NCSP Accomplishments for Fiscal Year 2010

Analytical Methods

LANL:

- Distributed a beta version of NJOY2009 to selected users at BNL, ANL, and Bettis.
- Resumed work on an updated NJOY manual to accompany the new code. Began work on a comprehensive NJOY review paper scheduled to appear in the NNDC's December 2010 special issue of Nuclear Data Sheets.
- Presentation at the ANS Winter Meeting: B.C.Kiedrowski and F.B.Brown, "Estimating Reactivity Changes from Material Substitutions with Continuous Energy Monte Carlo."
- Forrest Brown is now the Chair of two OECD/NEA/WPNCS Expert Groups (Monte Carlo Source Convergence and the new EG on Advanced Monte Carlo Techniques).
- MCNP5 code maintenance has included about 20 minor changes to fix reported bugs. MCNP5 code improvements include extending the limits on cells, surfaces, and materials to enable larger problems.
- The MCNP5 Criticality Validation Suite has been run several times with MCNP5 and MCNP6 using ENDF/B-VII data, to confirm that results are consistent and correct.
- The application of adjoint-based sensitivity theory to geometry sensitivities is being investigated. Uniform expansions or contractions of a surface are well handled; translations of a body are more difficult. A paper was submitted and accepted in Annals of Nuclear Energy ("Eigenvalue Sensitivity to System Dimensions").
- Several papers on MCNP development have been submitted to PHYSOR-2010 and the ANS June meeting.
- MCNP5 code maintenance has included several minor changes in the parallel OpenMP threading, due to changes in the latest Intel and gfortran Fortran-90 compilers.
- Two new MCNP validation suites have been prepared & tested: A 91-problem set of critical experiments provided by the Data Team, and the Kobayashi benchmark suite for neutrons in models containing voids (relevant to alarms & detectors).
- The MCNP Validation Suites have been updated to include routines for automated comparison of MCNP results to the benchmark experiment values. Tests with ENDF/B-VI and ENDF/B-VII data (using the Intel 10.1 Fortran-90 compiler) show that results exactly match previously reported ones.
- During the MCNP validation testing, it was discovered that the newest version of the Intel Fortran-90 compiler (11.1) gives differences on 4 out of 31 criticality benchmark problems, compared to the Intel-10.1 compiler. These differences appear to be simple computer roundoff differences, but are being thoroughly investigated.
- The new adjoint-weighted tally feature developed over the past 2 years has been used to provide adjoint-weighted kinetics parameters (in the forthcoming MCNP5-1.60) and adjoint-weighted perturbation estimators (in the future MCNP6).
- Revisions to NJOY99 were completed that expanded the covariance processing capability to include scattering radius uncertainty and to include processing of MF40 (radioactive nuclide production) data.
- A talk was given at the ANS Winter Meeting (forgot to include in last quarterly report): Jeffrey A. Favorite, "On the Accuracy of the Differential Operator Monte Carlo Perturbation Method for Eigenvalue Problems," Transactions of the American Nuclear Society, 101, 460-462 (2009).
- A verification suite for perturbations and sensitivity analysis is being developed. It includes analytic problems and code-to-code comparisons previously documented as well as new problems.
- A new capability for adjoint-weighted perturbation theory was added to MCNP6, for eventual use in sensitivity / uncertainty analyses.
- Two MCNP papers were presented at the ANS San Diego meeting, on subcritical multiplication and on the Whitesides problem. A "Best Paper" award was presented to Kiedrowski and Brown.
- A paper and a Monte Carlo workshop were presented at the PHYSOR-2010 meeting.
- An in-depth review of approximately 50 additional ICSBEP benchmarks was performed to be included with the MCNP Criticality Validation Suite.

- Two summer students are working on verification and validation of MCNP5. Their focus is on criticality problems on Linux clusters.
- The final version of the NJOY paper ("Methods for Processing ENDF/B-VII with NJOY") to be published in this years' Nuclear Data Sheets special issue was submitted and accepted for publication.
- A beta version of NJOY2010 (Fortran 90 version) was distributed to Sandia (Pat Griffin).
- MCNP5-1.60 was distributed to RSICC with a release date of September 30, 2010. This version includes many bug fixes, adjoint-based reactor kinetics parameters (and Rossi alpha), and modifications to handle bigger problems. Documentation includes detailed description of new features, release notes, computers supported, and verification and testing document. In addition, over a dozen new reference reports on theory, perturbations, and criticality are included.
- MCNP Criticality and Introductory courses were taught at Los Alamos during the year. A class at PNNL/Hanford is scheduled for November 2010.
- The MCNP Validation Suites have been updated to include routines for automated comparison of MCNP results to the benchmark experiment values. Two new MCNP validation suites have been prepared & tested: A 91-problem set of critical experiments provided by the Data Team, and the Kobayashi benchmark suite for neutrons in models containing voids (relevant to alarms & detectors).
- Revisions to NJOY99 that expanded the covariance processing capability were completed.

