

**United States Department of Energy**  
**Nuclear Criticality Safety Program**  
**Five-Year Execution Plan for the Mission and Vision**  
**FY 2010 through FY 2014**



**October 2009**

Nuclear Criticality Safety Program Five-Year Execution Plan, for Fiscal Years 2010-2014,  
October 2009.

Approved:

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## ACRONYMS AND DEFINITIONS

AM	Analytical Methods
AMPX	Nuclear Cross-Section Processing Computer Code Developed by ORNL
ANL	Argonne National Laboratory
ANS	American Nuclear Society
ARH	Atlantic Richfield Hanford
BNL	Brookhaven National Laboratory
CEA	Commissariat à l'Énergie Atomique
C <sub>ed</sub> T	Critical-Subcritical Experiment Design Team
CE-KENO	Continuous Energy Version of the KENO Code
CEF	Criticality Experiments Facility
CENTRM	Continuous-Energy Transport Module Within the SCALE Code System
CFD	Computational Fluid Dynamics
COG <sup>(1)</sup>	Lawrence Livermore National Laboratory Monte Carlo Computer Code
COMBINE	Idaho National Laboratory Cell Code
CSCT	Criticality Safety Coordinating Team
CSEWG	Cross-Section Evaluation Working Group
CSSG	Criticality Safety Support Group
DAF	Device Assembly Facility
DICE	Database for the International Criticality Safety Benchmark Evaluation Project
DOE	United States Department of Energy
EDA	Energy Dependent Analysis
EMPIRE	BNL Nuclear Reaction Model Code System for Data Evaluation
ENDF	Evaluated Nuclear Data File
EUG	End-Users Group
FY	Fiscal Year
GNASH <sup>(2)</sup>	A Statistical Nuclear Model Computer Code
GODIVA	Fast-Burst Reactor
GUI	Graphical User Interface
HEU	Highly-Enriched Uranium
IAEA	International Atomic Energy Agency

ICSBEP	International Criticality Safety Benchmark Evaluation Project
IE	Integral Experiments
INL	Idaho National Laboratory
IP&D	Information Preservation and Dissemination
IRMM	Institute for Reference Materials and Measurements
IRSN	Institut De Radioprotection et De Sûreté Nucléaire
JEFF	Joint Evaluated Fission and Fusion File
JENDL	Japanese Evaluated Nuclear Data Library
KALMAN	Bayesian Code that Estimates Covariances
$k_{\text{eff}}$	The mean number of fission neutrons produced by a neutron during its life within the system
KENO <sup>(3)</sup>	Monte Carlo Criticality Computer Code
LANL	Los Alamos National Laboratory
LANSCE	Los Alamos Neutron Science Center
LLNL	Lawrence Livermore National Laboratory
McGNASH	A modern version of the GNASH code developed at LANL to produce nuclear data evaluation files for the ENDF
MCNP	Monte Carlo N Particle (N currently equals 3) Computer Code
MIRTE	Matériaux Interaction Réflexion Toutes Epaisseurs
NA-17	Assistant Deputy Administrator for Facility and Infrastructure Acquisition and Operation
NCS	Nuclear Criticality Safety
NCSET	Nuclear Criticality Safety Engineer Training
NCSP	Nuclear Criticality Safety Program
ND	Nuclear Data
NDAG	Nuclear Data Advisory Group
NNSA	National Nuclear Security Administration
OECD/NEA	Organization for Economic Cooperation and Development/Nuclear Energy Agency
ORELA	Oak Ridge Electron Linear Accelerator
ORNL	Oak Ridge National Laboratory
RPI	Renssalaer Polytechnic Institute
PUFF	Multigroup Covariance Processing Code for the AMPX Cross-Section
RSICC	Radiation Safety Information Computational Center
SAMMY <sup>(4)</sup>	A Nuclear Model Computer Code

SCALE <sup>(5)</sup>	Standardized Computer Analyses for Licensing Evaluation
SILÈNE	Commissariat à l'Énergie Atomique Uranium Solution Critical Assembly
SNL	Sandia National Laboratories
SNM	Special Nuclear Materials
SQA	Software Quality Assurance
SRNL	Savannah River National Laboratory
S/U	Sensitivity/Unsensitivity
TRACY	Japan Atomic Energy Agency's (JAEA) – Transient Experiment Critical Facility
TSUNAMI	Tool for Sensitivity and Uncertainty Analysis Methodology Implementation
TSURFER <sup>(6)</sup>	Tool for Sensitive and Uncertainty Analysis of Response Functionals Using Experimental Results
T&E	Training and Education
URR	Unresolved Resonance Region
U.S.	United States
USLSTATS	Computer Program for Statistics
V&V	Verification and Validation
VIBE	Validation Interpretation and Bias Estimation
VIM	Vastly-Improved Monte Carlo Computer Code
VIMB	VIM Cross-Section Library Processing System
WINCO	Westinghouse Idaho Nuclear Company
WNR	Weapons Neutron Research Facility
WPEC	Working Party on International Evaluation Cooperation
ZPR	Zero-Power Reactor

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<sup>1</sup>COG was originally developed to solve deep penetration problems in support of underground nuclear testing. Variance reduction techniques are very important to these problems and hence the name COG was chosen as in “to cog the dice” or cheat by weighting.

<sup>2</sup>GNASH is a pre-equilibrium, statistical nuclear model code based on Hauser-Feshbach theory (and additional models) for the calculation of cross sections and emission spectra, primarily in the epithermal and fast neutron energy ranges.

<sup>3</sup>KENO is a family of Monte Carlo criticality codes whose name came from an observation of the KENO game in which small spheres, under air levitation, arbitrarily move about in a fixed geometry.

<sup>4</sup>SAMMY is a nuclear model code, which applies R-Matrix theory to measured data and produces resolved and un-resolved resonance parameters in Reich-Moore and other formalisms.

<sup>5</sup>SCALE is a system of well-established codes and data for performing nuclear safety (criticality, shielding, reactor physics and fuel irradiation) analyses.

<sup>6</sup>TSURFER is a prototype module of the SCALE code system that performs a generalized linear least squares adjustment of cross-section data to produce consistency between calculated and experimental results. When coupled with TSUNAMI sensitivity data for a criticality safety application, the adjusted cross-section data can be used to predict a computational bias and its uncertainty.

**United States Department of Energy  
Nuclear Criticality Safety Program  
Five-Year Execution Plan**

## **1.0 Nuclear Criticality Safety Program Mission and Vision**

The Nuclear Criticality Safety Program (NCSP) Mission and Vision, as stated in *The Mission and Vision of the United States Department of Energy Nuclear Criticality Safety Program for the Fiscal Years 2009-2018* (<http://ncsp.llnl.gov/NCSP-MV-COMPRESSED.pdf>), are:

The NCSP mission is to provide **sustainable expert** leadership, direction, and the technical infrastructure necessary to develop, maintain, and disseminate the essential technical tools, training, and data required to support **safe, efficient** fissionable material **operations** within the United States (U.S.) Department of Energy (DOE).

The NCSP will be a **continually improving, adaptable, and transparent** program that **communicates** and **collaborates** globally to incorporate technology, practices, and programs to be **responsive** to the essential technical needs of those responsible for developing, implementing, and maintaining nuclear criticality safety.

