NCSP Activities and Accomplishments in FY16

Analytical Methods (AM)

LANL AM

- Provided MCNP criticality class at Sandia National Laboratory (Nov 2015). 22 participants.
- Continued to provide training & assistance to LANL NCS division, including lectures, consultations, assistance with validation & reviews, etc.
- MCNP criticality user support by web site, MCNP Forum email, user email, & direct assistance.
- Presentation & paper on MCNP at ANS Winter Meeting, in NCSP Review session.
- Presentation & paper on criticality benchmarks at ANS Winter Meeting.
- LANL SME (Forrest Brown) received Technical Excellence award from ANS Nuclear Criticality Safety Division.
- MCNP6 team received Richard P. Feynman Innovation prize from the LANL Feynman Center for Innovation.
- Continuing work on MCNP 2020 - standards compliance, coding improvements, V&V, etc.
- Initial work on evaluating the use of explicit fission neutron multiplicity data in criticality calculations.
- Development of an analytic benchmark problem (with exact results) for the free-gas scattering thermal scattering model in continuous-energy physics.
- Completed initial release of temperature-dependent treatment of (alpha, beta) scattering in MCNP.
- Reported on NJOY status during CSEWG's Formats & Processing Committee session.
- Provided in house, domestic and international support to NJOY2012 users.
- Hosted a visit at Los Alamos by Tim Haeck of IRSN to collaborate on the development of nuclear-data processing tools and methods. Specifically this visit focused on checking tools for ACE formatted data.

NJOY21 Progress:

- Completed reading/parsing the cross section and angular distribution values of a neutron ACE table.
- Implemented interpolation capabilities throughout the code.
- Made our source code available on GitHub (http://github.lanl.gov/njoy) and have begun to use a variety of freely available tools for the continuous testing and verification of the code.
- Work continues on reading the energy distributions and photon production values of an ACE table.
- Presented progress and plans for NJOY21 at the NCSP Technical Program Review.
- Taught a class on using NJOY to generate ACE library files to 15 attendees.
- Provided NJOY user support.
- Beginning work on implementing covariance data in ACE files.
- Presented paper at 2016 ANS Annual Meeting regarding NJOY21.
- Visited IRSN for a week working to move forward the IRSN-LANL collaboration and to continue work on checking tools for the ACE-formatted data (XCP-5:16-030).
- Provided end-user support to domestic, international, and LANL users, including a two-day visit to BNL after the BEM to assist in upgrading their NJOY version.
- Continued to develop a code patch for a new ACE format that includes covariance data. Draft format for ACE covariance data has been finalized.
- Provided preliminary code patches to selected end-users (BNL and IRSN) for testing prior to formal code release.

- Visited IRSN following the ND2016 conference for a week and consulted on NJOY and benchmarking issues of common interest.

MCNP Code Work:

- MCNP6 & WHISPER code repositories & configuration management were converted from CVS to "git".
- Converted all WHISPER coding & scripts to portable versions that run on Linux, Macs, & Windows systems.
- Completely reworked & improved the MCNP Analytic K-effective Verification Suite (suite of verification problems where the EXACT results are known).
- Completed V&V testing of MCNP6.1, MCNP6.1.1, MCNP6.2 (pre-release) with analytic Keff suite & 2 validation suites of ICSBEP problems. No issues, correct results. (Report is in progress).
- Issued documentation on V&V testing of MCNP6.1, MCNP6.1.1, MCNP6.2 (pre-release):
- Verification of MCNP6.1, MCNP6.1.1, and MCNP6.2-pre for Criticality Safety Applications, F.B. Brown & M.E. Rising, LA-UR-16-24308.
- New Version of the MCNP Analytic Criticality Benchmark Suite, F.B. Brown, LA-UR-16-24254.
- The MCNP6 Analytic Criticality Benchmark Suite, F.B. Brown, LA-UR-16-24254.
- New Tools to Prepare ACE Cross-section Files for MCNP Analytic Test Problems, F.B. Brown, LA-UR-16-24290.
- Distribution of Whisper package to DOE criticality safety groups:
- The benchmark suite of 1101 ICSBEP problems have been given (on request) to 5 places.
- The Whisper package with benchmarks was given to the criticality safety group at Sandia National Laboratory and is operational there. This constitutes "friendly testing", with early feedback. Some additional documentation is being prepared, but the Whisper package is ready for distribution to other DOE sites (on request).
- Assisting with preparation for the release of MCNP6.2:
- Continued testing for criticality safety V&V suites using MCNP6.2.
- Fixed bug in coincident surface treatment for universe fills with rotations.
- Extended the limit on MCNP input line length from 80 to 128 characters.
- Updated MCNP Reference Collection.
- Testing with latest versions of Intel & gcc/fortran compilers.
- Examining changes needed for nuclear data to be included with MCNP6.2 release.

MCNP User Support and Training:

- Continued to provide training & assistance to LANL NCS division. Lectures, consultations, assistance with validation & reviews, etc.
- MCNP criticality class at LANL, introduced new 1/2 day session on validation using MCNP6 & Whisper.
- Criticality user support by web site, MCNP Forum email, user email, & direct assistance.
- Developed training lectures for LANL NCS group: Lecture Notes on Criticality Safety Validation using MCNP & Whisper, LA-UR-16-21659.
- Developed training lectures for 1/2 day short course on validation: Lecture Notes on Sensitivity-Uncertainty Based Nuclear Criticality Validation.
- Reproducing LA-10860-MS critical-mass curves using MCNP6 and Whisper to compare critical-mass with USL-mass at varying plutonium concentrations.
- Reproducing LA-UR-07-0160 to compare k-effective results for a moderated cubic array of plutonium pieces with Whisper USL.

- Conducted 2 half-day training classes at LANL for NCS Division: Sensitivity-Uncertainty Based Nuclear Criticality Validation.
- MCNP criticality class at LANL, with new 1/2 day session on validation using MCNP6 and Whisper.
- Continued to provide training and assistance to LANL NCS division. Lectures, consultations, assistance with validation and reviews, etc.
- Criticality user support by web site, MCNP Forum email, user email, and direct assistance.
- Conducted a 2-day workshop at the EFCOG-2016 meeting: Sensitivity-Uncertainty Based Nuclear Criticality Validation.
- MCNP criticality class at LANL, with new 1/2 day session on validation using MCNP6 & Whisper.
- 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.
- Presented University of New Mexico, NE Department colloquium on Sensitivity-Uncertainty Based Nuclear Criticality Validation.
- Submitted a paper on Whisper to the ANS Mathematics & Computation 2017 conference.
- Scheduled presentations at the NECDC-2016 meeting, (1) to introduce Whisper methodology to the weapons code developers, and (2) to present findings to date on fission multiplicity in criticality calculations.

MCNP International Collaboration:

- Visited IRSN in Paris, France, June 29 – July 4. Exchanged technical information on MCNP-Whisper, sensitivity-uncertainty methods, MCNP calculations, etc. A trip report will be provided soon.
- 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. A trip report will be provided soon.

MCNP R&D Progress:

- Continuing to improve & consolidate the fission neutron multiplicity capabilities in MCNP6 (CGMF, Freya, LLNL).
- Assisting the LANL nuclear data work, testing early versions of ENDF/B-VIII-beta nuclear data files.
- Investigating improved method for modeling plutonium solution, including considerations for oxidation state, complexation (speciation), and density.
- Presentations at the NCSP Technical Program Review on MCNP Status and Fission Neutron Multiplicity.
- Papers for PHYSOR-2016 meeting.
- Fission neutron multiplicity in MCNP6 criticality calculations, LA-UR-15-26822.
- An analytic benchmark of neutron free-gas scattering using continuous-energy cross-sections in MCNP6, LA-UR-16-20361.
- Investigating improved method for modeling plutonium solution, including considerations for oxidation state, complexation (speciation), and density. Paper submitted to ANS Winter meeting.
- Complexation of Pu (IV) Nitrate in Aqueous Solution and Considerations for Criticality Safety Analysis; J.A. Alwin, W.J. Crooks, A. Salazar-Crockett, F.B. Brown, M.E. Rising, LA-UR-16-24462.

- Presented papers at PHYSOR-2016 on multiplicity, analytic free-gas benchmark, temperature dependence, and unresolved resonance methods.
- Reproducing LA-10860-MS critical-mass curves using MCNP6 and Whisper to compare critical-mass with USL-mass at varying plutonium concentrations.
- Reproducing LA-UR-07-0160 to compare k-effective results for a moderated cubic array of plutonium pieces with Whisper USL.
- Continuing to improve and consolidate the fission neutron multiplicity capabilities in MCNP6 (CGMF - LANL, Freya - LLNL).
- Assisting the LANL nuclear data work, testing early versions of ENDF/B-VIII-beta nuclear data files.
- Co-authored (with ORNL and Michigan) a summary submitted to the ANS Winter Meeting: Adjoint-Based Sensitivity and Uncertainty Analysis for Density and Composition: A User's Guide; J.A. Favorite, B.C. Kiedrowski, and C.M. Perfetti.
- Ongoing investigation of improved method for modeling plutonium solution, including considerations for oxidation state, complexation (speciation), and density.
- Issued LA-UR-16-27371: JL Alwin & N Zhang, "Plutonium Critical Mass Curve Comparison to Mass at Upper Subcritical Limit (USL) Using Whisper".
- Reproducing LA-UR-07-0160 to compare k-effective results for a moderated cubic array of plutonium pieces with Whisper USL.
- Continuing to improve & consolidate the fission neutron multiplicity capabilities in MCNP6 (CGMF, Freya, LLNL).
- Collaborating with SNL criticality safety on the use of Whisper. Comparing results for ICSBEP benchmark models - 1101 from LANL vs. 866 from SNL.
- Summer intern (Pavel Grechanuk) worked on implementing 20 new analytic benchmarks for MCNP verification. This work will be incorporated into the MCNP V&V suites and will be submitted to an upcoming ANS meeting.

