%, Sandia–29%, Overall–60%).

- Completed the NCERC Manager Course in June 19-23, 2017.
- Completed coordination tasks for the 2-week Hands-on Course Aug. 14-25, 2017.
- Abstract submitted for the NCSD session “Recent Nuclear Criticality Safety Program Technical Accomplishments” at the ANS winter meeting.
- Initiated efforts with LANL to provide introductory 1-day S/U workshop training at Y-12 on August 8, 2017. Content based on LANL and ORNL training slides from the 2016 EFCOG meeting.

SNL T&E

- Delivered a Hands-On Managers training course in January, 2017.
- Provided HF&ER instructors to the classroom portion of a Hands-On criticality safety course for NCSEs in January/February, 2017.
- Delivered the experimental portion of a Hands-On criticality safety course in February, 2017 and August, 2017.

Y-12 T&E

- Observed NCSE training course in January.
- Met with course coordinator to discuss future support of class
- Reviewed draft of new emergency management module

NCSP TECHNICAL SUPPORT

NCSP TS2 Program MGT and Execution of the NCSP

- Prepared and maintain elements of NCSP Plan and associated activities:
- Monitor Five-Year Plan progress,
- Review/revise task list, and schedule/participate in meetings and teleconferences.
- Manage and provide oversight/coordinate efforts for the NCSP Information, Preservation, and Dissemination task element.
- Manage and provide oversight/coordinate efforts for the NCSP Training and Education Program task element.
- Cross-train for management team succession planning.
- Participated in several NCSP management team and other NCSP-related meetings, as required by the NCSP Manager.
- Monitored efforts for the NCSP International Collaborations with IRSN and AWE.
- Coordinated and executed ANS Winter Meeting NCSP session Best Papers.
- The NCSP MGT team attended the ANS Winter Meeting in Las Vegas, NV, Nov. 5-10, 2016.
- Completed and published IE FY17-21 Five-Year Plan.
- Prepared Q4 QPRs into a single bookmarked PDF file for use in QPR. Conducted Q4 telecon.
- The NCSP MGT team worked on designing and developing a new NCSP Quarterly Newsletter—Q1 Newsletter published Dec. 30, 2016.
- Developed new NCSP Organization Chart to reflect Jerry McKamy's departure and Angela Chambers as the new NCSP Manager.
- Initiated efforts to organize and solicit venue for the FY17 annual Budget Execution Meeting.
- D. Bowen hosted the NCSP Manager at Oak Ridge National Laboratory on March 30, 2017.
- D. Bowen and A. Chambers attended a KRUSTY status/budget meeting at Y12.
- Participated in several NCSP management team and other NCSP-related meetings, as required by the NCSP Manager.
- Monitored efforts for the NCSP International Collaborations with IRSN and AWE. D. Bowen attended collaboration meetings for the NCSP Manager March 14, 2017 at Forrestal for the DOE Office of Nuclear Energy and IRSN.
- Organized and conducted Technical Program Review meeting in Washington, DC, March 14-15, 2017. Selected best paper award winners for presentation at the ANS winter meeting. NCSP MGT team participated in the Analytical Methods Working Group and CEdT training meetings on Monday.
- Worked on collecting Five-Year Plan input from task managers.
- Prepared Q1 QPRs into a single bookmarked PDF file for use in QPR. Conducted Q1 telecon.
- The NCSP MGT team worked on designing and developing a new NCSP Quarterly Newsletter for client. NCSP FY17 Q1 Newsletter published April 18, 2017.
- Arranged a venue for the FY17 annual Budget Execution Meeting (National Atomic Testing Museum, Las Vegas, NV).
- Prepared pre-decisional task list for CSSG review and discussion at TPR in March 2017. Prepared proposals from FY17 and FY18 to assist the CSSG with their efforts to prioritize the pre-decisional task list.
- Redefined the process for tracking non-NCSP funded tasks to reduce costs and time tracking these.

- Monitored efforts for the NCSP International Collaborations with IRSN and AWE. D. Bowen and Angela Chambers conducted a telecon with IRSN for 5YP planning efforts on June 7, 2017.
- Worked on collecting Five-Year Plan input from task managers.
- Prepared Q2 QPRs into a single bookmarked PDF file for use in QPR. Conducted Q2 telecon.
- NCSP FY17 Summer newsletter in progress.
- Continued planning efforts for the FY17 annual Budget Execution Meeting (National Atomic Testing Museum, Las Vegas, NV).
- Modified pre-decisional task list for Angela Chamber's review for Budget Execution Meeting.
- Redefined the process for tracking non-NCSP funded tasks to reduce costs and time tracking these.

NCSP TS7 Succession Planning

- ORNL Post Doc working on Nuclear Data tasks with Doro Wiarda.
- ORNL junior R&D staff working with Luiz Leal on ND evaluation work.