The NCSP is funded by the National Nuclear Security Administration (NNSA). Dr. Jerry McKamy (NA-172.1) is the NCSP Manager. He is supported by the Criticality Safety Support Group (CSSG) and the Nuclear Data Advisory Group (NDAG) regarding technical matters and by the Criticality Safety Coordinating Team (CSCT), consisting of Federal Criticality Safety Practitioners at the sites regarding DOE field criticality safety issues. Charters for the CSCT, CSSG and the NDAG can be found on the NCSP website at: (<http://ncsp.llnl.gov/>).

## **2.0 Technical Program Elements**

The NCSP includes the following six technical program elements:

- Analytical Methods
- Information Preservation and Dissemination
- Integral Experiments
- International Criticality Safety Benchmark Evaluation Project
- Nuclear Data
- Training and Education

A description of how each of these elements contributes to the enhancement of criticality safety is contained in the NCSP Mission and Vision document. This Five-Year Execution Plan contains the road map for each of the six technical program elements, including a budget, subtasks, and milestones for completing the work and achieving the NCSP Vision. All subtasks are approved based on their contribution to the achievement of the five- and ten-year goals in the Mission and Vision document. A budget summary for the NCSP activities conducted in the

United States and the MIRTE Integral Measurements Program being conducted in France is contained in Table 2-1 (rounded to the nearest \$100K).

**Table 2-1. Nuclear Criticality Safety Program Funding  
(United States Activities and MIRTE Program in France)  
Fiscal Years (FY) 2010 – 2014**

<b>FY 2010 (\$K)</b>	<b>FY 2011 (\$K)</b>	<b>FY 2012 (\$K)</b>	<b>FY 2013 (\$K)</b>	<b>FY 2014 (\$K)</b>
\$15,000	\$15,300	\$15,400	\$15,500	\$15,600

Finally, the goal of the NCSP is to provide “transparent responsiveness” for the DOE and Stakeholders. Therefore, this Plan and all accomplishments achieved under the auspices of the NCSP are posted in a timely manner on the NCSP website at: <http://ncsp.llnl.gov/>.

## **2.1 Analytical Methods**

### **2.1.1 Program Element Description**

The Analytical Methods (AM) program element provides for the development and maintenance of state-of-the-art analytical capability for the processing of nuclear data from the Evaluated Nuclear Data File (ENDF) and the radiation transport analysis needed to support nuclear criticality safety evaluations for subcriticality and shielding. An essential aspect of this capability is the human expertise required to develop the analytical software, provide software configuration control, and train and assist the user community. Additional information about the AM vision and strategy can be found in the *Mission and Vision of the U.S. Department of Energy, Nuclear Criticality Safety Program*, dated March 2008. A funding table is provided at the end of this program element section. The status of all milestones will be reported to the NCSP Manager in quarterly reports that are due no later than the last day of the month following the end of the quarter.

### **2.1.2 Approved Subtasks**

#### **Los Alamos National Laboratory (LANL) AM Subtasks**

##### **FY 2010**

##### **LANL AM Subtask 1 (\$747K)**

Provide ongoing maintenance of the basic capabilities for performing Nuclear Criticality Safety (NCS) calculations with MCNP, including general code maintenance, user support, improved nuclear data libraries, Verification and Validation (V&V), documentation, user training, and implementation of limited new capabilities.

**Milestones:**

- Issue an MCNP V&V report (Q2).
- Implement direct adjoint calculation into a version of MCNP and provide documentation (Q4).
- Provide one on-site class at a DOE site on the theory and practice of Monte Carlo criticality calculations with MCNP (Q4).
- Issue a report on MCNP testing on the latest computer platforms (Q4).

**LANL AM Subtask 2 (\$100K)**

Develop and maintain the NJOY nuclear data processing code system. Implement capabilities as needed to process new general purpose nuclear data files in evolving ENDF-6 format, including covariance data. Base versions of the NJOY code system will continue to be distributed to the domestic user community through the Radiation Safety Information Computational Center (RSICC) and to the international user community through the Organization for Economic Cooperation and Development/Nuclear Energy Agency (OECD-NEA) with code updates distributed to all users through a LANL maintained website.

**Milestone:**

- Release NJOY code updates required to process modified versions of international general purpose nuclear data files (Q4).

**FY 2011****LANL AM Subtask 1 (\$750K)**

The scope for this Subtask is the same as FY 2010.

**Milestones:**

- Issue an MCNP V&V report (Q2).
- Release an updated version of MCNP to RSICC (Q4).
- Release quality-assured MCNP neutron cross-section library for priority NCSP isotopes (Q4).
- Provide one on-site class at a DOE site on the theory and practice of Monte Carlo criticality calculations with MCNP (Q4).
- Simplify, generalize, and document the user interface for generating sensitivity profiles with MCNP (Q4).
- Issue a report on MCNP testing on the latest computer platforms (Q4).

**LANL AM Subtask 2 (\$100K)**

The scope for this Subtask is the same as FY 2010.

**Milestone:**

- Implement new ENDF-7 formats into NJOY (Q4).

## **FY 2012**

### **LANL AM Subtask 1 (\$750K)**

The scope for this Subtask is the same as FY 2010.

#### **Milestones:**

- Issue an MCNP V&V report (Q2).
- Implement a test for population size and other new diagnostics into MCNP and issue a report (Q4).
- Provide one on-site class at a DOE site on the theory and practice of Monte Carlo criticality calculations with MCNP (Q4).
- Develop a capability for convoluting MCNP-generated sensitivity profiles with cross-section covariance data (Q4).
- Issue a report on MCNP testing on the latest computer platforms (Q4).

### **LANL AM Subtask 2 (\$100K)**

The scope for this Subtask is the same as FY 2010.

#### **Milestone:**

- Issue a new base version of NJOY (Q4).

## **FY 2013**

### **LANL AM Subtask 1 (\$750K)**

The scope for this Subtask is the same as FY 2010.

#### **Milestones:**

- Issue an MCNP V&V report (Q2).
- Release an updated version of MCNP to RSICC (Q4).
- Release quality-assured MCNP neutron cross-section library for priority NCSP isotopes (Q4).
- Provide one on-site class at a DOE site on the theory and practice of Monte Carlo criticality calculations with MCNP (Q4).
- Issue a report on MCNP testing on the latest computer platforms (Q4).

### **LANL AM Subtask 2 (\$100K)**

The scope for this Subtask is the same as FY 2010.

#### **Milestone:**

- Issue a revised NJOY User Manual (Q4).

## **FY 2014**

### **LANL AM Subtask 1 (\$750K)**

The scope for this Subtask is the same as FY 2010.

#### **Milestones:**

- Issue an MCNP V&V report (Q2).
- Provide one on-site class at a DOE site on the theory and practice of Monte Carlo criticality calculations with MCNP (Q4).
- Simplify, generalize, and document the user interface for convoluting MCNP5-generated sensitivity profiles with cross-section covariances (Q4).
- Issue report on MCNP testing on the latest computer platforms (Q4).

### **LANL AM Subtask 2 (\$100K)**

The scope for this task is the same as FY 2010.

#### **Milestone:**

- Release NJOY code updates required to process modified versions of international general purpose nuclear data files (Q4).