LLNL:

- Cullen processed the new 240Pu ENDF/A evaluation using PREPRO and provided comments to CSEWG.
- Heinrichs published LLNL-PRES-418844, 233U Benchmarks with a Comparison to COG and MCNPResults Using ENDF/B-VII.0, which was presented at the CSEWG meeting at BNL on Nov. 3, 2009.
- Heinrichs attended NDAG, CSEWG and ICSBEP prioritization meetings at BNL on Nov. 2-6, 2009.
- Heinrichs attended a Juliett experiment meeting and represented the NDAG in support of the CEDT process.
- Cullen processed new F-19 and Cl-35 evaluations using PREPRO and the results are in excellent agreement with MacFarlane's NJOY results.
- Heinrichs published LLNL-PROC-422485, "COG – Special Features of Interest to Criticality Safety Practitioners", which will be presented at the 2010 Annual ANS Meeting in San Diego in Q3.
- Installed and verified COG 10 on three Windows XP workstations for NSTEC at NTS.
- Heinrichs and John Scorby attended a CEdT-0 meeting at Sandia National Laboratory on May 17, 2010.
- Heinrichs presented LLNL-PRES-434714, "COG – Special Features of Interest to Criticality Safety Practitioners", at the 2010 Annual ANS Meeting in San Diego on June 15, 2010.
- Heinrichs attended the NDAG meeting at Port Jefferson, NY, on June 21, 2010.
- Heinrichs and Dave Brown attended the mini-CSEWG meeting at Port Jefferson, NY, on June 22, 2010.
- Cullen assisted the NRG Patten Laboratory (Holland) in processing the TENDL Library using PREPRO. Cullen assisted Patten in identifying a number of errors, which Patten is correcting.
- PREPRO2010 update in progress in cooperation with the IAEA Nuclear Data Section, Vienna, Austria.
- The Japan Atomic Energy Agency used the LINEAR, RECENT and SIGMA1 modules of PREPRO to process JENDL-4.0 point-wise continuous cross sections for distribution to the public (see http://wwwndc.jaea.go.jp/jendl/j40/j40.html).
- LLNL (Cullen) assisted the NRG Petten Laboratory (Holland) to process the TENDL
- Library using PREPRO. Cullen assisted Petten in identifying a number of errors, which Patten is correcting.
- LLNL approved COG11 distribution to RSICC as export controlled software. This completes a FY2009 carryover milestone.
- Heinrichs completed the paper "COG11 – Available Now to Criticality Safety Practitioners" for submittal to ICNC2011 in FY2011 Q2.
- LLNL (Lee) installed and verified COG 10 on three Windows XP workstations for NSTec at NNSS.
- LLNL approved LLNL-SM-461182, "Nuclear Criticality Safety Division Training Module, CSG-TM-016, COG Software", for unlimited distribution. This revision of the COG primer will be utilized in training external criticality safety users.

- LLNL-PRES-418844, "233U Benchmarks with a Comparison to COG and MCNP Results Using ENDF/B-VII.0", presented at CSEWG at BNL on Nov. 3, 2009.
- Heinrichs and Scorby attended CEDT meetings for Juliett at: Sandia National Laboratory on May 17, 2010; and Washington, DC, on November 9, 2009.
- Dulik, Heinrichs, Kim, Lee attended the CEDT meeting in Las Vegas, NV, on August 26, 2010. Dulik and Kim provided support to Thomas Miller (ORNL) for the final design review of the Silene CAAS benchmark experiment.

ORNL:

- RSICC activities for FY 2010: Distributed 3389 software packages and updated 35 software packages. 701 SCALE and 1261 MCNP packages distributed.
- SCALE/KENO/TSUNAMI Software Maintenance: Provided 155 responses to SCALE users requesting technical assistance; Updates made to configuration controlled SCALE version: 23 module revisions and 1 data revision; Partial migration to GForge configuration control system with advanced developers using the SCALE under the system; Completed review of SCALE/TSUNAMI input files for 12 ICSBEP benchmark experiments—verified SCALE input files and sensitivity data were archived in SCALE Models and Derived Data (MADD) repository; Provided SCALE workshop at ANS Winter meeting, including demonstration of CAAS capabilities of the MAVRIC sequence; Published paper on SCALE/TSUNAMI analysis of ^{233}U systems at ANS Winter meeting; Provided TSUNAMI and TRITON software updates on SCALE website
- Provided week-long TSUNAMI class at CEA.
- Provided 4 weeks of SCALE training in November 2009.
- SCALE spring 2010 training block organized with 4 classes at ORNL and 2 classes at OECD/NEA Data Bank.
- Co-authored WPNCS uncertainty analysis expert group paper for PHYSOR 2010.
- AMPX Maintenance and Library Generation: Generated revised CE and 238-group ENDF/B-VI.8 and B-VII.0 libraries for release with SCALE 6.1; Processed and tested final ORNL evaluations for ^{52,53}Cr , ^{58,60}Ni, ^{46,47,49,50}Ti—evaluations submitted to NNDC in October 2009; Processed and tested revised ^{55}Mn and ^{233}U evaluations in preparation for submittal to NNDC.
- Initiated planning for SILENE CAAS-related experiments. Wagner and Miller traveled to Valduc in October in support of planning for the SILENE CAAS-related experiments; experiment design activities progressed.
- SCALE/KENO/TSUNAMI Software Maintenance: Published annual SCALE maintenance report; Published Winter/Spring 2010 SCALE newsletter to a distribution of ~1800 users; Updates made to production SCALE version: 20 module revisions and 7 data revisions; Migration to GForge configuration control system completed for developers version of SCALE. Progressing with migration for production version of SCALE; Provided 7 software updates and 4 data library updates on SCALE website, including updated covariance data for titanium; Provided users with updated KENO3D visualization tool that fully supports SCALE 6.0 features and provides significant performance improvements for large models; Contributed ~100 page documentation of TSUNAMI methods and results to WPNCS uncertainty analysis expert group for the 2010 state-of-the-art report; Provided 2 weeks of SCALE training in March 2010; Provided ~180 responses to SCALE users requesting technical assistance.
- With joint support from NRC, completed review of SCALE/TSUNAMI input files and calculations for 35 ICSBEP benchmark experiments for the SCALE Verified Archived Library of Inputs and Data (VALID – formerly MADD) repository.
- AMPX Maintenance and Library Generation: Completed final testing of revised ^{55}Mn and ^{233}U evaluations for submittal to NNDC; Performed testing of automated AMPX sequences to produce SCALE cross-section libraries
- Completed design and documentation of proposed SILENE CAAS-related experiments.
- SCALE/KENO/TSUNAMI Software Maintenance: Updates made to configuration controlled SCALE version: 38 module revisions and 4 data revisions; numerous enhancements implemented in KENO and TSUNAMI to facilitate criticality safety analyses with SCALE 6.1.; Details of all SCALE enhancements since SCALE 6.0 are available on SCALE webiste: http://home.ornl.gov/~x4s/open/summary.html ; Hosted 5 top summer students to perform beta testing and regression testing for SCALE 6.1; Completed