NCSP TS8 NCSP MGT Tool

- Work on an initial prototype of a new NCSP Program Management Tool began in Q3. Prototype system expected by end of Q4 for the NCSP 5YP project management tools. Metrics capability will not be part of the prototype.

AM and ND

- Organized and conducted AM Working Group meeting on December 10, 2016 at the ANS Meeting in Las Vegas, NV
- Participated in NR/NCSP program review of the RPI accelerator modernization on December 14, 2016—met with NR staff about continued collaboration and resolution of DOE/SC sample lease issues.

IE:

- Managed and provided oversight/coordination of efforts for the NCSP IE task element.
- Processed IER approvals and BCRs for NCSP Manager.
- CEDT Coordinator and deputy CEDT lead developed process to track NCSP funded IERs, including how to work with the BCR process.
- Continued ongoing communication and collection efforts for foreign trip and WFO reports from task managers.
- NCSP management team attended the KiloPower Reactor Using Stirling Technology (KRUSTY) meeting in Washington DC, November 1-3, 2016.
- Prepared for an IER Meeting at Sandia National Laboratory on Apr. 6, 2017. Updated the status of all IERs in preparation for the meeting.
- Doug Bowen and Jamie Sweers worked a process to track NCSP-funded IERs, including how to work with the BCR process.
- Continued ongoing communication and collection efforts for foreign trip and WFO reports from task managers.
- NCSP management team attended the KiloPower Reactor Using Stirling Technology (KRUSTY) meeting in Washington DC, November 1-3, 2016. The NCSP MGT team participated in weekly KRUSTY telecons.

IP&D

- Worked with NCSP Website manager to develop a searchable database for easy retrieval of NCSP Products and WFO products.
- Continued work on revised NCSP website materials. IP&D Lead initiated annual NCSP website content review in Nov.

- Worked on compiling and organizing LANL Quarterly reports for fiscal years 2013-2016 for an NCERC audit being performed by the DOE Inspector General's office. CEDT Coordinator interfaced directly with the Inspector General staff on questions about the NCSP, CEDT process, and NCERC.
- Continued ongoing communication and collection of foreign trip reports from task managers.

T&E:

- Updated Student Information Booklets for the TEP manager courses on the NCSP website with updated logistical information.
- Began execution on CSSG assessment report comment resolution plan (CSSG tasking 2016-01). Continued development of an NCSP TEP course procedure. Plan to publish in FY17 Q1.
- Preparations began for the Sandia Manager Course in Jan. 9-13, 2017, and the 2-week Hands-on Course in Jan. 30-Feb. 10, 2017.
- Continued execution on CSSG assessment report comment resolution plan (CSSG tasking 2016-01). (% CSSG 2016-01 comments resolved: NFO –75%, NCERC–47%, Sandia–29%, Overall–60%).
- Continued work on the NCSP T&E Course Procedure based on lessons learned from the
- Jan/feb MGR and Hands-on courses, respectively, to standardize course registration, course materials/changes, logistics, and execution—feedback from CSSG Tasking 2016-01 will be incorporated into draft procedure prior to issuing procedure. The T&EP coordinator will be working with Becka Hudson to find a DAF and NFO badging coordinator to assist with student paperwork for these portions of the 2-week hands-on course.
- Preparations began for the NCERC Manager Course in Jun. 19-23, 2017, and the 2-week
- Hands-on Course in Aug. 14-25, 2017.
- ORNL Post Doc working on Nuclear Data tasks with Doro Wiarda
- The new experimenter is charged with the design, execution, and documentation of the titanium sleeve experiment in the BUCCX critical assembly.
- The new experimenter is charged with the design, execution, and documentation of the titanium sleeve experiment in the BUCCX critical assembly. The experiments will be done in the fourth quarter.

Criticality Safety Support Group (CSSG)

- CSSG Chair/Deputy duties.
- CSSG F-t-f (charged).
- ANS Winter attendance.
- Revise/review Membership Policy.
- CSSG conference call.
- Prep for NCSP Hands On Class review.
- TPR participation.
- CSSG Meeting at ANS
- Q2 data updated to reflect C. Hopper work on 2016-04
- Prepare/Review tasking's/responses (2015-02, 2016-04, 2016-05, 2017-01, 2017,02).