## **Lawrence Livermore National Laboratory (LLNL) AM Subtasks**

### **FY 2010**

#### **LLNL AM Subtask 1 (\$237K)**

Provide maintenance, user support and modest upgrades to the existing LLNL analytical methods including nuclear data processing, geometry modeling, and Monte-Carlo methods.

#### **Milestones:**

- Provide quarterly progress reports describing maintenance, user support, upgrades and participation in NCSP activities (Q1, Q2, Q3, Q4).
- Prepare a paper to be published at ICNC-2011 describing the new nuclear data and code features of COG11 for use in criticality safety applications (Q4).

#### **LLNL AM Subtask 2 (\$52K)**

Participate in NCSP activities including the Critical-Subcritical Experiment Design Team (C<sub>e</sub>dT), Cross Section Evaluation Working Group (CSEWG) and Nuclear Data Advisory Group (NDAG).

#### **Milestones:**

- Report level of C<sub>e</sub>dT, CSEWG, and NDAG participation in quarterly reports to the NCSP Manager (Q1, Q2, Q3, Q4).

## **FY 2011**

### **LLNL AM Subtask 1 (\$238K)**

Provide maintenance, user support and modest upgrades to the existing LLNL analytical methods including nuclear data processing, geometry modeling, and Monte-Carlo methods.

#### **Milestones:**

- Provide quarterly progress reports describing maintenance, user support, upgrades and participation in NCSP activities (Q1, Q2, Q3, Q4).

### **LLNL AM Subtask 2 (\$52K)**

Participate in NCSP activities including the Critical-Subcritical Experiment Design Team (C<sub>e</sub>dT), Cross Section Evaluation Working Group (CSEWG) and Nuclear Data Advisory Group (NDAG).

#### **Milestones:**

- Report level of C<sub>e</sub>dT, CSEWG, and NDAG participation in quarterly reports to the NCSP Manager (Q1, Q2, Q3, Q4).

## **FY 2012**

Scope, funding, and milestones for Subtasks 1 and 2 remain the same as in FY 2011.

## **FY 2013**

### **LLNL AM Subtask 1 (\$243K)**

Provide maintenance, user support and modest upgrades to the existing LLNL analytical methods including nuclear data processing, geometry modeling, and Monte-Carlo methods.

#### **Milestones:**

- Provide quarterly progress reports describing maintenance, user support, upgrades and participation in NCSP activities (Q1, Q2, Q3, Q4).

### **LLNL AM Subtask 2 (\$57K)**

Participate in NCSP activities including the Critical-Subcritical Experiment Design Team (C<sub>e</sub>dT), Cross Section Evaluation Working Group (CSEWG) and Nuclear Data Advisory Group (NDAG).

#### **Milestones:**

- Report level of C<sub>e</sub>dT, CSEWG, and NDAG participation in quarterly reports to the NCSP Manager (Q1, Q2, Q3, Q4).

## **FY 2014**

Scope, funding, and milestones for Subtasks 1 and 2 remain the same as in FY 2013.

### **Oak Ridge National Laboratory (ORNL) AM Subtasks**

## **FY 2010**

### **ORNL AM Subtask 1 (\$373K)**

RSICC. Collect, update, package, and distribute software and associated nuclear data libraries to the criticality safety community (i.e., SCALE, MCNP, VIM, and COG and nuclear data processing (i.e., NJOY, AMPX and SAMMY). Also, test and disseminate processed nuclear data associated with the software.

#### **Milestones:**

- Continue distribution of available and newly packaged software to the first 200 NCS community requesters (at no direct cost to them) and provide distribution totals quarterly (Q1, Q2, Q3, and Q4).
- Provide monthly newsletters to announce software updates, conferences and workshops newsletters and provide status quarterly (Q1, Q2, Q3, and Q4).

### **ORNL AM Subtask 2 (\$620K)**

Provide SCALE/KENO/TSUNAMI maintenance including: sustaining and continually improving SCALE NCS features through user-driven enhancements, software quality assurance (SQA) and V&V; assuring adaptability to various computing platforms and compilers; providing improved user interfaces and user documentation consistent with modern engineering software; supporting responsive communication to SCALE criticality safety users through SCALE Newsletters, email notices, and updates on the SCALE website. During FY2010, efforts will focus on the release of SCALE 6.1; this new SCALE release will include improvements to the KENO mesh volumes calculation and propagation of the variances in the mesh volumes to the variances of the sensitivities calculated by TSUNAMI.

#### **Milestones:**

- Release SCALE 6.1 to RSICC (Q4).
- Issue an annual SCALE maintenance report (Q1).
- Publish semiannual newsletters to users to communicate software updates, user notices, generic technical advice, and training course announcements (Q2, Q4).
- Provide a status of SCALE SQA maintenance activities (Q1, Q2, Q3, Q4).
- Complete migration of SCALE SQA maintenance to the GForge software maintenance system (Q4).
- Provide ongoing website maintenance including posting software updates for users to download, validation reports and other technical publications, training course schedules, and registration. Provide a status of these activities quarterly (Q1, Q2, Q3, Q4).

- Participate in OECD/NEA Working Party on Nuclear Criticality Safety (Q4)

### **ORNL AM Subtask 3 (\$50K)**

Provide SCALE/KENO/TSUNAMI user assistance and training by answering user questions via phone, e-mail, or user notebooks on the RSICC website. KENO and TSUNAMI training courses are offered in the spring and fall of each year at ORNL. In addition, one training course will be offered each year to university nuclear engineering faculty and students at no charge. Technical assistance to users is provided through [scalehelp@ornl.gov](mailto:scalehelp@ornl.gov).

#### **Milestones:**

- Conduct semiannual training courses at ORNL, subject to sufficient enrollment (Q1, Q3).
- Provide ongoing responses to user technical questions via email and SCALE electronic user notebook and report status quarterly (Q1, Q2, Q3, Q4).

### **ORNL AM Subtask 4 (\$100K)**

Conduct AMPX development and maintenance to include ensuring the AMPX software is up-to-date and in conformance with ENDF/B formats and procedures and the development of enhancements to the AMPX software to enable improved nuclear data processing capabilities in addition to providing new reaction physics capabilities needed to support radiation transport methods development and analyses (e.g., coupled energy/angle covariance data, continuous-energy adjoint capabilities, etc.). Also, continue to maintain and improve the PUFF-IV covariance processing package (which is part of AMPX) that is used to test the ability to process covariance files.

#### **Milestones:**

- Complete automated sequences for AMPX to produce continuous energy (CE) and multigroup SCALE cross-section libraries (Q3)
- Document technical support for SCALE CE, multigroup, and covariance libraries and report status annually (Q4)
- Process new ORNL evaluations produced by the Nuclear Data Element to demonstrate evaluations conform to ENDF/B formats/procedures (Q4)
- Chair the Working Party on International Evaluation Cooperation (WPEC) Subgroup on covariance processing (Q4)

### **ORNL AM Subtask 5 (\$200K)**

Provide the design, evaluation, and documentation of benchmark quality measurements for Criticality Accident Alarm System (CAAS) experimental configurations to be performed in the SILENE reactor cell. The design of the experimental configurations will consider input from DOE stakeholders, input from IRSN staff related to availability of shielding materials (e.g., the lead shielding that can be used around the SILENE reactor and the shielding materials being used in the MIRTE experiments), detectors and facility constraints, and results of design analyses. It is expected that no fewer than 12 different experimental configurations, with

varying interstitial shielding materials and thicknesses, and configurations with streaming paths will be designed. Experimental design and execution will occur during FY 2010. During FY 2011 through FY 2012 the experiment will be analyzed and published as an International Criticality Safety Benchmark Evaluation Project (ICSBEP) benchmark. Also during FY 2011 through FY 2012, the various calculational methods that were used to calculate the experiments will be evaluated and proposals to improve these methods will be forwarded to the NCSP Manager through the annual proposal process for consideration.