migration of SCALE to GForge configuration control system; Published papers at ANS Annual meeting on 1) SCALE/TSURFER analysis of ^{233}U systems, 2) criticality accident alarm system capabilities in SCALE and 3) SCALE/KENO validation; Provided covariance data seminar and ORNL/TSUNAMI results to OECD expert group on Uncertainty Analysis in Modeling in Pisa, Italy; Participated in Validation and Verification for Nuclear Systems Workshop and provided a presentation on SCALE validation; Provided 130 responses to SCALE users requesting technical assistance.

- AMPX Maintenance and Library Generation: SCALE data updates: generated revised 238-group library with improved flux weighing spectrum; added ^{48}Ti covariance data file based on latest ORNL evaluation; Completed final testing of revised ^{55}Mn and ^{233}U evaluations that were submitted to NNDC in Q3; Processed all ENDF/A-VII covariance evaluations and compared with NJOY; Developed preliminary AMPX package for release to RSICC—testing in progress.
- May 2010 trip to CEA/Valduc for planning of the SILENE CAAS-related experiments—submitted experimental conceptual design for CED-1.
- Initiated work on experimental final design, which involved contact with Y-12, LLNL, and LANL to provide CAAS detectors for the experiments.
- SCALE/KENO/TSUNAMI Software Maintenance: Updates made to configuration controlled SCALE version: 21 module revisions and 8 data revisions; numerous enhancements implemented in KENO and TSUNAMI to facilitate criticality safety analyses with SCALE 6.1; Details of all SCALE enhancements since SCALE 6.0 are available on SCALE website: http://home.ornl.gov/~x4s/open/summary.html ; Five summer students completed regression test suites for SCALE 6.1—over 200 issues identified and corrected during testing; Participated in OECD/WPNCS and associated expert groups; Provided 109 responses to SCALE users requesting technical assistance; SCALE 6.1 source code was unified across Linux, Mac and Windows platforms enabling more efficient testing and development.
- AMPX Maintenance and Library Generation: Completed automated sequence for AMPX to produce continuous-energy and multigroup SCALE cross-section libraries; Completed AMPX code package and submitted to RSICC in September 2010.
- CAAS/SILENE CED-2 final design report completed and approved by C_EDT—experiment scheduled for October 2010 at CEA Valduc.

Information Preservation and Dissemination

ANL:

- Inventory records of the ANL ZPR/ZPPR materials were identified and sample electronic format for conversion of the hard copy data has been produced and documented.

Hanford:

- CritView version 1.02 and associated ARH-600 database (version 1.03) care currently posted by LLNL onto the NCSP website.
- Completed initial work in identifying publicly available documents at Hanford that are relevant to the development of extracting actinide integral cross sections. Issued letter report documenting survey of Hanford published literature on January 11, 2010
- Completed calculations assessing sensitivity of MCNP calculations for selected Pu metal system parameters.
- "Anomalies of Nuclear Criticality" report (PNNL-19176) was placed on the NCSP website on March 31, 2010.
- Initiated retrieval of relevant actinide cross section data from SRS in March 2010.
- Resurrected simple analytical code to extract integral cross sections for the Pu-U tree.
- Decided to start with uranium target post irradiation data, simulate reactor exposure history with the 238 group ENDF/B-VII library, and compare results with earlier correlations.
- Resulting data will be in fine groups for additional evaluations, also in few-group ORIGEN-ARP format for simulation of graphite/H2O moderated, low-enriched uranium systems.
- Completed planned calculations assessing sensitivity of MCNP calculations and document drafted.
- Completed 90% planned MCNP calculations for ARH-600 comparisons.