LLNL AM

- Presented LLNL-PRES-678496, Testing a new thermal scattering law for $C_5H_8O_2$ (Tradenames: Lucite, Plexiglas, Perspex), at the NDAG meeting at BNL on November 4, 2015.
- Performed a literature review and identified integral data for testing a new thermal scattering law developed by BAPL for ice at -20, -45, -65 and -85 °C (AM1, ND2).
- Commenced ISQAP activities for compliance with NAP-24A, Weapon Quality Policy.
- Assisting Red Cullen (IAEA) in independent testing of PREPRO generated multi-band parameters as an equivalent alternative to the NJOY probability tables using existing ACE format requiring no changes to COG or MCNP. Preliminary results are available from IAEA at: https://www-nds.iaea.org/publications/indc/indc-nds-0701.pdf.
- Reviewing POI implementation in COG, MCNP and MERCURY.
- Metaphysics simulations continue in support of the KRUSTY critical experiments and reactor design.
- Participated in refining the instructions and specifications in the document Update of the Nuclear Criticality Slide Rule Calculations, Initial Configurations. Completed COG11.2 calculations at all distances for prompt neutrons, prompt photons, and delayed photons at 10, 50, 100, 500 and 1000 minutes.
- Participated in the NCSP Analytical Methods Working Group Meeting convened on March 14, 2016 at SNL.
- Installed COG11.1 on LANL SB-CS HPC ml-fey1.lanl.gov server using REDHAT LINUX on March 17, 2016. Recommended hardware/software additions for improved performance.

Provided introductory training to LANL criticality safety users and provided LLNL HEU and PU benchmark reports with 503 input decks.

- LLNL-ABS-680629, A Solid of Revolution Time Study using COG11.1 and MCNP6.1 was accepted for publication in the transactions and presentation at the ANS Annual Meeting in New Orleans.
- Implemented the BAPL thermal scattering law for ice in COG11.1 as thermal neutron library T.HZIce. FUDGE used to Doppler-broaden H and O cross sections to create COG neutron libraries ICE.188K, ICE.208K, ICE.228K and ICE.253K. Provided the results of COG11.1 calculations to BAPL for neutron pulse die-away experiments in ice at -20, -45, -65 and -85 °C.
- Implemented POI (SNIP) in COG11.2 and commenced testing using analytical and code benchmarks.
- Metaphysics simulations continue in support of the KRUSTY (IER-299) critical experiments and reactor design.
- Assisted IRSN as co-author of Update of the Nuclear Criticality Slide Rule for the Emergency Response to a Nuclear Criticality Accident for publication and presentation at ICSR-13/RPSD-2016.
- Provided COG11.1 total neutron and prompt and delayed fission gamma (DFG) results to IRSN for inclusion in their Update of the Nuclear Criticality Slide Rule for Emergency Response to a Nuclear Criticality Accident, which they presented at the NCSP TPR on March 16, 2016 at SNL.
- Provided COG11.1 to AWE and LANL and assisted with installation, verification and usage on their HPC machines.
- Provided COG11.1 libraries to Bettis containing their thermal scattering law data for solid water (ice, H_2O) at 188, 208, 220 and 253 °K. Also generated and provided Bettis the corresponding point-wise (continuous) cross-section libraries at these temperatures using the LLNL FUDGE data processing code and sample COG input decks simulating time-dependent pulse die-away experiments.
- Presented LLNL-PRES-694811, A Solid of Revolution Time Study using COG11.1 and MCNP6.1, on June 14, 2016 at the American Nuclear Society Annual Meeting in New Orleans, LA.
- Implemented a new "IMAGE" detector as a standard (internal) COG11.2 user feature based on an (external) user-specified detector feature originally developed by Dr. Jim Hall (LLNL). The output from this IMAGE detector is designed for compatibility with Image freeware developed by the National Institutes of Health.
- LLNL internal review of multiphysics simulation results in support of the KRUSTY (IER-299) critical experiments and reactor design completed in April.
- Provided COG11.1 total neutron and prompt and delayed fission gamma (DFG) results to IRSN for case 1 (uranyl fluoride solution, 4.95% ^{235}U) and case 4 (uranium metal, 93.2% ^{235}U) in air-over-ground geometry for 10 times at 15 distances for inclusion in the Update of the Nuclear Criticality Slide Rule for the Emergency Response to a Nuclear Criticality Accident and for presentation at ICSR-13/RPSD-2016.
- Assisting IAEA with independent (COG) testing of probability table data for the unresolved resonance region derived from equivalent multi-band (PREPRO) data using URR-PACK. Completed 25 of the 32 test cases from INDC (NDS)-0711, Rev. 1.
- Updated the thermal scattering law data library T.NCSU.ACE to include new data from Hawari (NCSU) for beryllium and oxygen bound in beryllium oxide.

Multiphysics

- A draft report for KRUSTY (IER-299) severe reactivity insertion analysis using multiphysics methods has been submitted for internal LLNL review.
- Initial multiphysics calculations of the Army Pulse Radiation Facility Reactor (APRFR) have been completed showing reasonable agreement with experiments. The path forward is to add damage models with an aim to simulate.

Criticality Slide Rule

- Provided COG11.1 total neutron and prompt and delayed fission gamma (DFG) results to IRSN for air-over-ground geometry for all five fissile systems at 10 times and 15 distances included in the Update of the Nuclear Criticality Slide Rule for the Emergency Response to a Nuclear Criticality Accident. This paper is published in the ICRS-13/RPSD-2016 conference proceedings and provided to the NCSP Manager completing the milestone for an annual IRSN-LLNL-ORNL status report on Sliderule development.

ORNL AM

- **RSICC activities: See rsicc.ornl.gov for monthly newsletters.**
- Distributed 794 software packages and updated 3 software packages.
- 84 SCALE, 338 MCNP, and 2 COG packages distributed.
- Distributed 965 software packages and updated 2 software packages.
- 146 SCALE, 548 MCNP, and 3 COG packages distributed.
- Distributed 1108 software packages and updated 4 software packages.
- 390 SCALE, 310 MCNP, and 8 COG packages distributed.
- RSICC quarterly reports issued.
- Distributed 1192 software packages and updated 4 software packages.
- 257 SCALE, 394 MCNP, and 7 COG packages distributed.
- RSICC quarterly report issued.

SCALE activities:

- Deployed SCALE 6.2 Beta5, including the new Fulcrum user interface, updated continuous-energy TSUNAMI capabilities, and improved installation procedures.
- Issued SCALE Annual Report.
- Continued V&V activities for SCALE 6.2, especially with VALID benchmark suite based on ~400 ICSBEP experiments.
- Scheduled 4 weeks of SCALE training at ORNL and 2 weeks at OECD/NEA Data Bank.
- Answered 214 requests for user assistance through scalehelp@ornl.gov
- 6 weeks of training: 4 at ORNL and 2 at OECD/NEA Data Bank.
- Finalized code modifications for SCALE 6.2 release for deployment in early Q3, including enhancements to TSUNAMI and Fulcrum GUI based on training feedback.
- Finalized and streamlined SCALE 6.2 manual documentation. The manual will be publically available and has been reduced from 4900 to 2700 pages and is no-longer export controlled document.
- Answered 169 requests for user assistance through scalehelp@ornl.gov
- Deployed SCALE 6.2. Available from RSICC, NEA Data Bank, and RIST center in Japan. 528 distributions in 2 months.
- 48th edition of SCALE Newsletter published in April, highlighting SCALE 6.2 features and capabilities.
- Answered 215 requests for user assistance through scalehelp@ornl.gov
- Deployed SCALE 6.2.1 update that implemented several enhancements to the Fulcrum Graphical user interface, corrected an issue on Windows system were extremely complex

KENO calculations would fail to run with a memory error, and implemented several minor bug fixes that are not safety related. (http://scale.ornl.gov/downloads_scale6-2.shtml).
- Answered 218 requests for user assistance through scalehelp@ornl.gov
- Participated in OECD/NEA WPNCS and Expert Group meetings on Advanced Monte Carlo Techniques (AMCT) and Uncertainty Analysis for Criticality Safety Assessment (UACSA).

AMPX Maintenance and Modernization:
- Delivered AMPX modernization status report at the annual CSEWG meeting.
- Updated the nubar data in the CE libraries for SCALE 6.2 library to not thin the data, but use unchanged ENDF data instead.
- Updated cross covariance data in the SCALE 6.2 covariance library.
- Performed final testing on covariance libraries and CE libraries for SCALE 6.2.
- Completed modernization of PUFF covariance processing module—allows use of updated ENDF reading routines, new resonance API and new in-memory covariance data memory resource.
- Finalized AMPX code package and manual for release with SCALE 6.2 package in Q3.
- Identified and investigated difference between MCNP and CE KENO eigenvalue calculations for systems sensitive to unresolved resonance region—presented initial findings to NCSP AM WG.
- Draft AMPX annual report completed and will be submitted to NCSP Manager in Q3.
- Participated in WPEC meetings to develop new ENDF Format.
- Implemented preliminary reading/processing of new ENDF/GND Format for covariance matrices—will facilitate assessment/improvements new GND format.
- Modernization of AMPX/POLIDENT resonance reconstruction capability—can read ENDF data using new ENDF reading routines and resolved and unresolved resonance parameters are processed using the new resonance processing classes.
- Modernization of POLIDENT module to produce continuous-energy (CE) data:
- Finalize combine functions to combine CE data from resolved and unresolved point-data with point-data given in ENDF.
- Expanded key-word based user input.
- Functionality of module to produce CE data for depletion folded into POLIDENT.
- Testing of libraries produced with the new POLIDENT started.
- Participated in IAEA Consultants Meeting (CM) to develop the new, modern ENDF/B Format and presented status of AMPX modernization efforts to process the new ENDF/B format.

SILENE Benchmark Analysis.
- Completed SCALE and MCNP simulations needed for the SILENE pulse 1 and 2 draft evaluations—draft evaluations submitted to CeDT and ICSBEP for final review (ICSBEP review meeting held in April 2016).
- Provided 3 AM presentations during March 2016 TPR and participated in NCSP AM WG Meeting in conjunction with TPR.
- ORNL performed simulations with SCALE 6.2 that duplicate the simulations performed for the 1997 Slide Rule. These results were provided to IRSN along with example input files that highlight differences between 6.1 and 6.2.
- IRSN, LLNL, and ORNL published a paper summarizing some of our work in FY16 on revising the SlideRule at the 13th International Conference on Radiation Shielding (Paris, France, October 3-6, 2016).