**Milestones:**

- Complete design and documentation of proposed experimental configurations (Q1)
- Complete pre-measurement analyses (Q3)
- Provide a trip report from travel to Valduc for the experiment (Q4)

**FY 2011**

**ORNL AM Subtask 1 (\$375K)**

Scope and milestones for ORNL Subtask 1 remains the same as in FY 2010.

**ORNL AM Subtask 2 (\$620K)**

Scope for ORNL Subtask 2 remains the same as in FY 2010.

**Milestones:**

- Complete user validation package with TSUNAMI sensitivity data files for release with SCALE 6.2 (Q4).
- Provide ongoing SCALE SQA maintenance activities (Q4)
- Issue an annual SCALE maintenance report (Q1).
- Publish semiannual newsletters to users to communicate software updates, user notices, generic technical advice, and training course announcements (Q2, Q4).
- Provide ongoing website maintenance including posting software updates for users to download, validation reports and other technical publications, training course schedules, and registration. Provide a status of these activities quarterly (Q1, Q2, Q3, Q4).

**ORNL AM Subtask 3 (\$50K)**

Scope and milestones for ORNL Subtask 3 remains the same as in FY 2010.

**ORNL AM Subtask 4 (\$100K)**

Scope for ORNL Subtask 4 remains the same as in FY 2010.

**Milestones:**

- Release AMPX cross-section processing package through RSICC and provide user support (Q4)

- Document technical support for SCALE CE, multigroup, and covariance libraries and report status annually (Q4)
- Process new ORNL evaluations produced by the Nuclear Data Element to demonstrate evaluations conform to ENDF/B formats/procedures (Q4).

### **ORNL AM Subtask 5 (\$200K)**

FY 2011 Scope ORNL Subtask 5 is described in the FY 2010 Subtask 5 description (above).

#### **Milestones:**

- Complete draft benchmark evaluation (Q4).
- Complete draft report that documents the evaluation and includes user-guidance for accurate CAAS analyses (Q4).

### **FY 2012**

### **ORNL AM Subtask 1 (\$375K)**

Scope and milestones for ORNL Subtask 1 remains the same as in FY 2010.

### **ORNL AM Subtask 2 (\$680K)**

Scope for ORNL Subtask 2 remains the same as in FY 2010.

#### **Milestones:**

- Release SCALE 6.2 to RSICC (Q4).
- Provide ongoing SCALE SQA maintenance activities (Q4).
- Issue an annual SCALE maintenance report (Q1).
- Publish semiannual newsletters to users to communicate software updates, user notices, generic technical advice, and training course announcements (Q2, Q4).
- Provide ongoing website maintenance including posting software updates for users to download, validation reports and other technical publications, training course schedules, and registration. Provide a status of these activities quarterly (Q1, Q2, Q3, Q4).

### **ORNL AM Subtask 3 (\$50K)**

Scope and milestones for ORNL Subtask 3 remains the same as in FY 2010.

### **ORNL AM Subtask 4 (\$100K)**

Scope for ORNL Subtask 4 remains the same as in FY 2010.

#### **Milestones:**

- Complete automated continuous-energy data library checking utility for AMPX to perform consistency checks on SCALE CE libraries (Q4).

- Document technical support for SCALE CE, multigroup, and covariance libraries and report status annually (Q4).
- Process new ORNL evaluations produced by the Nuclear Data Element to demonstrate evaluations conform to ENDF/B formats/procedures (Q4).

#### **ORNL AM Subtask 5 (\$140K)**

FY 2012 Scope ORNL Subtask 5 is described in the FY 2010 Subtask 5 description (above).

##### **Milestones:**

- Complete final benchmark evaluation (Q3).
- Complete final report that documents the evaluation and includes user-guidance for accurate CAAS analyses (Q3).
- Publish/present results of activity (Q4).
- Complete letter report describing outstanding user needs for CAAS analyses and recommended future work to address the needs (Q4).

#### **FY 2013**

#### **ORNL AM Subtask 1 (\$375K)**

Scope and milestones for ORNL Subtask 1 remains the same as in FY 2010.

#### **ORNL AM Subtask 2 (\$820K)**

Scope for ORNL Subtask 2 remains the same as in FY 2010.

##### **Milestones:**

- Complete initial version of automated verification tool and test suite for SCALE/KENO regression testing (Q4).
- Provide ongoing SCALE SQA maintenance activities (Q4).
- Issue an annual SCALE maintenance report (Q1).
- Publish semiannual newsletters to users to communicate software updates, user notices, generic technical advice, and training course announcements (Q2, Q4).
- Provide ongoing website maintenance including posting software updates for users to download, validation reports and other technical publications, training course schedules, and registration. Provide a status of these activities quarterly (Q1, Q2, Q3, Q4).

#### **ORNL AM Subtask 3 (\$50K)**

Scope and milestones for ORNL Subtask 3 remains the same as in FY 2010.

#### **ORNL AM Subtask 4 (\$100K)**

Scope for ORNL Subtask 4 remains the same as in FY 2010.

**Milestones:**

- Release updated version of AMPX through RSICC (Q4).
- Document technical support for SCALE CE, multigroup, and covariance libraries and report status annually (Q4).
- Process new ORNL evaluations produced by the Nuclear Data Element to demonstrate evaluations conform to ENDF/B formats/procedures (Q4).

**ORNL AM Subtask 5 (\$0K)**

Continued work in this area will be based on approval of proposals by the NCSP Manager through the annual proposal process.

**FY 2014****ORNL AM Subtask 1 (\$375K)**

Scope and milestones for ORNL Subtask 1 remains the same as in FY 2010.

**ORNL AM Subtask 2 (\$820K)**

Scope for ORNL Subtask 2 remains the same as in FY 2010.

**Milestones:**

- Release SCALE 7 to RSICC (Q4).
- Provide ongoing SCALE SQA maintenance activities (Q4).
- Issue an annual SCALE maintenance report (Q1).
- Publish semiannual newsletters to users to communicate software updates, user notices, generic technical advice, and training course announcements (Q2, Q4).
- Provide ongoing website maintenance including posting software updates for users to download, validation reports and other technical publications, training course schedules, and registration. Provide a status of these activities quarterly (Q1, Q2, Q3, Q4).

**ORNL AM Subtask 3 (\$50K)**

Scope and milestones for ORNL Subtask 3 remains the same as in FY 2010.

**ORNL AM Subtask 4 (\$100K)**

Scope for ORNL Subtask 4 remains the same as in FY 2010.

**Milestones:**

- Release updated version of PUFF covariance processing package (Q4).
- Document technical support for SCALE CE, multigroup, and covariance libraries and report status annually (Q4).

- Process new ORNL evaluations produced by the Nuclear Data Element to demonstrate evaluations conform to ENDF/B formats/procedures (Q4).