- Issued letter report documenting progress on survey of unpublished reports, letters and personal notes (posted on NCSP Website).
- Issued peer reviewed report (PRC-NS-00009) documenting added MCNP calculations for CritView libraries for major systems.
- Provided updated CritView MCNP data libraries and documentation (CHPRC-00340) to LLNL for posting on the NCSP website updated for major systems.
- Identified and documented sensitivity of MCNP calculations to ARH-600 model assumptions as part of the peer reviewed report (PRC-NS-00009) documenting added MCNP calculations for CritView libraries for major systems.
- Issued letter report (PRC-NS-00010) documenting proof of principle test for extracting nuclear data for single set of data points.
- Issued letter report listing irradiated targets that are available for radiochemical analysis.
- Paper generated for the Winter ANS meeting.

LLNL:

- Added one hundred and eighteen new users to NCSP registration database.
- Modified and enhanced IER form CED-0 to include CEdT Manager comments and approval sections.
- Attended NCSP Sponsor ANS/DOE workshop in November 15-21, 2009, Washington, DC.
- Created beta version of IER form CED-1, CED-2,CED-3 and CED-4.
- Deployed the first beta version of IER form on a new NCSP beta website http://ncsp-backup.llnl.gov.
- Attended Joint Meeting of CSSG, NDAG, and Task Managers with NCSP Manager at ORNL.
- Scanned and posted KARLSRUSHE SYMPOSIUM 1961 on NCSP website.
- Added five hundred thirty nine new entries to the Bibliographic database.
- Created and deployed searchable CSE database on NCSP beta version website - http://ncsp-backup.llnl.gov.
- Attended Hazard Analysis of Nuclear Criticality Safety Evaluations Tutorial – I and II at the 2010 ANS Annual Meeting, San Diego, CA.
- Performed live demonstration on various features of the searchable CSE database and the beta version of IER forms – CED-1, CED-2, CED-3, and CED-4 at the 2010 ANS Annual Meeting, San Diego, CA.
- Deployed 2nd beta version of IER Forms – CED-1, CED-2, CED-3, and CED-4 on NCSP beta version website – http://ncsp-beta.llnl.gov.
- Restored NCSP web server temporary to another Dell server due to fatal hardware failure.
- Procured a new Dell server to replace current crashed NCSP web server.
- Merged beta version of IER Forms – CED-1, CED-2, CED-3, and CED-4 into NCSP website – http://ncsp.llnl.gov.
- Attended NCSP FY 2011 Budget Execution and CEdT Meeting at Nevada Support Facility, Las Vegas, Nevada, August 24-16.
- Performed live demonstration on various features of the IER forms: CED-1, CED-2, CED-3, and CED-4.
- Converted and deployed LACEF Heritage video series on NCSP website.
- Deployed beta version of Nuclear Data Request Form on NCSP beta website http://ncsp-beta.llnl.gov.

ORNL:

- Reviewed ORELA tape archive and identified 9 tapes of various speeds for test reading/conversion to assess feasibility of converting tapes to modern format.
- During review of ORELA archives, learned that some previously measured ORELA data are only available in printed form—assessed feasibility of converting printed data to electronic format by scanning ORELA transmission data for ^{241}Am as test case.
- Contacted 3rd party company in to read select set of ORELA tapes to assess feasibility of converting tapes to modern format—plan to establish contract with 3rd party company in FY11 Q1 to test reading of select set of ORELA tapes.

Integral Experiments

INL:

- The INL Task Manager and NCSP Management participated in the annual Institut De Radioprotection et de Sûreté Nucléaire (IRSN) Structural Materials Experiment Program, now named *Matériaux en Interaction et Réflexion Toutes Epaisseurs (MIRTE)* Program Meeting at IRSN offices in Paris during November, 2009.
- All of the planned 42 experiments included in Phase 1 of the *MIRTE* Program have been completed.
- The agreement between IRSN and INL has been amended to reflect the actual completion schedule and to add Pantex and the Nevada Test Site to the list of Beneficiaries.

LANL:

- Successfully completed all critical assembly maintenance activities and started the official operational maintenance cycle.
- Successfully completed all applicable in-service-inspections (ISIs) and TSR surveillances and started the official timing cycle for these surveillances.
- Hired the second Cognizant Systems Engineer (CSE) who was successfully qualified through the LANL CSE program.
- Received LANL PAD-level exemption for external hires in support of the CEF operational staffing plan (LA-UR-09-01787).
- Hired a maintenance manager, 5480.20A training SME and Quality Assurance manager.
- Executed all CEF CORR recovery efforts.
- Prepared for CEF ORR.
- Completed all operator training at Valduc in September 2010.
- Attended CEDT process review meeting in Las Vegas in August 2010.
- Supported resolution of CEF ORR pre and post start findings to help enable execution of CEF startup plan.
- Two measurement campaigns were performed at the DAF in support of assessing the functionality of PATRM/PMC data acquisition system for performing ^{252}Cf source driven measurements. The Berp Ball and Poly reflected Berp Ball measurements were performed at the DAF in Q4. Results were compared to previous results and a report was written.
- UNLV got the four codes (MCNP-DSP, MCNP-Polimi,MCNP5/MCNPX, and PARTISN) running on their computers in support of the collaboration.
- Two measurement campaigns were performed at the DAF where benchmark models of the measurements were put together to compute the List-mode data using the MCNP patch being developed. A comparison of the measured and computed list-mode results was performed.
- The mechanically cooled HPGe gamma spectrometer was delivered from ORTEC and was ESO inspected.
- Data acquired with the PATRM is being utilized to write preliminary code to analyze the data using several subcritical methods. (The current focus is on the Feynman variance-to-mean, the Cf-252 source driven noise analysis, and the rossi-alpha methods). A comparison with previously measured data was performed. A mini-manual describing how to use the software with PATRM/PCM data was written for end users.