Integral Experiments (IE)

LANL IE

- Operator training occurred for new operators and proficiency was maintained for current operators when evolutions were executed using the assemblies in all quarters.
- Much effort and resources were utilized for completing the Godiva IV restart plan.
- Some initial dynamic simulation studies were performed to investigate the basic characteristics for a burst reactor design.
- Papers of interest were presented at the 2015 ANS Winter Meeting hosted in Washington, DC:
    - J. Hutchinson, B. Richard, T. Cutler, A. Sood, M. Smith-Nelson, "Tungsten-Reflected Subcritical Measurements."
    - J. Hutchinson, M. Smith-Nelson, A. Sood, R. Sanchez, D. Hayes, T. Cutler, "Neutron Noise Measurements on HEU Foils Moderated by Lucite."
    - George E. McKenzie, Travis J. Grove, William L. Myers, Rene G. Sanchez, "Reactivity Worth Studies Associated with a Rossi-alpha Measurement System."
- A preliminary Flattop-25 detailed model and uncertainty analysis have been completed.
- A punch list for Flattop is being generated with information that could be contributing to the to the preliminary detailed model uncertainties.
- Participated in regularly scheduled project conference calls hosted by NASA.
- Have been providing feedback and support to NCERC safety basis team for KRUSTY project.
- Have been working with NASA and the lead LANL designer to provide a cross check of the dynamic nuclear performance of the design that will feed into development of the experiment final design by having developed methods for analyzing the following:
    - Reactivity feedback coefficient for temperature.
    - Radial flux profile.
    - Nuclear kinetics equations with reactivity insertions and temperature feedback.
    - Thermal hydraulic model for heat removal and effective feedback to core temperature.
    - Time dependent system simulation for complete loop of core and heat removal from startup to steady-state.
    - Candidate transfer functions for stability analysis.
- Planet Ops.
- Godiva Restart, Top Hat and AFS.
- Comet Ops.
- Critical Assembly quarterly maintenance:
    - Flat-Top Ops.
    - NCSP Class.
    - MC-15.
    - NPOD Certifications.
    - SSS Annual Surveillance.
    - MC&A Inventory Support.
    - HEPA Testing.
    - Papers of interest were presented at the 2016 NCSP TPR hosted at Sandia in Albuquerque:
        - J. Goda, "Evaluation of Engineering Controls Implemented to Mitigate Godiva Contamination."

- J. Goda, “Use of Comet to Support Development of the Design Basis for JAEA’s Transmutation Physics Experiments Facility (TEF-P).”
- J. Favorite, “Preliminary Flattop-25 Reevaluation Results.”
- J. Hutchinson, “Subcritical Benchmark of the BeRP Ball Reflected by Tungsten.”
- J. Hutchinson, “Uncertainty as a Function of Time for Subcritical Experiment Parameters.”
- B. Margevicius, “Material Consideration for Burst Reactor Design.”
- T. Cutler, “Final Critical Experiment Design to Measure the Fission Neutron Spectrum Shape Using Threshold Activation Detectors.”

- Revised an internal report describing the status of the Oy-Flattop evaluation (LA-UR-15-29961).
- Presented the current status of Oy-Flattop at the NCSP TPR (LA-UR-16-21646).
- Submitted a summary on Oy-Flattop to the American Nuclear Society Annual meeting (New Orleans, June 12-16, 2016), and the summary was accepted.
- Prepared a dynamic system simulation of the KRUSTY experiment including the HEU fuel core and heat pipes thermal model to describe the time evolution to steady-state of the system and reaction to normal and off normal events that effect reactivity. Model is a set of coupled non-linear differential equations describing nuclear kinetics and thermal hydraulics of the system.
- Used the set of coupled equations from the KRUSTY simulation model, together with model results at steady-state, to prepare open and closed loop transfer functions for the system. These transfer functions were used to generate linear stability plots including Nyquist, Bode amplitude and phase, and Nichols graphs.
- Presented an update of this work at the NCSP TPR.
- S.Klein, “Dynamics and Stability Analysis for the Kilowatt Reactor Using Stirling Technology (KRUSTY) Experiment.”
- Supported the EA-31 reactor assessment in June. Draft report is at NFO for review. During this time period, we hired two R&D 1 Engineers – very pleased with level of talent. In May we had the following tour group visit NCERC: Cheryl Cabbil, LANL AD-NHHO, two new DNFSB Board members, and NE-75 executives.
- Hosted senior NASA leadership associated with the Krusty project.
- Operations for preparation and execution of the International Dosimetry Intercomparison occurred the weeks of May 16 and May 23.
- Summary of burst diagnostic data available as LA-UR-16-24787, Godiva Burst Data.

Presentations

- J. A. Arthur, R. Bahran, J. Hutchinson, A. Sood, S Pozzi "Advanced Critical and Subcritical Neutron Multiplication Measurements for Nuclear Data and Computational Methods Validation." Raleigh, NC: University and Industry Technical Interchange, 2016 (poster). LA-UR-16-23909.
- J. A. Arthur, R. Bahran, J. Hutchinson, M. Rising, S. Pozzi "Comparison of the Performance of Various Correlated Fission Multiplicity Monte J. A. Arthur, R. Bahran, J. Hutchinson, A. Sood, S Pozzi "Advanced Critical and Subcritical Neutron Multiplication Measurements for Nuclear Data and Computational Methods Validation." Raleigh, NC: University and Industry Technical Interchange, 2016 (poster). LA-UR-16-23909.
- J. A. Arthur, R. Bahran, J. Hutchinson, M. Rising, S. Pozzi "Comparison of the Performance of Various Correlated Fission Multiplicity Monte.

- ANS Winter Meeting 2016, Jeffrey A. Favorite, Brian C. Kiedrowski, and Christopher M. Perfetti, "Adjoint-Based Sensitivity and Uncertainty Analysis for Density and Composition: A User's Guide," Transactions of the American Nuclear Society, 115, submitted (2016). Favorite has begun writing a journal article based on this summary.
- Participated in regularly scheduled project conference calls hosted by NASA.
- Have been providing feedback and support to NCERC safety basis team for KRUSTY project.
- A draft of the CED-2 document has been created which is awaiting results from the electrically heated system tests to if see further changes to the final design are required.
- Began the planning process for putting together multiple experiment plans to execute a phased approach for obtaining the required data for enabling a successful full power demonstration at NCERC.

LLNL IE

- Participated in a VTC and a meeting at AWE to hone conceptual design.
- Presented Design of Two New Critical Experiments at the ANS Winter Meeting in Washington, DC.
- Completed all procurements and fabrication activities, and completed (TEX) experimental plan (with Rene Sanchez) for submittal to LANL Reactor Safety Committee and NCERC.
- Completed (BeRP/Composite) Final Design Report and submitted it to the C_EdT for review and concurrence.
- Investigating facilities for absolute calibration of the detector using ^{252}Cf and mono-energetic beams for Godiva-IV yield determinations.
- Reviewed IRSN models and scoping calculations.
- Completed the (TEX-Hf) Preliminary Design Report and submitted to the C_EdT for review and concurrence. IRSN provided MCNP6 CE S/U calculational results.
- Presented preliminary results of reactivity insertion accident analysis including k-eff, α, yield and POI calculations for (KRUSTY) at a joint NASA/NNSA meeting at the UC Washington Center on October 27-28, 2015.
- Completed the Report for the ISSA Subcritical Multiplicity Benchmark and distributed it to CEDT Members for review and comment.
- Convened two video teleconferences with IRSN to continue detailed discussions.
- NCSP Manager approved completion of (NAD Godiva Exercise).
- Completed Preliminary Design for (TEX-Hf) and presented TEX-Hf Preliminary Design at the NCSP Technical Program Review at SNL in Albuquerque, NM.
- Internal LLNL review of (KRUSTY) preliminary results scheduled for April 2016.
- NCSP Manager approved completion of (Cf-252 Reference Field Benchmark) Preliminary Design. Assisted AWE and IRSN in performing PNS and BGO measurements, respectively.
- NCSP Manager approved completion of (ISSA Subcritical Multiplicity Benchmark) Preliminary Design.
- In collaboration with AWE and SNL, LLNL completed Godiva radiation field characterization measurements using the Passive Neuron Spectrometer and CaF2 TLDs. NCSP Manger approved CED-3b and initiated CED-4a.
- LLNL completed Experiment Execution the weeks of May 16 and May 23, 2016 as described in LLNL-ABS-695558, International Intercomparison Exercise for Nuclear Accident Dosimetry at the DAF Using Godiva-IV: Summary of Experiment Execution.

- LLNL CEdT Lead (Percher) and LANL Experiment member (Sanchez) resolved the few outstanding issues and completed the IER-203 (BeRP/Composite) Final Design (CED-2) Report. CEdT Lead requested NCSP Manager to approve CED-2 completion and CED-3a initiation.
- LLNL convened a meeting on May 27, 2016 to plan for Characterization of the Flattop radiation field, with AWE, IRSN and SNL. AWE agreed to document these plans in support of Experiment Execution in FY-2017.
- Continuing to participate with IRSN in preliminary design of (TEX-MOX) using aluminum, alumina and borated polyethylene to create intermediate spectrum experiments, which appear to be feasible. Reviewed the paper preliminary sign of the TEX-MOX criticality experimental program using optimization algorithms implemented in the IRSN PROMETHEE tool, which has been submitted to the ANS Winter Meeting in Las Vegas.
- LLNL met at IRSN for PROMETHEE training and to utilize this software for multi-parameter preliminary design and optimization calculations. This approach was efficient and succeeded in identifying a set of feasible critical configurations using U-233 oxide ZPPR plates with intermediate spectra.
- LLNL completed a detailed simulation model in support of Final Design for Cf-252 Reference Field Benchmark. Incorporating the AWE PNS into the model is in progress.
- Completed fabrication of a new Lucite support structure for the ISSA Subcritical Multiplicity Benchmark.
- NCSP Manager approved (Benchmarking Multiplication Calculations with Neutron Multiplicity Measurements) Experiment Execution (CED-3b) and Publication (CED-4a) on October 6, 2016. LLNL-TR-703914, C_EdT Summary Report, provides the details of the measurements of the TACS shells inside a steel shell within a 5-inch thick reflector of low-Z simulant with two MC-15 detectors; and, provides a comparison of measured results to MCNPX calculated results. In FY-2017, LLNL plans to continue this effort with new measurements as (V&V of 4 Corners of Detection/Theory Capabilities).
- A (CED-4a) report containing (Godiva NAD Exercise) preliminary results is in internal review. Final (CED-4b) reports from the exercise participants are in preparation.
- NCSP Manager approved (BeRP/Composite) Final Design on July 29, 2016. Major procurements are on hold. See Issues/Path Forward.
- LLNL completed a one-week (CED-3b) measurement campaign in support of the Nuclear Threat Reduction Program, which consisted of background measurements and calibration testing of various instruments, and culminated in a blind discovery and analysis performance exercise of 3 LLNL RTOs. Detailed analysis of the data will occur over FY-2017 and inform future exercises.
- LLNL foil irradiation successfully completed as an add-on to (NCT #2) in June 2016. A draft (CED-4a) report has been prepared, and is available upon request.
- LLNL completed a draft Final Design (CED-2) Report for (TEX: Jemima Plates with Hafnium) and submitted a BCR revising the CED-2 milestone completion date to FY-2017 Q2 to provide additional time for internal and external reviewer.
- LLNL completed characterization of the U-233 oxide ZPPR plates with additional information received from ISOTEK and completed a detailed high fidelity model for (TEX-23) Preliminary Design (CED-1).
- LLNL completed preliminary calculations of neutron fluence, spectrum and dose using a detailed, high fidelity model of the Cf-252 radiation field within B255 at LLNL Site 200 in support of IER-406 (Cf-252 Reference Field Benchmark) Final Design (CED-2). The calculational results are being evaluated by comparison to AWE and LLNL

measurements using the PNS and ROSPEC, respectively. The model has been provided to AWE for further analysis and refinement.