### ORNL AM Subtask 5 (\$0K)

Continued work in this area will be based on approval of proposals by the NCSP Manager through the annual proposal process.

#### 2.1.3 Analytical Methods Budget

<b>Analytical Methods Budget, Fiscal Years 2010 – 2014</b>
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LABORATORY	FY 2010 (\$K)	FY 2011 (\$K)	FY 2012 (\$K)	FY 2013 (\$K)	FY 2014 (\$K)
LANL	\$847	\$850	\$850	\$850	\$850
LLNL	\$289	\$290	\$290	\$300	\$300
ORNL	\$1,343	\$1,345	\$1,345	\$1,345	\$1,345
<b>TOTAL</b>	<b>\$2,479</b>	<b>\$2,485</b>	<b>\$2,485</b>	<b>\$2,495</b>	<b>\$2495</b>

## 2.2 Information Preservation and Dissemination

### 2.2.1 Program Element Description

The Information Preservation and Dissemination (IP&D) program element preserves primary documentation supporting criticality safety and makes this information available for the benefit of the technical community. The NCSP internet website (<http://ncsp.llnl.gov>) is the central focal point for access to criticality safety information collected under the NCSP, and the gateway to a comprehensive set of hyperlinks to other sites containing criticality safety information resources. Additional information about the IP&D vision and strategy can be found in the *Mission and Vision of the U.S. Department of Energy, Nuclear Criticality Safety Program*, March 2008 document. A funding table is provided at the end of this program element section. The status of all milestones will be reported to the NCSP Manager in quarterly reports that are due no later than the last day of the month following the end of the quarter.

## 2.2.2 Approved Subtasks

### Argonne National Laboratory (ANL) IP&D Subtasks

#### FY 2010

##### ANL IP&D Subtask 1 (\$40K)

Collect and preserve the inventory records (size, composition, construction, etc.) of the ANL Zero Power Reactor (ZPR)/Zero Power Physics Reactor (ZPPR) materials. This is important because some portion of these ZPR materials are planned to be retained and used at the Critical Experiment Facility in Nevada.

##### Milestones:

- Identify the available inventory records of the ANL ZPR/ZPPR materials (Q2).
- Document and provide a sample electronic format for conversion of the hard copy data (Q4).
- Document the electronic files produced from the available inventory records of the ANL ZPR/ZPPR materials (Q4).

#### FY 2011

##### ANL IP&D Subtask 1 (\$40K)

Complete the conversion of the data to that electronic format specified in FY 2010, Subtask 1.

##### Milestone:

- Document the electronic files produced from the available inventory records of the ANL ZPR/ZPPR materials (Q4).

#### FY 2012 - FY 2014

Continued work in this area will be based on approval of proposals by the NCSP Manager through the annual proposal process.

### Hanford IP&D Subtasks

#### FY 2010

##### Hanford IP&D Subtask 1 (\$80K, all FY 2009 Carryover)

Continue to enhance the Atlantic Richfield Hanford Handbook (ARH)-600 Database. This handbook requires revision, correction, and reissue as an electronic handbook. ARH-600 contains novel data presentations. It was developed, starting in the 1960's, with computer codes and cross section sets that do not have documented validation. Furthermore documentation of

independent peer review will be accomplished. ARH-600 is accessible through the NCSP website.

**Milestones:**

- Identify and document sensitivity of MCNP Calculations to ARH-600 Model assumptions (Q2)
- Issue peer reviewed report documenting added MCNP calculations for CritView libraries (Q4)
- Provide updated CritView MCNP data libraries and documentation to LLNL for posting on the NCSP website (Q4)

**Hanford IP&D Subtask 2 (\$0K)**

Develop a 55-Gallon Drum Standard. The development of an analytical 55-Gallon Drum Standard for waste drums could provide a more consistent and defensible approach to criticality safety and greater latitude in the management of these drums. A standard analysis for 55-gallon drums could also help reduce non-conformances. The need for such a standard was assessed in FY 2009 but due to competing priorities a decision on whether or not to proceed was not made. A placeholder with funding has been reserved in the out years in the event that the decision is made to proceed with developing a 55-Gallon Drum Standard.

**Milestone:**

- Obtain a decision from the NCSP Manager on whether or not to proceed with the development of a 55 Gallon Drum Standard (Q3).

**Hanford IP&D Subtask 3 (\$86K; includes \$21K carryover from FY 2009)**

Develop a method for obtaining integral cross sections for actinides from reactor operations and special test data. The cross sections or reaction rates can be used for validating burn-up codes experimental parameter studies and other cross section sets to ensure safe designs of facilities, equipment, and fuel cycle processes. The first activities will be to begin a recovery of relevant data from production and tests at Hanford and the Savannah River Site production reactors and identify relevant cross section data associated with testing and surveillance. A proof of principle demonstrating the approach for extracting nuclear data for a specific actinide will also be completed. The following partitioning of funds is planned (Hanford - \$46K; SRS - \$15K; and ORNL - \$25K). The ORNL contribution is to evaluate the mathematical approaches and application of advanced statistical models for data manipulation and extraction. The SRS contribution will be reactor and analyses data.

**Milestones:**

- Issue letter report documenting survey of Hanford and Savannah River published literature (Q1).
- Issue letter report documenting progress on survey of unpublished reports, letters and personal notes (Q3)
- Issue letter report documenting proof of principle test for extracting nuclear data for single set of data points (Q4)

- Issue letter report listing irradiated targets that are available for radiochemical analysis (Q4)

## **FY 2011**

### **Hanford IP&D Subtask 1 (\$40K)**

Continue verification and validation for MCNP and SCALE code calculations to be added to the database for CritView; provide documentation of these data and incorporation into the CritView program. Maintain and upgrade CritView as funding permits; provide limited response to user queries and any error identification.

#### **Milestones:**

- Issue a peer reviewed report documenting added LA10860 Data for CritView libraries (Q4)
- Provide updated CritView data libraries and documentation to LLNL for posting on the NCSP website (Q4)

### **Hanford IP&D Subtask 2 (\$100K if decision is to develop the standard)**

Develop a 55-Gallon Drum Standard. If decision is made to develop the standard, the following milestones will be met this year:

#### **Milestones:**

- Document the scope and preliminary outline for the Technical Report (Q1)
- Issue Technical Report draft to CSSG for Comment (Q4)

### **Hanford IP&D Subtask 3 (\$70K)**

Continue developing a method for obtaining integral cross sections for actinides from reactor operations and special test data.

#### **Milestones:**

- Issue letter report containing relevant reactor operations data (Q2)
- Issue letter report providing identification and compilation of potential benchmarks (Q4)
- Issue letter report documenting computer model for extraction and sensitivity calculations (Q4)

## **FY 2012**

### **Hanford IP&D Subtask 1 (\$40K)**

Continue verification and validation for MCNP and SCALE code calculations to be added to the database for CritView; provide documentation of these data and incorporation into the CritView

program. Maintain and upgrade CritView as funding permits; provide limited response to user queries and any error identification.