LLNL:

- Procured the Canberra Falcon 5000 Gamma Spectroscopy System with state-of-the-art ISOCS software in June 2009.
- Completed “Proposal Non-Classified Research Progress under the CEA-DOE Agreement Cooperation in Fundamental Science Supporting Stockpile Stewardship” for the nuclear accident dosimetry exercises at CEA-Valduc and the Device Assembly Facility.

- Completed and executed logistics plans and participated in the October 2009 Silene nuclear accident dosimetry (NAD)exercise at CEA Valduc (France): completed an estimate of resource requirements; issued a list of approved US participants on 8/31/2009; issued an approved itinerary on 9/1/2009; provided CEA with US participant passport information and proof of DOE Radworker II training and medical fitness on 9/22/2009; obtained approval from the LLNL Director to reimburse the travel costs of the US participants as LLNL invited lecturers/discussants on 9/24/2009; and arranged transport to and from Valduc with Customs clearance for equipment necessary to perform.
- NAD measurements: issued a detailed schedule on 10/11/2009; pre-programmed ISOCS calibration factors for all US pellet and foil designs; provided LLNL travel dosimetry for DOE, LLNL and ORNL personnel on 10/12/2009; performed measurements for all US laboratories during actual participation in the exercise on 10/12-19/2009; arranged return transport of irradiated materials that could not be hand-carried on 10/19/2009; distributed three CEA-Valduc reports with reference data for the Silene irradiations to all U.S. participants and posted these reports on the NCSP website; and distributed 5 technical reports from LANL, LLNL, PNNL, SRS, and Y12 summarizing the results of their participation in the October 2009 Silene NAD exercise of CEA-Valduc and posted these reports on the NCSP website
- Completed and executed logistics plans and participated in the September 2010 Caliban nuclear accident dosimetry exercise at CEA Valduc (France); as the lead laboratory, provided liaison to CEA-Valduc and assistance to the US participants from LANL, PNNL, SNL, SRS and Y12.
- Provided technical support to Thomas Miller (ORNL) for a CAAS benchmark experiment scheduled for October (FY2011) at the Silene reactor at CEA-Valduc: Dulik and Kim completed electronics and neutron verification testing and calibration of 12 Rocky Flats detector heads at the LLNL B255 Radiation Calibration Laboratory and the UC-Davis McClellan reactor; and Dulik and Kim participated in the final design review CEDT meeting on August 26, 2010, at Las Vegas, NV.
- Participated in the ANSI N13.3 nuclear accident dosimetry standard working group meetings on 1/26/2010 in Albuquerque, NM, and 6/30/2010 in Salt Lake City, UT.

ORNL:

- Provided feedback (to ICSBEP Manager and the CSSG) re the NCSP five-year plan regarding prioritization for integral experiments performance and benchmark reporting. Included a closure recommendation re the IER-104 experimental need for fast-spectrum experiments with vanadium as a reflector and/or diluents. Included a recommendation re the IER-104 experimental need for thermal-spectrum experiments with vanadium as an absorber (that Russian VNIITF reference experiments with HEU and poly plates be procured for IHECSBE addition). These highly-correlated reference experiments are needed to accompany existing IHECSBE VNIITF experiments with HEU, poly, and vanadium plates, to identify bias associated specifically with thermal absorption cross section data for vanadium.
- Performed QA verification of models and data used for FY09 CEdT assessment of vanadium as a reflector and/or diluents for fast-spectrum systems. (These HEU-vanadium plate assembly models and TSUNAMI sensitivity data files are to be released as part of the fall 2010 IHECSBE DVD.)
- Performed SCALE/TSUNAMI assessment to investigate feasibility options for MIRTE critical experiment redesign to enable testing of chromium, manganese, and molybdenum cross-section data in epi-thermal (0.625 eV to 100 keV) and fast energy (> 100 keV) regions—provided informal report to NCSP Management in March 2010. provided final report to NCSP Management in May 2010.
- Completed CED-2 final design report for CAAS/SILENE benchmark to be performed at CEA Valduc in October 2010.

SNL:

- Operations carried out in November, 2009, updated the operator proficiencies and the readiness of the facility.
- The approach-to-critical experiment on the second core in the 7uPCX series was substantially completed in February, 2010. These operations updated the operator proficiencies and the readiness of the facility.