NCSP Activities and Accomplishments in FY17 Q4
Analytical Methods (AM)

LANL AM

MCNP

- MCNP Criticality class at PNNL, including sensitivity-uncertainty methods & Whisper.
- MCNP Criticality class at LANL.
- Issued report with full set of theory lectures used for Univ New Mexico Monte Carlo class.
- 1-day workshop at NCSU-2017 topical meeting on MCNP6 & SU methods & Whisper (on MCNP website).
- Presented talks at NCSU 2017:
 - Brown, Release of MCNP6.2 & Whisper-1.1 - Guidance for NCS Users.
 - Rising, Using Whisper-1.1 to Guide Improvements to Nuclear Data Evaluations.
 - Alwin, Investigations into Validation of Plutonium Solutions for Criticality Safety Analysis.
- 1-week visit by Univ Michigan Profs Martin & Kiedrowski with discussion of advanced MC & SU methods.
- Monte Carlo lectures to students at 2017 XCP Computational Physics Workshop
- Ongoing support:
 - LANL NCS & PF4
 - MCNP User Forum,
 - MCNP Reference Collection
 - MCNP website
 - email assistance to many users
- FY2016 Milestone, Carryover - COMPLETED:
Issued status report on MCNP 2020 initiative (LA-UR-17-28985).
- MCNP6.2/Whisper-1.1 was sent to RSICC, but has not yet been publicly released, pending completion of the detailed release notes & user manual. (NCSP-related work was finished long ago.)
- Expanded the set of ICSBEP benchmarks for MCNP6 and Whisper.

NJOY

- Resonance reconstruction
 - Resonance reconstruction capabilities exist for SLBW, MLBW, and Reich-Moore formats. We see *significant* speed ups over what is done in NJOY2016.
- Ongoing support
 - Github issues—formal requests for bug fixes and enhancements. Many of these are related to processing for ENDF/B-VIII.0.
 - email assistance to many users.
 - Chat forum.

LLNL AM

Analytical Methods

- LLNL hosted the ‘2017 ENDF Hackathon’ on August 21-25, 2017. The focus of this year’s Hackathon was fixing format errors using checking and processing codes, including testing covariance data. This effort is intended to expedite the process for inclusion of ENDF/B-VIII.0 nuclear data into application codes.
- LLNL also hosted a separate ‘Validation’ meeting on August 21, 2017.
- LFO and the LLNL SQA Manager performed an Internal Independent Assessment of the implementation of SQA activities and processes used in COG software development as 10CFR830 safety software for criticality safety applications. Only two deficiencies were identified pertaining to:
 - There is no Software Verification and Validation Plan or documented equivalency based on the RL3 institutional template.
 - Traceability of changes from developmental-level testing, to test cases, and results.

Multiphysics

- Thermal scattering law data is now available for use in LLNL multiphysics methods. Future development plans include delayed neutrons for validation using sub-prompt super-critical solution excursion data (e.g., CRAC, SILENE, TRACY).

Criticality Slide Rule

- LLNL presented the annual IRSN-LLNL-ORNL status report, *Introduction of Plutonium Systems to the Nuclear Criticality Slide Rule*, at the ANS NCS D Topical Meeting on September 14, 2017 at Carlsbad, NM.
- A video teleconference will be convened in October 2017 to discuss the third phase of the Slide Rule project.

ORNL AM

- RSICC activities: See rsicc.ornl.gov for monthly newsletters.
 - Distributed 1120 software packages and updated 4 software packages.
 - 400 SCALE, 418 MCNP®, and 1 COG packages distributed.
 - RSICC quarterly report issued.
- SCALE activities:
 - Answered 393 requests for user assistance through scalehelp@ornl.gov.
 - Since 2004, there have been over 12,800 distributions of SCALE to 8,200 unique users in 58 nations.
 - Since April 2016, the distribution centers have issued licenses for 3,119 copies of the latest SCALE version.
 - Held a one-day SCALE 6.2 Criticality Safety Calculations and Sensitivity/Uncertainty Methods for Criticality Safety Validation training course at the ANS Nuclear Criticality Safety Division (NCS D) Topical Meeting in Carlsbad, NM in September.
 - Presented 5 papers at the ANS NCS D Topical Meeting.
 - Hosted the first ever SCALE Users’ Group Workshop in September 2017.
 - There were 130 registered participants from NRC, DOE, national Laboratories, industry and academia.
 - The workshop included technical and tutorial sessions.
 - Technical tours of ORNL facilities were given.

- The full agenda with links to the presentations is available at <https://www.ornl.gov/scale/scale/2017-scale-users-group-workshop>.
- A series of photos from the workshop are available at <https://www.ornl.gov/scale/scale/2017-scale-users-group-workshop-photos>.
- **AMPX Maintenance and Modernization**
 - Participated in the ENDF “hackathon” to help correct some inconsistencies in the ENDF data libraries before the release of ENDF/B-VIII.0.
 - Processed ENDF/B-VIII- β 4 data files into a CE library, and ran the VALID suite. Data were presented at the ANS NCSD Topical Meeting.
 - Add preliminary coding into AMPX to allow to a new format for the fission nuclide distribution that will be used in some ENDF/B-VIII.0 data files.

Slide Rule Activities

- All work requested of ORNL by IRSN, who is leading the new slide rule developed, was completed. A summary of FY17 activities was presented at the 2017 NCSD topical meeting.