**Milestones:**

- Update and document changes to data files (MCNP, ARH-600, LA10860) (Q3)
- Update and document CritView code to new operating system (Q4)

**Hanford IP&D Subtask 2 (\$100K if decision is to develop the standard)**

Develop a 55-Gallon Drum Standard. If decision is made to develop the standard, the following milestones will be met this year:

**Milestones:**

- Issue Technical Report draft to NCSP Endusers for Comment (Q2)
- Publish Technical Report incorporating NCSP Enduser comments on NCSP website (Q4)
- Issue PINS to ANSI/ANS for Drum Standard (Q4)

**Hanford IP&D Subtask 3 (\$120K)**

Continue developing a method for obtaining integral cross sections for actinides from reactor operations and special test data. Also develop a data record matrix for isotopes and reactors.

**Milestones:**

- Issue letter report providing comprehensive evaluation of data for all possible nuclear parameters (Q4)
- Issue letter report providing identification and compilation of potential benchmarks (Q4)

**FY 2013**

**Hanford IP&D Subtask 1 (\$40K)**

Continue verification and validation for MCNP and SCALE code calculations to be added to the database for CritView; provide documentation of these data and incorporation into the CritView program. Maintain and upgrade CritView as funding permits; provide limited response to user queries and any error identification.

**Milestones:**

- Issue peer reviewed report documenting added SCALE calculations for CritView libraries (Q4)
- Provide updated CritView SCALE data libraries and documentation to LLNL for posting on the NCSP website (Q4)

### **Hanford IP&D Subtask 2 (\$50K if decision is to develop the standard)**

Develop a 55-Gallon Drum Standard. If decision is made to develop the standard, the following milestones will be met this year:

#### **Milestone:**

- Issue draft Standard for review (Q4)

### **Hanford IP&D Subtask 3 (\$50K)**

Complete developing a method for obtaining integral cross sections for actinides from production reactor operations and special test data and apply to common actinides. Perform validation by cross section checks between alternate pathways to obtain same cross section. Future work will involve completing an exhaustive search of relevant actinide irradiation data at Hanford and SRS, exploring different options for extraction of relevant, uncommon actinides (e.g. outside the Pu chain) cross sections and reaction rates and selecting best option for application to available data, identification of unanalyzed targets and the funding need to recover relevant data from these targets. If successful, future work beyond the original scope of this Subtask may be expanded to an examination of relevant fuel irradiations in FFTF and HFIR and subsequent chemical analyses.

#### **Milestones:**

- Issue final report that assembles results into documentation suitable for nuclear criticality analyses (Q2)
- Issue letter report providing identification and compilation of potential benchmarks (Q4)

**FY 2014**

### **Hanford IP&D Subtask 1 (\$40K)**

Continue verification and validation for MCNP and SCALE code calculations to be added to the database for CritView; provide documentation of these data and incorporation into the CritView program. Maintain and upgrade CritView as funding permits; provide limited response to user queries and any error identification.

#### **Milestones:**

- Issue peer reviewed report documenting added SCALE calculations for CritView libraries (FYQ4)
- Provide updated CritView data libraries and documentation to LLNL for posting on the NCSP website (Q4)

## **LLNL IP&D Subtasks**

**FY 2010**

### **LLNL IP&D Subtask 1 (\$72K)**

Operate and Maintain the NCSP Web Site: monitor on-going operations; install monthly Operating System patches; perform daily backup of the Integral Experiment Request Form database; upgrade web server software; perform monthly risk assessment required by NNSA cyber security policy; and maintain computer operations.

**Milestone:**

- Provide status reports of website activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

### **LLNL IP&D Subtask 2 (\$31K)**

Post information to the website: coordinate the implementation of the NCSP information from NCSP management, CSSG, and the CSCT onto the web site; convert various document types into PDF files or web pages; and assist NCS users to solve website access and printing problems.

**Milestone:**

- Provide status reports of website activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

### **LLNL IP&D Subtask 3 (\$120K)**

Continue development and maintenance of the electronic Integral Experiment Request Form (i.e. CED-0, CED-1, CED-2, CED-3, CED-4, databases).

**Milestones:**

- Develop and deploy beta version of IER form CED-1 & CED-2 (FY 2010, Q1).
- Develop and deploy beta version of IER form CED-3 & CED-4 (FY 2010, Q3).
- Maintain the electronic form and provide status reports in NCSP Quarterly Progress Reports (FY 2010 - FY 2014: Q1, Q2, Q3, Q4)

### **LLNL IP&D Subtask 4 (\$10K)**

Periodically upgrade website hardware and software: upgrade new software to enhance the operations in security and data management and provide replacement electronic components such as power unit and the uninterruptible power supply unit in the event of power interruptions and failures.

**Milestone:**

- Provide status reports of website activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

**LLNL IP&D Subtask 5 (\$30K)**

Institute multimedia web based training: revamp training web pages to provide DOE-STD-1135-99, Section VIII Continuing Training Requirements, with multi-media streaming video feature. This subtask utilized LLNL HS3104 training module as a starting point in FY 2008, and is adding the Oak Ridge Critical Experiments Facility Heritage video series (10 DVDs) in FY 2009, the Los Alamos Critical Experiments Facility (LACEF) Heritage video series (9 DVDs) in FY 2010 and other materials as deemed necessary by IP&D Manager in the out years.

**Milestones:**

- Process and deploy the LACEF Heritage video series (9 DVDs) (Q4).
- Process additional videos as directed by the IP&D Manager and provide status reports of website activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

**LLNL IP&D Subtask 6 (\$10K)**

Create an electronic Nuclear Data Request Form similar to Integral Experiments Request Form, to provide requestors with a means to submit online nuclear data measurement requests.

**Milestone:**

- Develop a beta version of Nuclear Data Request Form (FY 2010: Q4).
- Maintain the electronic form and provide status reports in NCSP Quarterly Progress Reports (FY 2011 - FY 2014: Q1, Q2, Q3, Q4)

**LLNL IP&D Subtask 7 (\$50K)**

Digitize and Archive hardcopy bibliography reports starting with the LLNL hardcopy reports collection. The scanned bibliography files will be uploaded onto the NCSP website and will also be stored in CDs for distribution. In addition, limited copy services will be provided per individual requests.

**Milestone:**

- Provide status reports of digitize hardcopy bibliography reports in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

**LLNL IP&D Subtask 8 (\$50K)**

Digitize and Archive classified critical experiments data and benchmarks starting with the LLNL classical reports collection.

**Milestones:**

- Provide status reports of digitize classified critical experiments data and benchmarks in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

**FY 2011 - FY 2014**

Scope and milestones for LLNL IP&D Subtasks 1-8 remain the same as stated above. Funding for these Subtasks is contained in the following table.

**LLNL IP&D Budget for Subtasks 1-8 (Fiscal Years 2011 – 2014)**

<b>Subtask</b>	<b>FY2011</b>	<b>FY2012</b>	<b>FY2013</b>	<b>FY2014</b>
Subtask 1	\$74K	\$76K	\$78K	\$80K
Subtask 2	\$32K	\$33K	\$34K	\$36K
Subtask 3	\$124K	\$66K	\$68K	\$70K
Subtask 4	\$10K	\$10K	\$10K	\$10K
Subtask 5	\$30K	\$30K	\$30K	\$30K
Subtask 6	\$62K	\$30K	\$31K	\$32K
Subtask 7	\$52K	\$54K	\$56K	\$58K
Subtask 8	\$52K	\$54K	\$56K	\$58K

**ORNL IP&D Subtasks**

**FY 2010**

**ORNL IP&D Subtask 1 (\$48K)**

Preserve previously measured Oak Ridge Electron Linear Accelerator (ORELA) Nuclear Data: catalog and archive previously measured ORELA data taken over the past 40 years in a modern, retrievable database to support current and future resonance-region cross-section evaluation efforts. The measured data, currently on magnetic tape reels (~350 tapes), will be converted to a modern, retrievable storage medium (e.g., DVD).