- Completed drawings of the new Lucite support structure for the ISSA Subcritical Multiplicity Benchmark and the Final Design Report is under review.

NNSS IE

- Provided support to the Godiva Restart effort.
- Provided resources to support the LANL Bioassay program.
- Provided input to the NCSP 5 Year Plan.
- Coordinated the development of the Safety Basis schedule and cost estimate for KRUSTY.
- Coordinated the development of the Safety Basis cost estimate and schedule for Change Notice 3 (MAR/TEX/Small Quantity).
- Submitted NNSS/NSTec FY 2015 Accomplishments.
- NCSP/NCERC Experiment Support:
  - Planet Ops.
  - Comet Ops.
  - Godiva Ops.
  - Instrument Set up.
  - Comet Maintenance.
  - Material Moves.
  - NCT/TACS

Non-NCSP 1st Quarter efforts:

Note: The following non-NCSP expenditures are not included in the Budget totals:

- (Comet Operations).
- (Advanced Testing).
- Godiva successfully restarted.
- Provided resources to support the LANL Bioassay program.
- Received NFO approval of the Safety Basis Strategy and began development of the 90% SB document for KRUSTY-DAF DSA CN 2.
- Began development of the Safety Basis Strategy for DAF DSA CN 3-MAR/TEX/Small Quantity.

Non-NCSP 2nd Quarter efforts:

Note: The following non-NCSP expenditures are not included in the Budget totals:

- (Godiva SLFPY, LLNL Hot Operations).
- (Material Move & Comet Operations).
- (MC-15 Characterization).
- (Comet Operations).
- Provided resources to support the LANL Bioassay program.
- Continued the development of the 90% SB document for KRUSTY-DAF DSA CN 2.
- Received approval of the Safety Basis Strategy for DAF DSA CN 3-MAR/TEX/Small Quantity. Began development of the 90% SB document.
- Provided monthly input for non-NCSP (WFO) work products.
- Began engineering tasks to support KRUSTY.
- Developed and submitted the NNSS portion of the NCSP 5 Year Plan.

Non-NCSP 3rd Quarter efforts:

Note: The following non-NCSP expenditures are not included in the Budget totals:

- (FlatTop Operations).
- (5) (Comet Operations).
- (Measurements).
- (Radiography).
- Provided resources to support the LANL Bioassay program.
- Continued the development of the 90% SB document for KRUSTY-DAF DSA CN 2.
- Continued the development of the 90% SB document for DAF DSA CN 3-MAR/TEX/Small Quantity. Internal comment resolution of 90% document conducted. Ready for submittal to NFO.
- Provided monthly input for non-NCSP (WFO) work products.
- Formed an IPT to manage engineering tasks to support KRUSTY.
- Attended the BEM. Finalized FY 17 NCSP budget for NNSS.

Non-NCSP 4th Quarter efforts:

Note: The following non-NCSP expenditures are not included in the Budget totals:

- (Support NCSP NCT-LLNL).
- (Comet Operations, Comet LEU, Comet JAEA).
- (CNEC Measurements).
- (CVT Measurements)).
- (5) (Advanced Testing, RTO Build).
- (ER Class).
- (Godiva Operations).
- (Planet Operations).
- (NA-22 Measurements).
- (NEN Intern Support).

ORNL IE

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.
- A benchmark evaluation, LEU-COMP-THERM-097 was prepared and submitted for ICSBEP review.
- Rod-replacement experiments.
- Sandia participated in the LANL CESC annual review.
- We are beginning to support the NFO SBRT for KRUSTY.

Information Preservation and Dissemination (IPD)

LLNL IP&D

ICSBEP Accomplishments

- NCSP evaluations in progress for the next ICSBEP-IRPhEP meeting scheduled the week of April 18-22, 2016 at OECD NEA include:
- 7uPCX with Ti rods and sleeves by Harms (SNL).
- SILENE CAAS Benchmark Parts 2 and 3 by Miller (ORNL).
- BeRP/W by Hutchinson (LANL).
- Flattop by Favorite (LANL).
- JEZEBEL (rev. 4) by Favorite (LANL).
- Presented LLNL-PROC-672875, "New NCSP Contributions to ICSBEP and DICE," with Ian Hill (OECD) at the ANS Winter Meeting in Washington, DC.
- 100 (September 2015 edition) ICSBEP DVDs received from OECD NEA (Dyrda) on January 4, 2016, and 63 copies forwarded to previous NCSP requestors.
- The following five draft NCSP evaluations were submitted to ICSBEP for review by the TRG at the annual meeting at OECD NEA HQ on April 18-22, 2016:
- 7uPCX with Ti rods and sleeves (LCT097) by Harms (SNL).
- SILENE Pulse 2 (ALARM-TRAN-PB-SHIELD-001) by Miller (ORNL).
- SILENE Pulse 3 (ALARM-TRAN-CH2-SHIELD-001) by Miller (ORNL).
- BeRP/W (FUND-NCERC-PU-HE3-MULT-002) by Hutchinson (LANL).
- JEZEBEL (PU-MET-FAST-001, Rev. 4) by Favorite (LANL).
- The status these evaluations were presented at the NCSP TPR at SNL on March 15-16, 2016 in addition to the presentations "ICSBEP Accomplishments" by Heinrichs (LLNL) and "Preliminary Flattop-25 Reevaluation Results" by Favorite (LANL).
- Angela Chambers has commenced work on an ICSBEP evaluation for HEU class foils moderated/reflected by Lucite as confirmed by Hayes (LANL).
- The following NCSP evaluations were submitted to the ICSBEP-IRPhEP TRG meeting on April 18-22, 2016 and were approved for (CED-4b) publication pending satisfactory resolution of review comments:
- 7uPCX with Ti rods and sleeves by Harms (SNL).
- SILENE CAAS Benchmark Parts 2 and 3 by Miller (ORNL).
- BeRP/W (IER-160) by Hutchinson (LANL).
- JEZEBEL (rev. 4) by Favorite (LANL).
- Provided LLNL-MI-704079, Report of Foreign Travel to Paris, France, to the NCSP Manager summarizing participation in the ICSBEP TRG Meeting and documenting (CED-4b) completion of the following NCSP evaluations:
- LEU-COMP-THERM-097 (IER-285) 7uPCX with Ti rods/sleeves by Harms (SNL).
- ALARM-TRAN-PB-SHIELD-001 and ALARM-TRAN-CH2-SHIELD-001. SILENE CAAS Benchmark by Miller (ORNL).
- FUND-NCERC-PU-HE3-MULT-002, (IER-160) BeRP/W by Hutchinson (LANL).
- JEZEBEL (rev. 4) by Favorite (LANL).

Website and Red Net Accomplishments

- (a) Converted Joe Thomas 2007 Interview DVD to adobe flash video and posted on NCSP website; (b) revamped Hands-on T&E registration, course information, flyers, and class pictures webpages; and (c) created new NCSP Foreign Trip Reports webpages for FY2013, FY2014 and FY2015.
- Installed Red Hat Linux kernel critical patches and changed security posture to block on-going hacks attempts from IP addresses that were originated from China.
- Completed deployment of OpenAM interoperability SSO on classified NCSP webserver.

- Added new approved user accounts to the LANL "Red" network in support of IER-307.
- Worked with NERC to (a) identify, approve for use, and procure a new system to display critical information on a wall mounted TV in the control room; (b) install a new unclassified PC in the control room; and (c) installed a new LANL critical key control lock box in a control room.
- Provided IT support for the annual NCSP Budget Execution Meeting on July 26-28, 2016 at the University of California Washington Center, Washington, DC.
- Modified website program logic granting Angela Chambers NCSP Manager privileges on all IERs in the CEDT database.
- Created and deployed webpages containing FY2016 NCSP foreign travel trip reports.
- Patched unclassified and classified NCSP webservers' BIND and Firefox security vulnerabilities.
- Updated the NCERC classified network images to ensure the latest Microsoft patches were installed as required to avoid vulnerabilities found and published by Microsoft.
- Provided "authenticated" scans for NCERC network devices to LANL as part of new monthly "Continuous Monitoring" requirement. Received a final excellent review from the management assessment of the NTS-LNL system for "Continuous Monitoring" and operation of NTS-LAN.
- Deployed six 1G TACLANES to the LANL network replacing obsolete 1A models.
- Reserved UC Washington Center auditorium for the NCSP Technical Program Review (TPR) scheduled for March 14-17, 2017.

Searchable Database Accomplishments

Attended 2015 ANS Winter Meeting and participated in ANS discussions on website modernization / new database / TEP website / 5YP simplification.