- The critical assembly was operated in May, 2010 to maintain the readiness of the facility in the proficiencies of the staff.
- The critical assembly was operated in August and September, 2010 to maintain the readiness of the facility in the proficiencies of the staff.

International Criticality Safety Benchmark Evaluation Project

INL:

- The ICSBEP Benchmark Prioritization Meeting was held in conjunction with the NDAG Meeting in New York during the first quarter of FY-2010 (November 2009).
- The annual International Criticality Safety Benchmark Evaluation Project (ICSBEP) Meeting was held in Ljubljana, Slovenia May 3 - 7, 2010. Representatives from 9 of the 20 participating countries attended, including the United States (Bettis, INL, ANL, LANL, ORNL, SNL, and WSMS), United Kingdom, Japan, Russian Federation (IPPE, RRCKI, VNIITF), France (IRSN, CEA), Slovenia, Brazil, Argentina and Sweden. A total of 44 individuals participated in the meeting, including Jim Gulliford (OECD NEA), Jim Felty (Deputy to the DOE NCSP Manager), Andrej Stritar (Slovenian Nuclear Safety Authority), and Andrej Trkov (Jožef Stefan Institute). Twenty-seven evaluations and one revision of a previously published evaluation were reviewed and discussed. Twenty-six evaluations were approved for publication, subject to satisfactory resolution of all assigned actions. One evaluation is still in progress and deferred until next year or referred to the International Reactor Physic Experiment Evaluation Project (IRPhEP). A second evaluation, SUB-PU-MET-FAST-003 was subsequently deferred until better analytical capabilities become available. If all of the remaining approved evaluations are completed in time for publication of the 2010 Edition of the "International Handbook of Evaluated Criticality Safety Benchmark Experiments", the Handbook will contain nearly 4405 critical or subcritical configurations. There were no new criticality-alarm/shielding or fundamental-physics measurements reviewed at this meeting.
- Publication of the 2010 Edition of the International Handbook of Evaluated Criticality Safety Benchmark Experiments was delayed due to other NNSA priorities. The revised publication date is December 2010.

Nuclear Data

ANL:

- Participated in Oct. 2009 IAEA Burnup Credit Workshop and BUC Expert Group meeting in Cordoba, Spain.
- Participated in Nov. 2009 CSEWG meeting, including organizing and chairing Covariance Committee (D. L. Smith), and presenting data validation results testing the new NCSP and IAEA evaluations on ENDF/A for ^{240}Pu, ^{35,37}Cl and ^{180,182,183,184,186}W, and participating in Executive Committee.
- Organized and chaired November 2009 NDAG meeting; produced and distributed minutes for the Nov. 2009 NDAG meeting.
- Facilitated ongoing discussions with D. W. Muir and D. L. Smith to define QA Requirements for ENDF/B covariance evaluations.
- Provided input and feedback on NCSP IER website and Process Manual to C_EdT manager and on formation of NCSP Nuclear Data Request website.
- Led the NDAG Prioritization of FY11 Proposals.
- Provided input on formation of NCSP Nuclear Data Request website.
- Provided NDAG reviews (with comments, approvals and/or rejections) for 23 new IERs.
- Participated in expert subgroup on Sub-Critical Measurements.
- Preparation of two invited papers and one plenary talk for the ND2010 meeting.
- Participated in June CSEWG meeting included presentation of validation testing results for the latest preliminary ENDF/B-VII.1 evaluation for ^{52}Cr and ^{53}Cr; chair of Covariance Committee; and lead in defining and documenting QA standards for covariance data.

- Organized and chaired the June NDAG meeting.
- Participated in the June WPEC meeting and subgroup meetings.
- Provided (revised) input on formation of NCSP Nuclear Data Request website.
- Presented 4 invited papers and one plenary talk for the April ND2010 meeting in Jeju, Korea.
- Continued validation testing results for the latest preliminary ENDF/B-VII.1 evaluation for ^{58}Ni (for Nov. CSEWG meeting).
- Continued Participated in September WPNCS meeting and subgroup meetings (including the EG on Burnup Credit, the EG on Criticality Excursions, the EG on Advanced Monte Carlo Methods, the meeting of DICE task force, and the EG on Uncertainty Analysis).

BNL:

- Eight new NCSP sponsored evaluations (46,47,49,50-Ti; 52,53-Cr; 58,60-Ni) submitted to the NNDC in October 2009 were processed, reviewed and included to ENDF/A library and quality assurance of the covariance data for these evaluations was accomplished.
- A new version of the resonance covariance module in EMPIRE based on kernel approximation was developed and successfully tested on 55-Mn and 56-Fe.
- Resonance parameters for 23-Na and 56-Fe were reviewed and data for 23-Na in Atlas were updated.
- Updated evaluation of covariances for 55Mn has been received from ORNL and included in the GForge based ENDF/A library. Format inconsistencies were corrected in 60Ni, 206Pb, 207Pb, 237Np, and 241Pu evaluations.
- QA on 233U detected a format error in covariance data, which has been corrected.
- Modified/updated evaluations from ORNL and LANL for 58Ni, 239Pu fission spectrum, were included in the GForge based ENDF/A library. Format and physics consistency checking has been performed at NNDC.
- Quality assurance on covariances for all 110 materials in the AFCI-2.0 library has been performed including NCSP materials 16O, 55Mn,239,240Pu, and 237Np.