Integral Experiments (IE)

LANL IE

- Planet Operations with shipment
- N-Pod Certifications
- Godiva Operations for Y12 Criticality Accident Alarm Systems detectors
- RTO Operations
- Material Receipt
- CNEC RTO Measurements
- Comet Ops for JAEA
- CVT RTO Measurements
- Planet TEX
- NDSE support operations
- Godiva Operations, with shipment in September
- OPSIS Train-up
- Flattop Operations demo for Effectiveness Evaluation Team
- OPSIS II
- Planet Ops
- Comet Operations in preparation for KRD
- Beryllium work in support of KRD

We have spent a significant amount of time working to support KRD by doing calculations, creating drawings and critical lift plans, and preparing Commercial Grade Dedication documentation. There was a great deal of work that could not begin until everyone else was finished with their portions of the project. We will provide a roll-up of hours at the end of the project.

- Operator training occurred for new operators and proficiency was maintained for current operators when evolutions were executed using the assemblies in Q4.
- New candidate operators performed OJT as part of their initial certifications.
- Multiple Continuing training seminars were held to meet the DOE Training standards for certified operator positions.
- A measurement campaign to explore the “clustering” of fission chain phenomenon was executed at the RPI Reactor. IRSN participated in the measurement campaign.
- George Mckenzie completed measurements using Planet/Class foils in support of completing his Phd dissertation.
- Kim Klain presented “Simulated Rossi-Alpha Analysis of an Asymmetrically Coupled Bare Metal HEU Reactor System,” at the ANS 2017 Nuclear Criticality Safety Division Topical ; 2017-09-10 - 2017-09-15 ; Carlsbad, New Mexico, United States, LA-UR-17-22837.
- Participated in regularly scheduled project conference calls hosted by NASA.
- Participated in the comment resolution process for the KRUSTY safety basis addendum 100% review.
- Working with different safety management program SMEs to generate documentation to successfully execute KRUSTY experimental work in a safe and compliant manner.
- Working with NSTec/DAF facility personnel to coordinate execution of necessary facility modifications to successfully execute KRUSTY experimental work.
- Experiment plan for cold/warm critical experiments was reviewed and approved.
- A draft of the Full power demonstration experiment was created.
- Final walk through of equipment was executed at NASA Glenn in support of procedure development for operations at NCERC.

LLNL IE

- NCSP Manager approved International Intercomparison of Nuclear Accident Dosimetry at the DAF using Godiva. Final Reports from AWE, IRSN, LANL, LLNL, NDC and NNSY are available.
- Two criticals for 'Baseline Experiment No. 5' - Two criticals achieved for 'Baseline Experiment No. 4 - See Issues regarding scheduling of remaining experiments.
- NCSP Manager approved Int. Intercomparison Exercise for Nuclear Accident Dosimetry Using Flattop.
- LEMC and NCT/AWE Measurements campaign completed constituting the fourth and final week of three separate experimental campaigns in FY-2017.
- Samples taken from ISSA Subcritical Multiplicity Benchmark materials and chemical analyses in progress at LLNL to determine the impurities present in water, Lucite, polyethylene, Delrin, etc., in support of the ICSBEP benchmark.
- Y-12 CAAS Testing experiments were completed. CSAM 17-053, Criticality Accident Alarm Detector Testing at Godiva IV was completed.

NNSS IE

- Completed the development of the SB document for KRUSTY-DAF DSA, CN 2. SER received (1 COA, resolution submitted to NFO). No Readiness Review required. IVR to commence 10/16/2017.
- Submitted the 100% SB document for DAF DSA CN 3-MAR/TEX/Small Quantity, to include requirements of the Technical Direction Letter from NFO which added scope to this CN. SER expected early November. No Readiness Review required. IVR to follow.
- Managed engineering, procurement and construction tasks to support KRUSTY. Provided input to the NASA/KRUSTY schedule. Task exhaust, plate and gasket, LN hoses, O2 monitor install and facility engineering walk down remain to be completed, per NASA schedule. LN to support cold/warm critical experiments on hand.
- Formed an IPT for the Vault Modification Project for NCERC. Planning complete. Calculations prepared. Construction scheduled to commence.

SNL IE

- The capability and authorization of the Sandia Critical Experiments was maintained.
- Staff proficiencies were maintained by performing critical operations.
- The critical experiments were on-going through Q4 and completed in early October. A draft of the revised evaluation was circulated in mid-October.
- Preparations for the experiments are being made. Critical experiments are projected to start in FY18Q1.
- Staff participated in the review of the KRUSTY final DSA submission and issue of the SER.

Information Preservation and Dissemination (IPD)

LLNL IP&D

ICSBEP

- Meeting rooms reserved (and pre-paid) at George Washington University (GWU) in Washington, DC for the NCSP Manager to host the 2017 ICSBEP/IRPhEP meetings with official “sponsorship” from the GWU Department of Physics.
- LLNL provided ‘ICSBEP101’ training at DNFSB HQ.