**Milestone:**

- Complete conversion of ORELA data from magnetic tapes to a modern data format (Q3)

**FY 2011 - FY 2014**

**ORNL IP&D Subtask 1 (\$0K)**

Currently there is no identified funding for continuation of this Subtask. However, if a proposal to continue this effort is approved in FY 2010, work will proceed as follows: ORELA nuclear

data staff will work with retired experimentalists to organize and catalog the data to facilitate future retrieval. Once the salvageable datasets are identified, the data will be processed to convert the raw measured data to cross-section units thereby making the data readily retrievable for future use. Moreover, some software development effort may be needed to update the Graphical User Interface retrieval software tool (i.e., developed previously at ORELA) to accommodate data currently not supported by the software (e.g., energy-angle scattering measurements). In addition, the ORELA logbook data must be used to interpret the data for cataloging and determining its utility. Efforts in FY2012 would focus on scanning the ORELA logbooks into a modern electronic format.

**Milestones:**

- Complete cataloging and archiving of the ORELA data with transmission of experimental data to National Nuclear Data Center as needed (FY 2011: Q4).
- Electronic version of ORELA experimental logbooks (FY 2012: Q4).

**2.2.3 Information Preservation and Dissemination Budget**

**Information Preservation and Dissemination Budget (Fiscal Years 2010 – 2014)**

LABORATORY	FY 2010 (\$K)	FY 2011 (\$K)	FY 2012 (\$K)	FY 2013 (\$K)	FY 2014 (\$K)
ANL	\$40	\$40	\$0	\$0	\$0
Hanford	\$65	\$210	\$260	\$140	\$40
LLNL	\$373	\$436	\$353	\$363	\$374
ORNL	\$48	\$0	\$0	\$0	\$0
<b>TOTAL</b>	<b>\$526</b>	<b>\$686</b>	<b>\$613</b>	<b>\$503</b>	<b>\$414</b>

**2.3 Integral Experiments**

**2.3.1 Program Element Description**

The Integral Experiments (IE) program element maintains a fundamental capability for the DOE/NCSP to be able to perform critical, subcritical, and fundamental physics measurements, within the limits of its resources, to address specific site needs on a prioritized basis. This program element also supports maintaining a fundamental nuclear materials handling capability which enables hands-on nuclear criticality safety training programs and various other programs for the DOE/NCSP and other government agencies. Additional information about the Analytical Methods vision and strategy can be found in the *Mission and Vision of the U.S. Department of Energy, Nuclear Criticality Safety Program*, March 2008 document. A funding table is provided at the end of this program element section. The status of all milestones will be reported to the

NCSP Manager in quarterly reports that are due no later than the last day of the month following the end of the quarter.

### **2.3.2 Approved Subtasks**

#### **Idaho National Laboratory (INL) IE Subtasks**

##### **FY 2010**

##### **INL IE Subtask 1 (\$250K)**

The Institut De Radioprotection et De Sûreté Nucléaire (IRSN) has initiated an experimental program, Matériaux Interaction Réflexion Toutes Epaisseurs (MIRTE), in which integral reactivity characteristics of various structural materials will be tested in critical assemblies on the APPARATUS B facility at the Commissariat à l'Énergie Atomique (CEA) Valduc Centre.

Phase 1 of the MIRTE Program consists of about 20 subcritical approaches extrapolated to critical conditions using the neutron amplification method. A similar number of reference and reproducibility experiments will also be performed. Most configurations will be focused on interaction, but some will be reflected. Only low-enriched UO<sub>2</sub> (4.738% enriched uranium) water-moderated rod arrays with thermal energy spectra will be constructed. The experiments have been designed such that the reactivity worth of the structural materials exceeds 4%. Uncertainties in the experimental  $k_{\text{eff}}$  values are expected to be lower than 0.2%. The materials to be tested include: large absorber screens of concrete, iron, nickel, lead, zirconium, aluminum, copper, and cast-iron; thin plates of iron, nickel, copper and titanium; and reflected experiments with aluminum and SiO<sub>2</sub> (glass).

##### **Milestone:**

- Provide status reports in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

##### **FY 2011**

##### **INL IE Subtask 1 (\$250K)**

The results of Phase 1 of the IRSN MIRTE Program will be compiled and evaluated in accordance with the requirements of the ICSBEP. Phase 1 of the MIRTE Program, including funding, will end in FY-2011; however, evaluation of the data will extend into 2012.

##### **Milestone:**

- Provide status reports in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

##### **INL IE Subtask 2 (\$300K)**

Phase 2 of the IRSN MIRTE Program is an expansion in which integral reactivity tests of Mn, Cr, and Mo will be performed. The purpose of this subtask is to design experiments that will

also be performed on the APPARATUS B facility at the CEA Valduc Centre. Design of Phase 2 of MIRTE should be completed during FY-2011.

**Milestone:**

- Provide informal experiment design report (Q4).

**FY 2012**

**INL IE Subtask 1 (\$0K)**

Evaluation of Phase 1 MIRTE experimental data will continue into FY-2012. Once the evaluation phase is completed, final reports will be submitted to the ICSBEP for a proprietary peer review and preparation for publication. Release of the data will be restricted to the designated beneficiaries (including DOE and all DOE national laboratories) for up to seven years after completion of the experiments.

**Milestone:**

- Receipt of Final Evaluation Report (Q3).

**INL IE Subtask 3 (\$500K)**

Conduct Phase 2 of the IRSN MIRTE Program (Integral reactivity tests of Mn, Cr, and Mo).

**Milestone:**

- Provide status reports in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

**FY 2013**

**INL IE Subtask 3 (\$500K)**

Phase 2 MIRTE experiments will be completed. Phase 2 results will be compiled and evaluated in accordance with the requirements of the ICSBEP.

**Milestone:**

- Provide status reports in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

**FY 2014**

**INL IE Subtask 3 (\$500K)**

Evaluation of Phase 2 MIRTE experimental data will continue into FY-2014. Once the evaluation phase is completed, final reports will be submitted to the ICSBEP for peer review and preparation for publication.

**Milestone:**

- Receipt of Final Evaluation Report (Q3).

## **LANL IE Subtasks**

**FY 2010**

### **LANL IE Subtask 1 (\$3400K)**

Provide Critical Experiments Facility (CEF) Operational Support at the Device Assembly Facility (DAF): The funding associated with this subtask is to be used to support the basic infrastructure associated with owning and operating CEF. These basic infrastructure costs – also referred to as fixed costs – are those costs that exist even if there is no programmatic work. These costs come from (1) safety-, security-, and regulatory-compliance-related activities that accompany owning, and being responsible and accountable for, a large quantity of special nuclear material and (2) maintaining the infrastructure and capability necessary to execute the programmatic mission. A detailed breakdown of these fixed operational and infrastructure costs is provided in LA-UR-09-01787, *Criticality Experiments Facility (CEF) Operational Staffing Plan, Revision 1, March 2009*.