- Created "NCSP Foreign Trip Reports" web section and uploaded & posted 32 trip reports from LLNL, ORNL, and RPI.
- Added additional nine new CEdT users for access to Integral Experiments Requests.
- Created the "Non-NCSP Work for Others Products at NCERC" web page and posted 32 NCERC Non-NCSP Work Products' forms.
- Deployed new "NCSP Annual Technical Program Review Meeting" and posted meeting agenda & travel logistics.
- Revamped NCSP CS Support Groups web pages and added CSSG tasking & responses 2015-03, 2015-4, and 2016-02.
- Attended NCSP Annual Technical Program Review meeting at Sandia National Laboratories, March 15-16, 2016, Albuquerque, NM.
- Updated NCERC classified computers network images with the latest Microsoft patches.
- Provided NCERC escort support for IER-281 and implemented external storage NAS to provide "off-site" backup of all control room data files.
- Created an NCSP FY2016 TPR webpage and posted all 42 presentations.
- Extracted and delivered NCSP webserver and system security logs to LLNL SAFE Office to assist in an investigation of hack attempts on NCSP website.
- Updated the NCSP webpages (a) adding four new FY 2017 NCSP T&E course dates; (b) three CSSG periodic telecom minutes; and (c) two CSSG tasking's.
- Installed NCSP webserver OS kernel bug fix, and openssl and Firefox security updates.
- Traveled to LANL for meeting with LANL cyber and network/infrastructure personnel to resolve REDNET issues with NTS-LAN communication with LANL.
- Resolved Mac and PC Wi-Fi connectivity issues at the NNSS.
- Provided classified IT support at DAF and Mercury.
- Received and deployed two 1G TACLANEs in support of the LLNL SRD network.

- Created http://ncsp-new-dev.llnl.gov behind the LLNL firewall to expedite prototyping and http://ncsp-new.llnl.gov which is public to expedite NCSP Management reviews. Completed prototypes of a new top-level NCSP webpage and subpages for Analytic Methods, Nuclear Data, CSSG and CSCT.

Searchable Database Accomplishments

Ready to develop a searchable database using either (a) internal resources or (b) LLNL institutional resources such as https://myconfluence.llnl.gov/display/DMT using Oracle SQL Server or MySQL database technologies.

SRS IP&D

- Prepared revised FY-16 Plan.
- Resources to support program revision have been identified/retained.
- Began drafting the following 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

- Minor systems maintenance on ADVANCE server
- Developed "svnhooks" that will reject evaluations if they do not meet most basic checks (correct linefeeds, no tab characters, etc.). Will be deployed to production GForge server in Q2.
- Released ENDF/B-VIII.β0 prior to Mini-CSEWG meeting in Apr. 2016. This release contained the first version of all CIELO files except ^{235}U.
- Released ENDF/B-VIII.β1 just following Mini-CSEWG meeting in Apr. 2016. This release contains the CIELO ^{235}U file as well as minor iron isotopes from BNL and isotopic carbon evaluations from LANL.
- Major upgrades to ADVANCE software: integration of new INTER, addition of GROUPIE, one of the codes in PREPRO2015, and major upgrades to Fudge.
- Preparing for the next beta release, ENDF/B-VIII.β2, due mid-August.
    - Deployed new version of ADVANCE to production server.
    - Released ENDF/B-VIII.β2 on 19 Aug. 2016.
    - Preparing for the next beta release, ENDF/B-VIII.β3, due Oct. 31, 2016.

LANL ND

- Co-59: Initial screening of available experimental data was done, and re-normalization of some experimental data was performed by using updated standards or nuclear structure data. Evaluations for total and capture cross sections were done. Evaluations for other reaction channels are underway. Nuclear reaction model calculations have been performed.
- Chaired annual NDAG meeting (during BNL "Nuclear Data Week").
- Appointed to represent NCSP interests as a member of Romano's Nuclear Data Working Group (have the lead to develop a 5-year roadmap of "covariance's evaluation and testing" needs and will contribute to other committees as appropriate).
- Chaired CSEWG Data Validation Committee session.
- At CSEWG, reported on LANL data testing to support CIELO and next generation ENDF.
- Served as Chair for the IAEA's Consultant's Meeting on "New Evaluated Data File Processing Capabilities."
- Added the capture cross section to the n+13C evaluation so that there would be some measure of the radioactive14C buildup arising from natural carbon.
- Kahler presented two talks at the NCSP Technical Program Review:
    - "NDAG and Nuclear Data Working Group Update"
    - "Data Testing CIELO Evaluations with ICSBEP Benchmarks"
- We have performed prompt fission gamma-ray spectrum calculations for U-235 and Pu-239 isotopes up to 20 MeV incident neutron energy. We have also calculated the time-dependence of the prompt gamma-ray data in the nanosecond to microsecond time-since-fission window. Preliminary results were presented at the NCSP Technical Program at Sandia National Laboratory (LA-UR-16-21797). A more in-depth publication is in progress. We are now working on assembling ENDF-formatted files for both isotopes, as well as on an extension to the current ENDF format for including multiplicity-dependent spectra and gamma-ray multiplicity distributions.
- Statistical model calculations for Co59 were performed, and model parameters were tuned to reproduce available experimental data. The final optimization of the (n, p), (n, alpha), and (n, 2n) channels is underway.

- Elastic scattering angular distributions of Pb208 were reconstructed from the resolved resonance parameters, and stored in the evaluated file. We have investigated the capture gamma-rays in the current evaluated file as well as an earlier version.
- A complete n+16) evaluation was submitted for the CIELO project that has also been included in the ENDF/B-VIII – beta1 file set. Detailed relative covariance for the cross sections are included at energies up to 20 MeV. The evaluation has performed well in preliminary data testing.
- Organized the data testing session at the spring mini-CSEWG meeting.
- Reported on LANL data testing supporting CUIELO and preliminary ENDF/B-VIII.0 at mini-CSEWG and at WPEC.
- New elastic scattering angular distributions for PB208 in the resonance region were tested against the double-differential cross section data from RPI. Measured neutron yields were well reproduced by the updated angular distributions up to 1 MeV. Further investigation of the angular distributions above 1 MeV is ongoing.
- Modeling of actinide neutron inelastic scattering in the fast energy range was improved by including the scattering matrix diagonalization technique. A Phys. Rev. C paper was published on this subject, and the results were applied to major actinides.
- A complete new evaluation for oxygen up to 150 Med as an ENDF/B-VIII.0 beta evaluation and as a CIELO candidate. Data testing with this and other new actinide evaluations gives benchmark results that are at least as good (and in some cases better) than ENDF/B-VII.1.
- A new evaluation for Co-59 was finalized and submitted to NNDC.
- New elastic scattering angular distributions for Pb-208 in the resonance region were re-evaluated and compared with the RPI semi-integral data. There still are issues in the higher-energy region and we plan to continue to work on this problem.
- The NDAG Chair attended the FY17 BEM and contributed to updating the 5-Year Plan. He also reviewed selected IER submittals.
- Attended the ND2016 conference and gave an invited paper on processing and criticality benchmark testing of ENDF/B-VIII.0 beta files.
- We have finalized the CGMF calculations of the prompt fission gamma-ray spectra for U235, U238 and Pu239 from thermal up to 20 MeV. They contain the gamma multiplicity-dependent spectra, which are being formatted into an extended ENDF section (this extended format must be accepted by CSEWG). Because of recent changes in the U235 and U238 files proposed by the IAEA for ENDF/B-VIII.0_beta2, we need to revisit the total (n, g) production sections to be compatible with our new PFG evaluations. This work is still in progress.
- We also report progress on prompt fission neutron spectrum (PFNS) work:
- U-235: Chi-Nu provided preliminary low-energy data recently (Sep. 2016), which were promptly integrated into a preliminary ENDF/B-VIII.0_beta3 proposed file. The Chi-Nu data lowered slightly the average PFN energy for the thermal point. The new evaluation does not contain the high-energy data from Chi-Nu, which have yet to be finalized. We are working closely with the Chi-Nu team to update our evaluation efforts. The high-incident neutron energy evaluation contains a proper accounting of the multi-chance fission and neutron pre-equilibrium processes, which were not tackled properly in ENDF/B-VII.
- Pu-239: A new evaluation is being included in the ENDF/B-VIII.0 beta3 library. It is based on an extended Madland-Nix model, and makes use of all experimental data sets available at present. Many past experiments were either rejected or uncertainties revisited thanks to extensive MCNP simulation efforts by the Chi-Nu team. Chi-Nu recently acquired preliminary low-energy data for Pu239, which is being analyzed. More data will be taken in FY17, but will not impact the ENDF/B-VIII library.

LLNL ND

- The thermal neutron scattering data evaluation for Lucite ($C_5O_2H_8$) was generated in ENDF-6 File 7 and ACE format and submitted to NNDC as reported in the QPR for FY2015Q3 completing this milestone five quarters in advance of the schedule in Appendix B.
- Progress continued towards finalizing the models and analysis of thermal neutron scattering in polyethylene (CH_2). The interplanar constraint (previously reported) and its effect on the polyethylene density of states were further tested. Generation of the thermal scattering law in ENDF-6 File 7 format is on track for early completion.
- Three presentations were made to the Nuclear Data Advisory Group (NDAG) on November 4, 2015 on the recommended path forward for thermal scattering law data generation:
- Thermal Scattering Law Data Generation and Validation in the 21st Century, Ayman I. Hawari (NCSU).
- Testing a new thermal scattering law for $C_5H_8O_2$ (Trade- names: Lucite, Plexiglas, Perspex), Dave Heinrichs (LLNL).
- Thermal Neutron Scattering Research – Bettis Perspective, Michael L. Zerkle (BAPL).
- Analysis of Thermal Neutron Scattering in Polymethyl Methacrylate (Lucite) was presented by Ayman Hawari at the ANS Winter Meeting on November 11, 2015 detailing the Lucite TSL work and describing the progress to date on polyethylene.
- The thermal neutron scattering data evaluation for polyethylene (CH_2) was generated in ENDF-6 File 7 and ACE formats.
- The paper Analysis of Neutron Thermalization in Polymethyl Methacrylate and Polyethylene Polymers was submitted for presentation September 11-16, 2016 at the International Conference on Nuclear Data for Science and Technology (ND2016).
- A video presentation was prepared for the NCSP TPR meeting on March 15-16, 2016 in Albuquerque, NM. This presentation detailed the progress to date in development of new thermal scattering cross sections and next generation codes.
- NCSU received signed Standard Research Subcontract No. B615702 from the LLNS Contract Administrator on March 17, 2017.