LANL:

- The analysis of the ^{17}O compound system was finalized and the updated ENDF-6 format evaluation for n+^{16}O was also finalized. This evaluation was sent to the NNDC for inclusion in ENDF/A.
- A preliminary updated evaluation of Be-9 to ENDF/A that included the RPI iron-window total cross section measurement has been submitted to the NNDC. Other reaction cross sections have also been re-evaluated. A comprehensive R-matrix analysis that includes all channels and reactions will be generated (including break-up) in the Be-10 system.
- An updated evaluation for n+ ^{237}Np was sent to the NNDC for inclusion in ENDF/A. Recent improvements have focused on the (n,2n) reaction: more experimental data exist for the production of the short-lived ^{236}Np isomer than for the total production, and these data have been used to create the (n,2n) cross section for the 22 hr isomer; the Ignatyk and Maslov calculations of the ratio of the cross sections to the long vs. short lived isomers were used, thereby allowing a calculation of the total (n,2n) cross section; cross sections for elastic scattering, (n,3n), and total were also adjusted as a result of the (n,2n) work; reaction rate ratios for ^{237}Np(n,2n)/^{235}U(n,f) were calculated with the revised (n,2n) cross section in the LANL Godiva, Flattop-28 and Big-10 assemblies. The revised (n,2n) cross sections yield a ratio that is typically several per cent smaller than previously obtained but remains up to 30% larger than expected in the threshold region, decreasing to about 10% too large above 1 MeV, compared to unpublished LANL measurements.
- Monte Carlo simulations of the evaporation of the excited fission fragments following neutron-induced fission of 239Pu have been performed. Preliminary results indicate a softer spectrum than what currently exists in ENDF/B-VII.0. Results will be made available in ENDF format for beta testing by the end of the CY.
- Six presentations were given at ND2010 - the International Conference on Nuclear Data for Science and Technology, to be held in South Korea during the last week of April.
- LANL Nuclear Data specialists participated in the joint meeting of CSSG, NDAG, and Task Managers with NCSP Managers at Oak Ridge during the first week of April.

- The R-matrix analysis of data in the 17O system has been completed. Generation of covariances is complete, including cross sections and mu-bar. The updated ENDF cross-section file for n + 16O has been constructed, checked, and sent to ENDF/A for testing.
- A new evaluation for n + 51V is nearly complete. Hauser-Feshbach model calculations have been performed. Neutron cross sections have been converted to ENDF format.
- A new suite of codes has been developed to calculate, analyze, and evaluate prompt fission neutron spectra and multiplicities. The PFNS code implementing the Madland-Nix model is now an integral part of this package. A sensitivity module was added so that PFNS+KALMAN uncertainty quantification calculations can be performed easily.
- Data testing of revised 239Pu evaluation using Pu solution benchmarks was performed in support of WPEC-34.
- At the direction of the Federal Program Manager, three CEF experiments in support of Stockpile Stewardship were proposed.

LLNL:

- Completed a review of the ENDF/B-VII.0 time-dependent delayed fission gamma data previously provided by LLNL for 235U and determined that it is not suitable for dosimetry applications.
- Completed a review of published time-dependent and total delayed gamma multiplicity data and spectra.
- The results of these reviews were provided to the evaluating laboratory and discussed off-line at the mini-CSEWG meeting in Port Jefferson, NY, on June 22, 2010.
- Developed a simplified method using recently published delayed-photon multiplicity data together with older measured average delayed-photon spectra. This approach yielded low-fidelity data of similar quality to the average prompt spectra in ENDF/BVII.0 that was implemented in an R&D version of COG for testing against the ORNL criticality slide rule. The results were published in the LLNL internal document, "COG11x – New User Friendly Features for Assessing Criticality Accident Photon Doses", and presented at an LLNL technical seminar. This approach was subsequently abandoned in favor of a high-fidelity method (described in the next bullet).
- Initiated and completed a new effort to generate high-fidelity time-dependent and equilibrium delayed fission gamma multiplicity data and spectra using the England and Rider fission product yield database together with the JENDL/FPD-2000 photon library. The method and testing results were documented as LLNL-PRES-460638, "Delayed Fission Gammas", which was presented to the CSEWG Validation Subcommittee and NDAG at Santa Fe, NM, on November 1-5, 2010. The report includes: A summary of the known deficiencies in the current ENDF/B-VII.0 data; A summary of recent advances at JAERI (Japan); A description of technical basis for a new high-fidelity method to calculate delayed fission gamma multiplicity and spectra; A summary of the calculational results; A comparison of calculated delayed photon multiplicities to measured data; A comparison of calculated delayed photon spectra to measured data; Preliminary COG results with a comparison to the ORNL criticality accident slide rule; Proposed minor changes to the ENDF-6 format manual; and Multiplicity and equilibrium spectrum in (proposed) ENDF-6 format.