Website and Red Net

- Converted the LLNL ‘Koponen’ Bibliography from ‘htdig’ to ‘Zoom’ search engine to provide Full-Text search capabilities.
- LLNL presented two papers on the LLNL ‘Koponen’ Bibliography at the ANS NCSD Topical Meeting in Carlsbad, NM, on September 12-13, 2013:
 - Seventy-Five Years of Nuclear Criticality Safety Documents–A Bibliography – Part I.
 - Seventy-FiveYearsofNuclearCriticalitySafetyDocuments–ABibliography– Part II – Online Links to Full-Text Documents.
- Completed website modernization design on <https://ncsp-new-dev.llnl.gov> behind the LLNL firewall.
- The websites ncsp.llnl.gov, ncsp-beta.llnl.gov and cog.llnl.gov were hardened to enforce ‘HTTPS’ and ‘Strong HSTS’ (HTTP Strict Transport Security) as mandated by the LLNL Cyber Security Program. Completed the annual archive of the (deployed) NCSP website content to LLNL LC long term storage.
- Updated NTS-LAN/NCERC classified network images and servers. Installed 694security patches on NCERC’s Microsoft Windows servers and workstations.

Nuclear Data (ND)

BNL ND

- Hackathon 21-25 Aug, 2017 @ LLNL
 - 12 participants from LLNL, LANL, BNL, ORNL and PSI
 - 138 commits, 783 evaluations modified
- ENDF/B-VIII.0 Beta4.1 released 3 Sep
 - Deuterium angular distributions
 - 235U, 238U, 239Pu(n,f) tweak from standards evaluation
 - Add Pt, Ne from TENDL
 - TENDL+EMPIRE project
 - Options for light water
- ENDF/B-VIII.0 Beta5 released 2 Oct
 - Covariance data added
 - Standards based 10B, 12C updated
 - Graphite troubles
 - P(nu) data added to 235U
- Last minute changes to ENDF-6 format: Caused late rewrite of a format and reworking of several evaluations
- All papers describing ENDF and CIELO releases are submitted and with referees

LANL ND

- Prompt Fission Gamma Spectra (PFGS) for U235, U238 and Pu239 have been finalized and included in the beta-5 release of the ENDF/B-VIII library. The gamma-ray multiplicity distributions $P(N_g; E_{inc})$ have also been evaluated based on CGMF calculations for incident neutron energies from thermal up to 20 MeV, using a new format developed for this quantity. We will try to incorporate the multiplicity-dependent PFGS in the files as well before the official release of the library. The CGMF-calculated PFGS get significantly softer as the gamma multiplicity is increased.
- New Prompt Fission Neutron Spectra (PFNS) for both U235 and Pu239 have been included into the beta-5 release of the ENDF/B-VIII library. The U235 PFNS makes use of chi-nu data, while the preliminary chi-nu data could only be used to validate the evaluated Pu239 PFNS a posteriori. A new evaluation for Pu239 PFNS will be performed in FY18 using all of Chi-Nu data (low- and high-energy), which should be available then.
- Covariance matrices were evaluated for both nuclei, and include for the first time more than one incident neutron energy covariance matrix. Cross-energy correlations could not be included in the library due to format limitations.
- A publication on the new prompt fission gamma-ray evaluations is in preparation. The most relevant results are being documented as part of the Special Issue of the Nuclear Data Sheets accompanying the release of the ENDF/B-VIII library.
- Note that NJOY patches have been developed to handle the new format for P(nu), P(nu_gamma), and multiplicity-dependent spectra. Last-minute changes to the format were discussed and informally accepted, leading to the need for last-minute efforts to develop a robust NJOY patch that can handle the new files. This work is still in progress, but is very close to being successfully handled.
- ENDF/B-VIII.0 data testing continues. We are keeping up with the beta releases and processing the data.

LLNL ND

Thermal Scattering Cross Sections

- NCSU completed updating the thermal scattering laws (Be, BeO, C (crystalline), C(nuclear), SiC, SiO₂, UO₂, UN, C₅H₈O₂, CH₂) which were contributed to ENDF/B-VIII.beta4. All libraries are now based on optimized a,b grids and enhanced elastic scattering models. This update is included in ENDF/B-VIII.beta5 (test) and ENDF/B-VIII.0 (production) releases. Additionally, a modified version of NJOY has been completed to enable independent testing and QA of the contributed TSL libraries.
- NCSU finalized the thermal scattering law library for heavy paraffinic oil. A modified version of NJOY2016 was created to treat viscous materials using a Langevin representation of the diffusional component of the TSL. Based on this, the TSL for hydrogen in oil was generated. In the process, it was discovered that NJOY2016 computes the diffusive S(a,b) onto a finer grid (before convoluting with the bound component) and has a hardwired default cutoff (10⁻⁷) that arbitrarily limits this computation. This can result in the exclusion of a significant portion of the diffusive component from the convolution. To address this issue, the cutoff value was set to 10⁻¹⁴–10⁻¹⁵. A cutoff for the number of b grid points in the convolution was increased to facilitate these changes.