Thermal Scattering Cross Sections

- Prof. Ayman Hawari elected Monitor of WPEC SG42 on Thermal Scattering S (α, β): Measurement, Evaluation and Application.
- NCSU thermal neutron scattering data for polyethylene (CH_2) was generated in ENDF-6 File 7 and ACE formats at several temperatures and provided to Bettis and LLNL for testing.
- NCSU initiated work for production of the TSL for heavy paraffinic oils. An MD supercell (100 $C_{33}H_{68}$ molecules) was set up. Simulations under NPT conditions (P = 1 atm, T = 300 K) yield density within 5% of measured values.
- LLNL provided COG11.1 to Bettis laboratory with libraries implementing their new thermal scattering law data for solid water (ice, H_2O) at 188, 208, 228 and 253 °K. LLNL also generated and provided the corresponding point-wise (continuous) cross-section libraries at these temperatures for hydrogen (H) and oxygen (O) using FUDGE. LLNL also provided sample input decks simulating available time-dependent pulse die-away integral experiments.
- The paper Development of a Thermal Neutron Scattering Law for Polyethylene Using Molecular Dynamics Simulations was submitted for presentation November 6-10, 2016 at the American Nuclear Society Winter Meeting in Las Vegas.

Next Generation Codes

- NCSU continued development of the "next generation" TSL code. The generalized elastic scattering module was completed and is under testing. The inelastic scattering module

(incoherent approximation) was completed. A generalized coherent inelastic scattering (1-phonon) module is in advanced development stage.

ORNL ND

- Data reduction to cross sections of ORNL measurements at IRMM:
  - Natural cerium (Ce) neutron transmission data for 10mm sample obtained with the boron, tungsten, and cobalt background filters were reduced to transmission.
  - Evaluated resonance parameter files for the Ce isotopes—obtained from ENDF library and developed SAMMY input files including all experimental effects.
  - Tested capture and transmission data for natural Ce.
  - Natural Ce data are ready for evaluation phase.
  - Order 30 mg enriched ^{142}Ce sample and shipped to RPI for activation measurements. in order to investigate level of activation under new DOE lease policy.
  - Determined resolution function of old Ca total cross section data from ORELA in order to be included in the evaluation process.
  - Travel in March/April to IRMM to resume data analysis tasks and experiments after refurbishment of the south flight stations.
  - Travel in June/July to IRMM to continue experiments and perform data reduction tasks.
  - Vanadium (V) thick sample neutron experiments completed and thin V sample neutron capture data reduced to cross-section data.
  - Transmission experiment using a natural Zr sample was started.
- Presented ORNL measurements at the CSEWG meeting at BNL in November.
- ^{40}Ca Evaluation
  - Resonance parameters extended up to 1.5 MeV.
  - Analysis performed on thermal cross sections for each reaction channel.
  - 8 experimental data sets selected and included in the evaluation procedure: 5 transmission data, 2 capture cross sections, and 1 set of data for angular distribution (3 angles).
  - Performed work on covariance evaluation including the resonance parameters but also uncertainties related to each experimental data set.
  - Performed work on level spacing and strength functions to test the statistical consistency of the resonance parameters.
- Validation of tungsten evaluations
  - Validation work on the Grenoble Lead Slowing Down (LSD) benchmarks performed in collaboration with EC-JRC IRMM—analysis showed an improved agreement with the experimental response of the LSD benchmarks when ORNL tungsten evaluations are included in the ENDF/B-VII.1 library. Abstract submitted to ND2016.
- ^{63,65}Cu Resolved Resonance Region Evaluations
  - Developed a physics based methodology to reduce the memory footprint of the angular distribution (ENDF File 4) while maintaining a high degree of physical fidelity and ensuring consistent integral benchmark performance.
- Coupled Differential and Integral Nuclear Data Evaluation
  - Developed a methodology in the SAMINT computer code to compute isotope-isotope- correlations resulting from proper statistical treatment of the nuclear data adjustment process.
- Thermal scattering evaluation capability development:
  - GA Tech graduate student and ORNL intern outlined the thermal neutron scattering kernel evaluation framework at the SNS/HFIR User Group Meeting, October 26-27, 2015, SNS, ORNL, Oak Ridge, TN.

- Drastically improved agreement between simulations and the measured thermal scattering cross sections has been achieved after correcting a bug in a third-party molecular dynamics trajectory processing code nMOLDYN that is used in this project.
- Several quantum corrections to classical molecular dynamics simulations have been implemented for an improved agreement with the data.
- ORNL experiments at IRMM and RPI for the NCSP:
    - Traveled to IRMM to resume data reduction tasks for previous measurements and complete vanadium measurements after flight station refurbishments in 2015.
    - Compared measured cerium (Ce) data from IRMM with ENDF/B-VII.1—discrepancies identified with current evaluation and attributed to errors in WPEC SG 23 evaluation that needs to be corrected in new evaluation.
    - In effort to comply with new DOE/SC isotope lease policy, performed activation measurements on enriched 30 mg ^{142}Ce sample at RPI to determine activation level relative to requirements—no activation detected and will now procure enriched ^{142}Ce sample and perform measurements.
    - Travel in September to JRC-Geel to continue experiments and perform data reduction tasks.
    - Initiated data sorting for thick V-sample capture measurements.
    - Thick V sample transmission factors produced.
    - Transmission experiment using natural Zr sample started.
    - Different Zr samples evaluated for use in the experiments for transmission and capture.
    - Performed neutron activation calculation for an enriched ^{142}Ce-oxide sample with SCALE/ORIGEN to assess compliance with new DOE/SC Isotope Lease policy.
- Performed data assessment of latest strontium (Sr) evaluation and compared with available experimental data—new measurements likely not needed but new evaluation needed to provide consistent covariance data with resonance evaluation.
- Provided 5 ORNL ND presentations at TPR in March 2016.
- ^{40}Ca Evaluation—completed evaluation with covariance data.
    - GIT repository created to store all SAMMY files and related ENDF evaluation.
    - Resonance parameters extended up to 1.5 MeV.
    - Analysis performed on thermal cross sections for each open reaction channel—evaluation includes 5 channels.
    - 7 experimental data sets selected and included in the evaluation procedure: 5 transmission, 2 capture cross sections.1 set of data for angular distribution (3 angles) compared to theory but not included in the fitting procedure.
    - Completed covariance evaluation including resonance parameters but also uncertainties related to each experimental data set.
    - Performed analysis of level spacing and strength functions to test statistical consistency of the resonance parameters.
- ^{235}U evaluation
    - Work on resonance parameters up to 100 eV was performed within the OECD/NEA WPEC CIELO collaboration—focused effort to improve resonance parameters to restore benchmark performance for ^{235}U solutions by combining changes to resonance parameters with prompt resonance ν-bar below 100 eV.
    - Abstract on the work performed up to 100 eV submitted to the ND2016 conference—accepted for full contribution. Work on ^{235}U resonance parameters up to 100 eV performed within WPEC CIELO collaboration— in collaboration with IAEA the benchmark performance for ^{235}U solutions by combining changes to resonance parameters with prompt resonance ν-bar below 100 eV was restored.

- Evaluation work on ^{235}U presented for the mini-CSEWG at Los Alamos National Laboratory (April 11-12).
- Evaluation work on ^{235}U presented for the Consultants' Meeting on ^{235}U evaluation at the IAEA (May 24-27).
- Work on ^{235}U resonance parameters up to 100 eV performed within WPEC CIELO collaboration— in collaboration with IAEA the benchmark performance for ^{235}U solutions by combining changes to resonance parameters with prompt resonance ν-bar below 100 eV was restored.
- Evaluation work on ^{235}U presented at ND2016—initiated development of paper for conference proceedings.

- Ce and Gd Evaluations
  - Gathered background material, reviewed previous evaluations, and collected experimental data.
  - Started evaluation of new Ce experimental measurements Continued work on Ce and Gd Evaluations.
  - Established a path of coordination and cooperation with Leal/IRSN on Gd Evaluations.
  - Continued evaluation work on Ce and Gd Evaluations.
- ^{63,65}Cu Evaluations: updated covariance evaluation based on recent improvements in resonance evaluation.
- Thermal scattering evaluation capability development:
  - GA Tech graduate student and ORNL intern successfully defended Ph.D. Thesis proposal for thermal neutron scattering kernel evaluation framework at Ga Tech, March 30, 2016, Atlanta, GA with Michael E. Dunn and Goran Arbanas as members of the Ph.D. Thesis Committee.
  - Obtained Spallation Neutron Source SEQUOIA detector resolution function for double differential cross-section data at several incoming neutron energies in the thermal range to improve evaluation.
  - Markedly improved agreement between simulations and measured thermal scattering cross sections has been achieved by observing that the integral of double differential cross section ought to be restricted over ranges of physically reasonable energy transfer.
  - Successfully reproduced double differential thermal neutron cross section reported in Figs. 4 and 5 of Y. Abe et al., Nucl. Instr. Methods in Phys. Res., A 735 (2014) 568-573.
  - New molecular dynamics (MD) simulations using TIP4P water molecular interaction performed using MD simulation code GROMACS in order to see whether TIP4P may yield improved thermal neutron scattering kernel and total elastic cross sections in the eV range over TIP3P due to additional parameters available in TIP4P.
  - A CPU-intensive computation of scattering kernel from MD trajectory files performed by MOLDYN can now be executed on arbitrary many NERSC nodes/processors. This will significantly reduce the wall clock time of each one of thousand(s) Monte Carlo runs relative to standard nMOLDYN's limitation of using at most 2 nodes and 48 processors.
  - A computation of a Fast Fourier Transform (FFT) of intermediate structure functions F(q,t) employed by nMOLDYN, although fast, was shown to work correctly for classical F(q,t)'s only. Quantum-corrected F(q,t)'s require a full computation of Fourier Transform currently performed by Matlab in our framework.
  - H2O TIP4P molecular interaction in MD simulation code GROMACS has performed favorably relative to TIP3P in comparisons to measured SNS total and triple-differential scattering cross section data.