ORNL:

- Completed data reduction tasks for tungsten data measured at IRMM in FY09: received capture yields from IRMM for all tungsten samples (60 m flight path/800Hz runs); all data have been normalized using the data for natural Fe samples; capture data was produced for SAMMY format and input; produced transmissions for 186W 1 and 2 mm samples; and checked capture and transmission data for consistency.
- Identified enriched Cu material from ORNL isotope inventory.
- Initiated fabrication of titanium material sample for capture resonance integral measurements at IPEN (Brazil).
- Performed investigation of current URR methodology and provided status report at November 2009 CSEWG Meeting.
- Participated in November 2009 NDAG and CSEWG meetings—chaired ENDF/B Formats Committee.

- Updated ^{48}Ti resolved evaluation based on revised ORELA capture data and completed preliminary analysis of URR.
- Updated ^{55}Mn and ^{233}U evaluations based on NNDC testing Initial Gd measurements and SAMMY analysis completed—determined additional measurements needed to complete Gd.
- ORNL measurement specialist participated in IRMM workshop to study the multiple scattering correction applied by the data analysis software SAMMY and REFIT.
- Initiated preparation tasks at IRMM for the ^{63,65}Cu experiments to be performed in Q3.
- ORNL task manager and measurement specialist traveled to RPI to discuss ORNL/RPI measurement collaboration to support NCSP.
- Initiated fabrication of titanium material sample for capture resonance integral measurements at IPEN (Brazil).
- Updated ^{48}Ti resolved resonance evaluation to correctly model detector sensitivity (required update to SAMMY software) thereby enabling improved fit to capture data throughout resonance region.
- ORNL Measurement specialist participated in Gd measurements at RPI—measurements completed.
- Completed Dy isotopic cross-section measurements at RPI. RPI completed data reduction analyses for Gd and Dy measured data and initiated SAMMY analysis of data measured at RPI.
- Initiated ^{63}Cu capture measurements and transmission measurements using natural Cu samples at IRMM—also identified previously measured ORELA transmission data on enriched Cu samples.
- Met with CNEA thermal moderator expert at ND2010 meeting and discussed thermal moderator needs and data assessment plans.
- Finalized ^{48}Ti material specifications with IPEN to complete sample fabrication for integral measurements to be performed in Q4.
- WPEC URR subgroup: collected draft URR methodology recommendations from subgroup participants and developed ORNL input for draft report.
- Participated in ND2010, WPEC, CSEWG, and NDAG meetings.
- Completed ^{48}Ti resonance evaluation and initiated work with LANL to combine with high-energy evaluation for submittal to NNDC.
- Prepared preliminary SiO_2 thermal evaluation in collaboration with NCSU and initiated data testing activities.
- RPI completed Gd and Dy isotopic cross-section measurements. RPI completed data reduction analyses for Gd and Dy but the data could be modified further as a result of the resonance analysis.
- Completed 63Cu capture measurements at IRMM and identified previously measured ORELA transmission data on enriched Cu samples—retrieved and checked data from previous experiments.
- Initiated 65Cu measurements at IRMM.
- Submitted article to *Phys. Rev. C* about Ni capture cross sections.
- Nuclear data evaluator travel to LANL in September 2010 to finalize cross-section evaluations for 46Ti, 47Ti, 48Ti, 49Ti, and 50Ti—combined ORNL resonance region evaluation work with LANL high-energy evaluations—LANL submitted final evaluations to NNDC.
- SiO2 thermal evaluation completed with NCSU; finalized evaluations for 50Cr, 52Cr, 53Cr, and 54Cr and submitted to NNDC.

Training and Education

ANL:

- NCSET module on Burnup Credit for Criticality Safety was produced in Q4 and awaits resolution of review comments.

LLNL:

- Provided a class schedule for FY2010 that was approved on 9/24/2009.
- Completed hands-on training classes on 12/10/2009; 1/28/2010; 2/4/2010; 3/4/2010; 3/11/2010; 4/15/2010; 5/13/2010; 5/20/2010; and on 9/25/2010 for JTOT.
- Provided a course transition plan to the NCSP Manager for approval on 9/10/2010.

ORNL:

- Issued a three-priority description of the T&EP based upon CSSG Subgroup considerations.
- Issued a second call for new proposals and updates of prior proposals, based on the CSSG subgroup recommendations.
- Reviewed new/updated proposals, developed preliminary ORNL T&EP proposal for 4 March, scheduled subsequent review meeting to finalize the proposal for transmittal to CSSG and the NCSP Management Team.
- Conducted a March 4 multi-lab personnel meeting in Albuquerque to review and discuss the second-call training proposals from the complex. Participants from LANL, LLNL, SNL, and ORNL. Objectives and characteristics of the training program were solidified and direction received to review the status with the CSSG at the April 6–7 Oak Ridge meeting.
- Provided a course transition plan to the NCSP Manager for approval on 9/10/2010.
- Developed, distributed, obtained review and concurrence among contributors to the U.S. Department of Energy Nuclear Criticality Safety Program Training and Education Project Strategic Plan-delivered October 5, 2010.

SNL:

- Sandia hosted a meeting on March 2 on the NCSP T&EP with participation from the NCSP, ORNL, LANL, LLNL, ANL, and SNL.
- Significant progress was made in developing the training class.