Next Generation Codes

- NCSU finalized *FLASSH* beta2. This version has a phonon expansion algorithm that is much faster than in the previous version, temperature scaling for the α,β grid, an optimized automatic α,β gridding algorithm, and input error checks in *FLASSH* GUI. Several bugs have been fixed including: a compatibility bug between the GUI and the calculation kernel in relation to the Debye-Waller matrix; a bug related to the calculation of n-th phonon order of S(α,β); a bug in reading the DOS (with eal=0 option) and scatterer number choice; and a bug in the plotting window legend generation.

ORNL ND

Nuclear Data Measurement and Evaluation Work

- Resonance Evaluation for the Isotopes of Gadolinium in collaboration with IRSN.
 - The extension of the upper energy limit for the resolved resonance region based on evaluation of differential experimental data is underway.
 - Results of the integral experiments performed at the ZED-II reactor at CNL are being incorporated into the evaluation using the developed SAMINT methodology of systematically combining evaluation information from differential and integral experiments.
 - An initial attempt has been made to extend the SAMINT methodology to the evaluation of the unresolved resonance region to allow for the systematic incorporation of proprietary IRSN integral experiments with significant sensitivity to the isotopes of gadolinium. Through the NCSP collaboration with IRSN, the new gadolinium evaluations will be able to benefit from the information contained in proprietary IRSN integral benchmarks without the necessity to share the exact benchmark specifications.
- Travel to JRC-Geel in July to perform cross section measurements and data reductions.
- Start to access data situation of 233U.
- Start cross section production from sorted TOF data for Zr.
- Initiated sample production for a natural Lanthanum sample for TOF experiments at JRC-Geel.
- ORNL experiments at JRC-Geel for the NCSP:

- Continued thick natural Ce sample (^{140}Ce) neutron capture experiment. ^{140}Ce has a closed neutron shell and thus a very small capture cross section. The aim is to achieve better statistics with a thicker sample.
- Finalized data sorting for Zr neutron capture samples of different thickness.
- Resonance evaluation of set of Dysprosium isotopes.
 - Fit of recent experimental data measured by RPI as well as other found in the EXFOR library is in progress.
- Work on the ^{239}Pu covariance evaluation submitted and included ENDF/B-VIII.0 beta5. The evaluation is currently being tested.
- Work on ^{235}U covariance evaluation included in the ENDF/B-VIII.0 beta5. The evaluation is currently being tested.

Thermal Neutron Scattering Work

- Thermal neutron scattering kernel evaluation framework.
 - After a successful defense of his Ph.D. Thesis “Thermal Neutron Scattering Evaluation Framework” at the Georgia Institute of Technology on June 23, 2017, Christopher Chapman has invested some time into converting the ORNL’s evaluation framework into Python, improving his C++ skillset, and familiarizing himself with Path Integral Molecular Dynamics (PIMD). PIMD is an advanced *ab initio* method that accounts for quantum effects of nuclear scattering never before accounted for in any thermal scattering libraries. The plan is to use PIMD in FY2018 for evaluations of water and other hydrogenous materials for which quantum effects are known to be large.
 - A collaboration has been initiated with Gilles Noguere of CEA, France, and with Luiz Leal, IRSN, France to advance thermal neutron scattering measurements, modeling, and evaluations.
 - A collaboration has been initiated with Gilles Noguere of CEA, France, and with Luiz Leal, IRSN, France to advance thermal neutron scattering measurements, modeling, and evaluations.

ND6- SAMMY Modernization

- A novel application of Bayesian theorem to nuclear data evaluations has led to a conceptually new optimization scheme that applies equally to model parameters (e.g. R-matrix resonance parameters, integral benchmark experiment parameters) and to experimental data (e.g. nuclear cross sections, k_{eff} or other responses) for a simultaneous optimization of differential and integral benchmarks, in a way that may obviate the need for conventional data adjustment method. Furthermore, this is the first method designed to account for known model defects. These findings will be presented at the upcoming 4th edition of the International Workshop on Nuclear Data Covariances, 2017, organized by CEA Cadarache and NEA, Aix en Provence, France, in October 2 - 6 2017, and will be implemented in the modernized SAMMY.
- In an ongoing collaboration with Prof. Dean W. Halderson of Western Michigan University that was initiated in FY 2017 Q3 to enable accurate calculation of Dirac relativistic R-matrix formalism, it was determined that a better implementation of Coulomb functions than currently used by Prof. Halderson’s code is needed for computation in the Mega electron Volt (MeV) incoming neutron energy range. Consequently, a modern and licensed implementation by our collaborator Nicolas Michel (MSU) was proposed as a replacement implementation of Coulomb functions. With this improved implementation Dirac relativistic R-matrix will be made more suitable for modernized SAMMY code.
- Jinghua Feng (RPI) was a successful NESLS summer intern June 5- August 11, 2017, at the ORNL during which he has implemented several prototype versions of R-matrix resonance parameter fitting algorithms. In collaboration with Dorothea Wiarda and Andrew Holcomb these prototype algorithms are being converted into SAMMY modernized Application

Programing Interface (API) framework that will make them available to AMPX and SCALE developers.