    - Universal Monte-Carlo (UMC) methods published by Donald Smith (ANL) and collaborators has been selected for computation of S(a,b) mean values and uncertainties.
    - All computing segments inside a single UMC calculation are being optimized to save time when running thousands of calculations in parallel on our nersc.gov allocation.
    - Preliminary results presented at ND2016 by Chris Chapman, who is Ga Tech Ph.D. student working at ORNL.
    - Application of Monte Carlo method to computations of uncertainties and covariance data on NERSC (nersc.gov) supercomputers to commence in Q3.
- ^{16}O evaluation
    - Work on ^{16}O resonance parameters up to 6.4 MeV was generated.
    - The evaluation work focused on improving the Sayer's ORNL evaluation (2000) per recommendations of OECD WPEC/CIELO.
    - Work recognized as valid alternative to the extant point-wise evaluation of oxygen in ENDF/B-VII.1 library.
    - Work also based on boundary conditions (B_c=-l) commonly used in the formal R-matrix but never used in the SAMMY code and any other evaluation in the ENDF/B-VII.1 library.
    - Presented at the 2016 R-matrix Workshop on Methods and Applications in Santa Fe (June 28 –July 01).
    - Abstract was also prepared for possible article in the Nuclear Data Sheets journal (waiting for approval).
- ORNL presented papers 2016 International Conference for Nuclear Data for Science and Technology (ND2016) in Bruges, Belgium covering NCSP nuclear data measurements, evaluations and resonance analysis capabilities with SAMMY to give a presentation about NCSP experiments at the.
    - Tungsten isotopes validation—paper presented at ND2016—initiated development of paper for the conference proceedings.

RPI ND

- Performed additional neutron capture measurement on Fe-56 to improve statistical quality of existing measurements, this completes the Fe-56 measurement.
- Presented work on elemental iron measurements at AccApp 2015 during ANS winter meeting in DC.
- Developed HDF5 database system for more efficient storage, retrieval and processing of raw neutron capture event data.
- Developed and tested a new plastic scintillator to measure the neutron flux shape during neutron capture measurements.
- Presented talk and poster about current research status at AccApp2015 embedded in ANS Winter Meeting in DC
- Produced thermal scattering library for polyethylene that has improved double differential scattering cross section, while matching experimental total cross section for polyethylene
- Began identifying possible criticality and physics benchmarks to test the RPI evaluations against.
- Project review with NR and NCSP took place at RPI on 11/14/2015. No concerns were raised.
- Factory acceptance test (with RPI participation) for first klystron was computed in December 2015.
- Performed scoping measurements on Niobium to determine the feasibility of separating s and p-wave capture resonances.

- Completed efficiency characterization of EJ-204 high-energy flux monitor to determine the in-beam flux shape and enable capture measurements up to ~4 MeV.
- Developed thick-sample photon attenuation correction method and incorporated the method into the SAMMY analysis code.
- Performed Ce sample activation test to support sample leasing under new activation limits (1Bq/g).
- Completed comparison of the effect of our polyethylene scattering kernel on critical benchmarks—improvement over ENDF/B-VII.1 is evident
- Submitted paper to ANS Winter meeting transactions.
- Implemented changes to LEAPR module of NJOY to generate coherent elastic part for SiO_2 module, and generated initial SiO_2 thermal scattering libraries.
- RPI accelerator modulator purchase proposal submitted to KAPL
- RPI accelerator modulator proposal was approved by NR.
- Performed scoping measurements exploring the feasibility of measuring angular distributions of capture photons for spin assignment.
- Completed analysis and documentation of iron and tantalum experimental work.
- Completed method for determining high-energy flux measurements using a new EJ-204 detector.
- Completed Fe-nat, Fe-56 RRR, and Ta URR analysis and documentation in a PhD Thesis.
- Journal publication on Ta URR capture is in final NR release review.
- Presented Fe-56 capture results in ND 2016.
- Working with IAEA and BNL evaluators on incorporation on the Fe and Fe-56 capture (and scattering) into ENDF/B-VIII.
- Finished testing CH_2 moderated critical benchmarks for sensitivity to thermal scattering law. RPI evaluation performs slightly better than ENDF/B-VII.1.
- Improved VISION model to represent instrument's physical dimensions.
- Assisted ORNL in creation of light water covariance framework using our experimental data (Chris Chapman ND2016 Paper).
- Made mdification to LEAPR to handle quartz.
- RPI accelerator modulator proposal was submitted to vendor.
- Factory acceptance tests for last klystrons scheduled for October 2016.
- Developed automated Python tools for weighting function calculations.
- Completed work on SiO_2 and concrete critical benchmarks that indicated a possible issue with the new thermal SiO_2 evaluation.
- Created model of VISION experiment in MCNP to recreate our experiment.
- Improved the inelastic scattering portion of scattering law for SiO_2, but coherent elastic part still needs some work.

Training and Education (T&E)

LANL T&E

- Participated in regularly scheduled NCSP T&E conference calls.
- Helped with any logistic issues associated with changing venues in FY16 for executing the 1st week of the two week Criticality Safety Analysts class.
- Supported the NCERC portion of the 2 week criticality practitioner training course held in Nevada in February—Godiva IV was available for the class.
- Supported the NCERC Managers training course held in Nevada the last week of June.
- Supported hands on portion of criticality safety practitioner training at NCERC.

LLNL T&E

- Provided registration and logistics support for NCSP 2 one-week Managers courses and 2 two-week Criticality Safety Practitioners courses.
- Participated in the T&E planning meeting convened at the ANS Winter Conference in Washington, DC.
- Updated and streamlined the modules on criticality safety fundamentals and criticality safety evaluations.
- Developed workshop materials including NCSE example evaluation based on an LLNL calorimetry operation.
- Updated T&E webpage information to reflect new courses and change of venue to NFO.
- Updated and consolidated course syllabus, travel and logistics information into two new detailed student information booklets, which are available for download from the T&E webpage.
- Participated in all T&E teleconferences.
- Updated NMO Secondary RE/OP, Work Package and IWS/SP.
- Provided registration and logistics support for the NCSP one-week Managers' course on Jan. 11-15, 2016 at SNL.
- Provided registration and logistics support for the NCSP two-week Criticality Safety Practitioners' course on Feb. 1-12, 2016 at NFO and NCERC/SNL.
- Developed and finalized workshop materials including the NCSE example evaluation based on an LLNL (B332) calorimetry operation.
- Provided first week academic instruction on February 1-5, 2016 at NFO for the following modules:
  - NCS Fundamentals.
  - NCS Evaluations.
  - Workshops 1-5.
- Provided hands-on instruction on February 8-12, 2016 at NCERC for the following modules:
  - Introduction to Experimental Methodology.
  - TACS.
- Provided factual accuracy comments on CSSG 2016-1, Review of US DOE NCSP T&E Hands-On Training and Education Course for Criticality Safety Professionals.
- Provided registration and logistics support for the NCSP one-week Managers' course on June 20-24, 2016 at NCERC. Provided academic and hands-on instruction for the following modules:
  - Introduction.
  - NCS Fundamentals.
  - NCS Evaluations.
  - Introduction to Experimental Methods.
  - TACS.

- Providing registration and logistics support for the NCSP two-week Criticality Safety Practitioners' course on August 15-26, 2016 at NATM and NCERC/SNL.
- Attended the ANSI/ANS-8.26 standard working group meeting on Criticality Safety Engineer Training and Qualification at the American Nuclear Society Annual Meeting in New Orleans, LA, on June 15, 2016.

ORNL T&E.

- Revised draft NCSP Training and Education (T&E) Course Procedure to standardize the course registration, course materials/changes, logistics, and execution—feedback from students and instructors since FY14 has been incorporated into updated procedure.
- Continued transition efforts for the LANL classroom portion of the 2-week hands-on course to the Nevada Field Office (NFO) in FY16.
    - Course coordinator organized and led routine telecons to coordinate work assignments and course material modifications.
    - Finalized NFO course agenda and instructor lists.
    - The T&E team has augmented the course evaluation module into a formal set of workshops to enhance NCSE training—NDA and Human Factors instructors are heavily involved to enhance these components of the course.
    - Validation module–provides overview of modern S/U techniques (e.g., Whisper and TSUNAMI)—ORNL developed validation module and incorporated NCSP MGR comments and feedback.
    - Bob Wilson completed new accident module for the 1978 Idaho accident.
- Began planning for 1-week Manager Course at SNL in January, 2016—conducted two telecons in Dec. 2015.
- Developed new Student Information Booklets based on the information available on the NCSP T&E website to make logistics information more readily available for students—also simplified NCSP T&E registration page improve usability and readability.
- Initiated efforts to hold the August 2016 NFO course at the Atomic Testing Museum—will allow easier access for uncleared students (NFO will be the backup location).
- Successfully completed NCS Manager Course at SNL, Jan. 11-15, 2016—lessons-learned telecom conducted with course instructors and student feedback provided to SNL Task Manager.
- Successfully completed 2-week Hands-on-Course at the NFO, SNL, and NCERC Feb. 1-5 and Feb. 8-12, 2016—lessons-learned telecom conducted with course instructors and student feedback provided to SNL and NCERC Task Managers.
- Hosted and supported CSSG Tasking 2016-01 for a Review of the US DOE NCSP T&EP Hands-on Training and Education Course for Criticality Safety.
- Professionals—plan being developed to address CSSG findings, observations, and recommendations prior to the August Hands-on Course.
- D. Bowen presented status report of the NCSP T&EP at the NCSP TPR held at SNL in March 2016.
- Continued work on the 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.
- Conducted telecons as necessary (usually start one month prior to course) to plan for the Jan. /Feb. T&EP courses as necessary.
- Continued transition efforts to the NFO and Atomic Testing Museum for both 2-week Hands-on Courses.