RPI ND

- Completed Ta transmission measurement at 100m time-of-flight station, data analysis in progress.
- Completed Ta capture measurement at 45m time-of-flight station, data analysis in progress.
- Developed methodology to produce S(a,b) by integrating experiments from SNS with DFT calculations.
- Completed analysis and evaluation of Polyethylene.
- Completed analysis of quartz and ice.
- Completed analysis of double differential data and calculation with S(a,b) for concrete. ENDF/B-8b5 ice works best to approximate elastic scattering.
- RPI is negotiating a contract with the accelerator sections vendor.
- RPI is negotiating a 5th modulator with the vendor.
- A 6th Klystron to the PO with the vendor.

Training and Education (T&E)

LANL T&E

- Participated in regularly scheduled NCSP T&E conference calls.
- Supported execution of the Criticality Safety Practitioners class (NCERC).
- 1-day tutorial with ORNL on SU methods & Whisper, at Y-12.

LLNL T&E

- Provided registration and logistics support for:
 - 2-week CSE course on Aug. 14-25, 2017
 - 2-week CSE course on Jan. 29-Feb. 9, 2018
 - 1-week Managers course on April 15-20, 2018 at SNL
 - 1-week Managers course on June 11-15, 2018 at NFO/NCERC
 - 2-week CSE course on Aug. 13-24, 2018
- Provided academic and hands-on instruction for the 2-week CSE course at NATM/NCERC on August 14-25, 2017 including the following modules:
 - NCS Fundamentals
 - NCS Evaluation
 - Evaluation Workshops
 - Introduction to Experimental Methods
 - TACS
- Incorporated review comments from Chris Haught (CNS) into the new Emergency Response training module for the 2-week CSE course developed by Catherine Percher.
- Participated in all T&E teleconferences.

ORNL T&E

- Continued execution on CSSG assessment report comment resolution plan (CSSG tasking 2016-01). (% CSSG 2016-01 comments resolved: NFO –85%, NCERC–47%, Sandia–90%, Overall–70%).
- Completed the 2-week Hands-on Course in Las Vegas, Sandia and NCERC August 14-25, 2017.
- Conducted a lessons learned telecon to discuss the 2-week course, grades, and student feedback.
- Completed efforts with LANL to provide introductory 1-day S/U workshop training at Y-12 on August 8, 2017. Content based on LANL and ORNL training slides from the 2016 EFCOG meeting.

SNL T&E

- Delivered a Hands-On Managers training course.
- Provided HF&ER instructors to the classroom portion of a Hands-On criticality safety course for NCSEs.
- Delivered the experimental portion of a Hands-On criticality safety course for NCSEs.
- Provided HF&ER instructors to the NCERC Hands-On criticality safety course for Managers.
- We provided HF&ER instructors to the classroom portion of a Hands-On criticality safety course for NCSEs.
- Delivered the experimental portion of a Hands-On criticality safety course for NCSEs.
-