- Feb. Hands-on-Course conducted at NFO and classroom environment much improved over previous classes.
- Aug. Hands-on course will be held at the Atomic Testing Museum and has the benefit of not having to process security paperwork, which is required at LANL and NFO (Only security preparations for the second week are necessary)—NCSP Management Team will decide which site to use in future Hands-on-Courses.
- Initiated work with SNL and LANL/NCERC to define FY17 course dates.
- Began planning efforts for the June Manager Course at NCERC and August Hands-on Course at Sandia/NCERC/NFO.
- Successfully completed NCS Manager Course at NCERC, June 20-24, 2016. Student and instructor feedback compiled by the course coordinator for course material and course execution improvement.
- Lori Scott and Doug Bowen updated the Student Information Booklets for the NCERC Manager Course.
- NCSP T&EP coordinator reviewed and prepared a 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.
- Continued work on the 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.
- Conducted telecons as necessary (usually start one month prior to course) to plan for the NCERC Manager Course.
- Continued transition efforts to the NFO and Atomic Testing Museum for both 2-week Hands-on Courses.
- Worked with the Sandia and NCERC points-of-contact to set FY17 course dates for the 2-week hands-on and manager courses.
- Began planning efforts for the August 2-week Hands-on Course.
- In collaboration with LANL/MCNP staff, initiated development of sensitivity/uncertainty (S/U) validation workshop materials for EFCOG meeting at ANL, August 6-12, 2016.
- Successfully completed 2-Week Hands-on Course at the National Atomic Testing Museum, Sandia, and NCERC, August 15-26, 2016. Student and instructor feedback compiled by the course coordinator for course material and course execution improvement. All course materials have been archived on the NCSP T&EP SharePoint.
- Lori Scott and Doug Bowen updated the Student Information Booklets for the 2-week hands-on course.
- NCSP T&EP coordinator reviewed and prepared a 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. Meetings planned for October with Sandia, NCERC and the classroom portion instructors to begin to resolve all comments.
- Continued work on the 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 is researching significant DAF access issues and why they continue to occur.
- In collaboration with LANL/MCNP staff, completed the sensitivity/uncertainty (S/U) validation workshop materials for EFCOG meeting at ANL, August 6-12, 2016.
- The T&EP coordinator has welcomed Bob Busch and Chris Haught as T&EP instructors to support Manager and Practitioner courses, respectively. Efforts are underway to provide both with course videos and course material in time to prepare for upcoming courses. Both instructors bring years of NCS teaching experience to the course.

SNL T&E

- We have completed preparations for a hands-on criticality safety class for Fissile Material Managers in January.
- We are preparing for a hands-on criticality safety class for Nuclear Criticality Engineers in February.
- We delivered a hands-on criticality safety class for Fissile Material Managers in January.
- We delivered the experimental portion of a hands-on criticality safety class for Nuclear Criticality Engineers in February.
- We supported a hands-on criticality safety course for Fissile Material Managers at NNSS/NCERC in June.
- We are preparing to deliver the experimental portion of a hands-on criticality safety course for Nuclear Criticality Engineers in August and to support the classroom portion of the course at NFO.
- We installed raised flooring to protect the class signal lines and carpet for noise control in the control room and classroom at SCX.
- Sandia supported the delivery of a hands-on criticality safety course for Nuclear Criticality Safety Engineers (NCSE) at NFO in August.
- Sandia delivered the experimental portion of a hands-on criticality safety course for NCSEs in August.
- Sandia began developing responses to the output of the CSSG review of the February NCSE course.

NCSP TECHNICAL SUPPORT

- NCSP TS2 Program MGT and Execution of the NCSP
  - Continued work on Task list budget for out-year budgets for FY 2017-2020 NCSP and NDA including funding distributions and Appendix D of the plan (MASTER Task List/WAS).
  - Managed and provided oversight/coordination efforts for NCSP 5YR plan task elements
  - Continued work on NCSP International Collaboration with IRSN and finalized Appendix E and F of Five-Year Plan.
  - Finalized the Five-Year Plan, including IE section and began monitoring 5-Year Plan progress.
  - Schedule/participate in meetings and teleconferences.
  - Coordinated NCSP FY15Q4 telecon and collected and reviewed task manager FY15Q4 reports.
  - Participated in NCSP management team and other NCSP-related meetings as required by the NCSP Manager.
  - Coordinated annual ANS Winter meeting session for the NCSP Technical Accomplishments—collected biographical information from the Technical Program presentation awardees for the special ANS session.
  - Prepared and posted NCSP FY 2016 Planning Calendar. Nichole Ellis updated the Planning Calendar with additional tasks and details for the activities being taken over by Jamie Swears.
  - Managed and monitored the NCSP International Collaboration with IRSN and AWE.
  - Organized and worked logistics for the annual NCSP TPR at Sandia National Laboratories in March 2016.
  - Prepare and Maintain MASTER Task List for NCSP activities (including proposal reviews and input, budget revisions, prioritization of tasks, coordinating input from CSSG, Universities, Task Managers, NCSP Manager, NCSP Management Team, and International Parties).
  - Nichole Ellis conducted succession planning with Lori Scott, Doug Bowen, and Jamie Sweers at the beginning of FY16Q1.
  - Prepare and maintain elements of NCSP Plan and associated activities:
    - Monitor Five-Year Plan progress.
    - Review/revise task list.
    - 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.
  - Organized and worked logistics for the annual NCSP TPR. Conducted the NCSP TPR at SNL March 14-18, 2016.
  - Provided support to the Feb. 2-week Hands-on-Course at the NFO.
  - Collected and organized NCSP FY17 proposals from task managers and universities.
  - Developed master task list that included FY17 proposals for use by the CSSG for review and prioritization during the CSSG meeting at SNL following TPR.
  - Completed and posted NCSP FY 2015 Accomplishments.
  - Coordinated NCSP FY16Q1 telecon and collected and reviewed task manager FY16Q1 reports.
- IE:
  - Generated final draft of the C_EdT Manual for NCSP Manager Review.

- Managed and provided oversight/coordination of efforts for the NCSP Integral Experiments task element.
- Participated as task team members to the Critical Subcritical Experiment Design Team (C_EdT) to improve the process and activities associated with new and progressing Integral Experiment Requests (IERs). Processed approvals for new IERs for non-NCSP funded work.
- Attended and participated in the October KRUSTY meeting and NCSP management meeting
- Completed all beginning of FY 2016 actions required for IE.
- Finalized FY 2016 Task List and all-out year funding based on information from the NCSP Manager in regards to out year funding.
- Completed all beginning of FY 2016 actions required for IE.
- Published Revision 1 of the C_EdT Manual to the IER website.
- Managed and provided oversight/coordination of efforts for the NCSP IE task element.
- Processed IER approvals and BCRs for NCSP Manager.
- Met with LANL NCSP staff, and worked with Jamie Sweers at LANL on the non-NCSP NCERC WFO products collection efforts task.
- Lori Scott and Jamie Sweers attended MS Projects course

• IP&D:
  - Tasking an IPD effort to collect past and current NCSP Work Products to be posted to our NCSP Website. Working with NCSP Website manager to develop a searchable database for easy retrieval of these products.
  - Worked with NCSP Website manager to develop a searchable database for easy retrieval of these products.
  - Working on revised NCSP website materials.
  - Continued ongoing communication and collection of foreign trip reports from task managers.

• T&E:
  - Began preparations for the Sandia Manager Course in Jan. 2016.
  - Working on the TEP action list for Classroom Training being moved from LANL to NFO. This is part of the 2-week hands-on course scheduled in Feb. 2016.
  - Developed a draft of an NCSP TEP course procedure
  - Completed required training for ORNL RSS 14426.0 "Off-site Participation and Observation of Hands-on Training Courses and Critical Experiments with Fissionable Material."
  - Successful execution of the Sandia Manager Course (Jan. 2016) and 2-Week Hands-on Course (Feb. 2016).
  - Created and reviewed new NCSP TEP Student Information Booklets for Manager and Hands-on Training Courses. Uploaded the booklets to the NCSP TEP website. Simplified the NCSP T&E registration webpage based on student feedback.
  - We have finished developing a new INTER code using LLNL's Fudge package, including many new features not present in the original INTER code. INTER has been ported to the new version of ADVANCE. The new version of ADVANCE will be deployed in Q4.
  - Prepare and maintain elements of NCSP Plan and associated activities:
    - Monitor Five-Year Plan progress,
    - Review/revise task list, and
    - 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.
- Made preparations for an MS Access course on July 20-21, 2016 at LANL.
- Worked with ANS for Winter session Best Papers.
- Finalized and submitted Best Papers invitations and awards from the TPR.
- Worked with Tim Beller on a metrics system tasking for client.
- Worked on collecting Five-Year Plan input from task managers.
- Worked on Five-Year Plan draft and pre-decisional task list to collect and analyze data.
- Prepared Q2 QPRs into a single bookmarked PDF file for use for the Q2 telecon.
- Worked with Chuck Lee to add TPR presentations and agenda to the NCSP website.
- Designed a one-page picture for client showcasing NA-50 work to display in the HQ 6G building.
- Began working on logistics for the annual NCSP Budget Execution Meeting.
- Completed required training for ORNL RSS 14426.0 "Off-site Participation and Observation of Hands-on Training Courses and Critical Experiments with Fissionable Material."
- Updated Student Information Booklets for the TEP manager courses on the NCSP website with updated logistical information.
- Analyzed CSSG assessment report of the TEP (CSSG tasking 2016-01) and generated a plan to resolve CSSG recommendations.
- Successful execution of the NCERC Manager Course (June 2016). Archived course materials, exams, and student evaluation forms on the TEP SharePoint site.
- Continued development of an NCSP TEP course procedure. Plan to publish in the Q1 FY17.
- Worked with Sandia and NCERC points-of-contact to set FY17 course dates and update the NCSP TEP website accordingly.
- Initiated efforts to reduce paper binder size by providing electronic files of the course materials on USB and NCSP website.
- Lori Scott and Jamie Sweers participated in an MS Access course on July 20-21, 2016 at ORNL.
- Completed and published main and IE FY17-21 Five-Year Plan—Lori Scott started developed new financial spreadsheets for future years.
- Prepared Q3 QPRs into a single bookmarked PDF file for use in QPR.
- Designed one-page picture for client showcasing NA-50 work to display in the HQ 6G building.
- Successfully completed the NCSP Budget Execution Meeting the week of Jul. 25, 2016.
- pdated Student Information Booklets for the TEP manager courses on the NCSP website with updated logistical information.
- Analyzed CSSG assessment report of the TEP (CSSG tasking 2016-01) and generated a plan to resolve CSSG recommendations.
- Successful execution of the 2-week Hands-on Course (August 2016). Archived course materials, exams, and student evaluation forms on the TEP SharePoint site.
- Continued development of an NCSP TEP course procedure. Plan to publish in FY17 Q1.
- TS7: Succession Planning
        - Vladimir Sobes completed Cu-63, 65 resonance evaluations working with Luiz Leal (IRSN)—new evaluations provide robust angular distribution data needed for systems reflected with copper.

- Sobes and Leal initiated new collaborative resonance evaluation work on gadolinium isotopes.
- Sobes succession planning work tasks included 2 multi-week trips in FY16 to IRSN to work with Leal on new NCSP evaluations.

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 Face-to-face in Germantown.
- Completed Tasking 2016-03 WTP Review.
- Prepare/Review tasking's/responses (2015-02, 2015-03, 2016-01, 2016-02, 2016-03, 2016-04, 2016-05).