Y12 T&E

- Participated as an instructor in Week 1 of NCSP training

NCSP TECHNICAL SUPPORT

- Prepare and maintain elements of NCSP Plan and associated activities.
- Monitor Five-Year Plan progress.
- Review/revise task list.
- Schedule/participate in meetings and teleconferences.
- Manage and provide oversight/coordinate efforts for the NCSP Information, Preservation, and Dissemination task element.
- Manage and provide oversight/coordinate efforts for the NCSP Training and Education Program task element.
- Cross-train for current and succession planning.
- Participated in several NCSP management team and other NCSP-related meetings, as required by the NCSP Manager.
- Worked with NDAG Chair to schedule and conduct the Nuclear Data prioritization meeting held in late July 2017.
- Conducted a telecon with Tim Wynn (ORNL) and staff about replacing the current 5-year plan tools and implementing integral experiment metrics.
- Worked on collecting Five-Year Plan input from task managers.
- Prepared Q3 QPRs into a single bookmarked PDF file for use in QPR. Conducted Q3 telecon.
- Published NCSP FY17 Summer newsletter and fall newsletter is in progress.
- Conducted FY17 annual Budget Execution Meeting (National Atomic Testing Museum, Las Vegas, NV).
- Finalized FY18 task list following the Budget Execution Meeting.
- Redefined the process for tracking non-NCSP funded tasks to reduce costs and time tracking these.
- No work performed on tracking NCERC/DAF metrics this quarter. Doug Bowen and Lori Scott have discussed how to proceed with this NCSP Manager task.
- All BCRs for FY17 have been processed by CEdT Manager and a final IER status report was sent to the NCSP manager.
- The NCSP manager and execution manager made changes to the management team. Organization chart updated accordingly.
- NCSP management team attended and attended the NCSP topical meeting in Carlsbad, NM. The management team met as needed to conduct NCSP business.
- Main 5-year plan completed and uploaded to the NCSP website. IE portion of the plan is nearing completion.
- Participated in CSSG telecons.
- ORNL Post Doc working on Nuclear Data tasks with Doro Wiarda
- ORNL junior R&D staff working with Luiz Leal on ND evaluation work.
- Work on an initial prototype of a new NCSP Program Management Tool began in Q3. Prototype system planning continued in Q4 for the NCSP 5YP project management tools. Metrics capability will not be part of the prototype. The NCSP manager is considering adding the IER database to the G2 system. Planning for this is in progress.
- Matrixed employee who is being trained as an experimenter.
- The new experimenter is charged with the design, execution, and documentation of the titanium sleeve experiment in the BUCCX critical assembly. The experiments will be done in FY19.
- New version of FUDGE (version 4.2.2) includes BNL implementation of Blatt-Biedenharn formalism for computing angular distributions from resonance parameters. FUDGE-4.2.2 released June 21, 2017.
- Report on angular distributions in resonance region completed Sep 2017. D.A. Brown and J. Vega, "Scattering Angular Distributions in the ENDF/B Nuclear Data Library" Brookhaven

- National Laboratory Report BNL-114446-2017-IR (2017).
- Atlas of Neutron Resonances submitted to publisher July 10, 2017.

Criticality Safety Support Group (CSSG)

- CSSG Chair/Deputy duties
- CSSG conference calls
- Prepare/Review taskings/responses (2016-04, 2017-03)

NCSP 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 (SCR α P) 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-

Conferences and Topicals

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.

NCSP Technical Program Review 2017 – Washington, D.C.

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

R. Bahran, et. al, Progress on the Development of a Neutron Multiplication Measurement Protocol at a Reactor Critical Facility.

R. Sanchez, et.al., Kilowatt Reactor Using Stirling TechnologY (KRUSTY) Experiment Update. *(Best Paper Award)*

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

D. Hayes, Flattop Startup. *(Best Paper Award)*

M. Paris, Los Alamos Evaluation Work for ENDF/B-VIII Relevant to the NCSP.

M. Duluc, International Intercomparison Exercise for Nuclear Accident Dosimetry at the DAF using GODIVA-IV (IER148) – MCNP Dosimetry Calculations.

B.J. Marshall, KENO Validation for SCALE 6.2 Release.

M. Jessee, SCALE 6.2 and AMPX Development and Modernization for the NCSP.

F. Brown, et. al., MCNP Progress for NCSP.

F. Brown, LANL-SNL Collaboration for NCS Validation.

D. Heinrichs, Website Modernization. *(Best Paper Award)*

G. Keefer, Joint AWE-LLNL Subcritical Benchmarks and Training.

D. Hickman, 1st Nuclear Accident Dosimetry Exercise Using Godiva at NCERC.

T. Nelson, TEX-Hafnium Final Design.

C. Percher, BeRP Ball with Composite CH₂/Ni Reflector Final Design.

S. Watson, Validating Analytical Methods with MC-15 Measurements.

G. Harms, NCSP IE and T&EP Activities at Sandia.

D. Ames, IER-451 – Titanium Sleeve Experiments in the BUCCX.

L. Clark, FLATTOP - Passive Neutron Spectrometer.

V. Sobes, Progress in Resonance Evaluations of Ce and Gd for the NCSP. *(Best Paper Award)*

M. Pigni, ORNL Leading Improvements to 235U Evaluation that will Impact Modeling & Simulation for Nuclear Applications.

K. Guber, ORNL Cross Section Measurements in the Resolved Resonance Range for the NCSP. *(Best Paper Award)*

L. Leal, Nuclear Data Evaluation Work at IRSN in Support of the NCSP.

S. Kahler, ICSBEP Benchmark Data Testing to Support ENDF/B-VIII.0.

S. Kahler, NDAG Update.

Y. Danon, NCSP Related Nuclear Data Activity at RPI.

D. Brown, ENDF/B-VIII.0 is Coming Soon.

D. Bowen, Status of the NCSP Training and Education Courses.

J. Alwin, et. al, Using Whisper to Support Nuclear Criticality Safety Validation Meeting ANSI/ANS-8.24 Requirements and Recommendations.

A. Hawari, Progress of TSL Evaluations at NCSU.

A. Hawari, Development of a Next Generation TSL Code.

C. Chapman, Thermal Energy Scattering Evaluation Framework. *(Best Paper Award)*