#### **Milestones:**

- Complete all required Technical Safety Requirement (TSR) surveillances (Q1, Q2, Q3, Q4).
- Complete all required maintenance (both preventive and corrective) activities to keep the critical assemblies, vaults and high bays operational (Q1, Q2, Q3, Q4).
- Maintain all documents, procedures, permits and licenses current and fully capable of supporting the CEF programmatic missions (Q1, Q2, Q3, Q4).
- Provide status and assessment of services procured and services provided in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

### **LANL IE Subtask 2 (\$0K)**

Conduct one subcritical experiment in the DAF during each fiscal year (FY 2011 through FY 2014). The experiment will be proposed, designed and executed in accordance with the guidelines promulgated in the C<sub>ED</sub>T process, and will be documented in accordance with the requirements of Section 1 of a standard ICSBEP benchmark. At the direction of the NCSP manager, no subcritical measurements will be performed during FY 2010. The priority activity during FY 2010 is startup of the CEF. Funds originally programmed for this Subtask have been re-allocated to other LANL IE Subtasks as follows: \$100K to Subtask 5; \$170K to Subtask 7; and 100K to Subtask 9.

#### **Milestones:**

- See Appendix D for details on subcritical experiment milestones.
- Provide status reports on all subcritical experiment activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

### **LANL IE Subtask 3 (\$500K)**

Maintain and Train CEF Team Members: This subtask supports maintaining proficiency for crew chiefs and crew members during the transition to CEF operations during FY-2010. Final certification will come with the completion of the CEF startup plan following the successful completion of the operational readiness review. This is the final FY that this subtask will require significant funding. The funding required for this subtask in out years will fall off significantly after CEF is operational. In FY 2010, approximately \$200K of the funding from this subtask will be committed to the contract with the French for maintaining operator proficiency. This is the final year of this contract.

#### **Milestones:**

- Continue collaboration and training activities with the French at Valduc (Q1, Q2, Q3, Q4).
- Successfully complete all of the requirements of the CEF startup plan following successful completion of the CEF operational readiness review. This will result in the final certification of all CEF crew members and crew chiefs (Q1, Q2, Q3, Q4).
- Provide status reports on all operator training and certification activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

### **LANL IE Subtask 4 (\$600K)**

Design and execute critical experiments following the successful completion of the CEF operational readiness review and successful completion of the CEF startup plan. All critical experiments will be proposed, designed and executed in accordance with the guidelines promulgated in the C<sub>ED</sub>T process, and will be documented in accordance with the requirements of Section 1 of a standard ICSBEP benchmark.

#### **Milestones:**

- See Appendix D for details on critical experiment milestones.
- Provide status reports on all critical experiment activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

### **LANL IE Subtask 5 (\$200K)**

Upgrade the electronics and data acquisition system for the current experimental setup used to perform sub-critical benchmark measurements. The proposed upgrade will augment NCSP capability by allowing the use other neutron noise analysis and sub-critical measurement techniques. Utilization of a list-mode data acquisition system, as proposed herein, enables the application of multiple analysis techniques on the same set of data (i.e., perform analysis in both the frequency and time domain). Passive and active measurement techniques are compatible with the proposed data acquisition system. Thus, static and dynamic benchmarks are possible.

LANL will upgrade the data acquisition system by integrating the Los Alamos custom designed PATRM/PMC (Pulse Arrival-Time Recording Module / PCI Mezzanine Card). This module has the capability to simultaneously record up to 32 channels of data (channel number and detection

time) with a time resolution of 10 nanoseconds. The PATRM/PMC's basic mode of operation provides time and channel tagging of every detected neutron which accommodates multiple data analysis techniques.

**Milestones:**

- Upgrade other electronics as needed to ensure easy replacement as modules or components fail (Q3, Q4).
- Assess the PATRM/PMC data acquisition system functionality by performing californium source driven measurements as well as measurements with SNM and comparing results with previous sub-critical benchmark experiments (Q3, Q4).

**LANL IE Subtask 6 (\$200K)**

Characterize new  $^{252}\text{Cf}$  Source and Determine/Validate Detection System for Future Subcritical Experiments. This will require measurements with both the old source and the new source to verify and compare performance. Measurements will be performed with the BRP ball and reflectors that have been previously used in benchmark evaluations (polyethylene, acrylic, and nickel) to verify that the results obtained with the new source are similar to results obtained with the old source. The measurements will also be used to determine/validate the PATRM/PMC (Pulse Arrival-Time Recording Module / PCI Mezzanine Card) data acquisition system described in Subtask 5 (above). This Subtask will be completed during this fiscal year.

**Milestones:**

- Characterize the new source ionization chamber; determine detector response (Q2).
- Perform basic measurements using both sources for comparison using the BRP ball with a variety of reflectors [e.g., Lucite, poly, nickel] (Q2).
- Analyze data and compare to the current source (Q3).
- Verify the lifetime of the new source and produce documentation of its characterization (Q3).
- Perform calculations and survey commercial and laboratory-designed capabilities to determine the optimal detector system (Q3).
- Perform  $^{252}\text{Cf}$  source measurements to ensure that the detector system works properly with the PATRM/PCM data acquisition system (Q3, Q4).
- Validate results by measuring BRP reflected with polyethylene (Q3, Q4).
- Submit results obtained for inclusion with the BRP ball / poly benchmark (SUB-PU-MET-FAST-001) (Q4).

**LANL IE Subtask 7 (\$470K)**

Improve MCNP simulation capability for subcritical multiplication comparisons. This subtask is a collaboration between LANL and the University of Nevada Las Vegas (UNLV) Nuclear Engineering program.

**Milestones**

- Update the list-mode multiplication capability to MCNP5.1.50 (LANL).

- Implement this capability as a routine that can be applied to any future version of MCNP through the SOURCEX and TALLYX routines provided with MCNP.
- Parallelize this capability to run calculations on LANL's high-performance computers, and Windows/Linux/Mac PCs
- Compare and document simulated results with previous experimental results performed at LANL (LANL).
- Compare and document simulated results with experiments to be performed at LANL or other ICSBEP experiments (LANL).
  - a) ( $\alpha,n$ ) sources with poly, SS shells, etc
  - b) SUB-PU-MET-FAST-001,002,and 003
- Begin R&D for application of variance reduction techniques to accelerate convergence of problems (current simulations are performed in analog mode) (LANL).
- Compare and document our simulation results using currently available codes MCNP-DSP and MCNP-Polimi via a code-to-code verification (UNLV).

### **LANL IE Subtask 8 (\$150K)**

Procure Equipment for the CEF Count Room that will support critical experiments. The instrumentation includes an alpha spectrometer, a portable electrically-cooled HPGe detector, a fission chamber assembly-and-test stand, and a flux-wire counter.

#### **Milestones:**

- Procure alpha spectrometer (Q3).
- Procure portable electrically-cooled HPGe detector (Q3).

### **LANL IE Subtask 9 (\$100K)**

Develop new subcritical analysis software. This Subtask will produce software which will take list-mode data from the new PATRM/PMC (Pulse Arrival-Time Recording Module / PCI Mezzanine Card) data acquisition system and format the data for analysis with various subcritical methods. All of the time domain methods (Feynman variance-to-mean, Rossi-Alpha, count-to-count interval distribution, etc.) require binning data in unique ways. The frequency domain methods (such as the  $^{252}\text{Cf}$  source driven noise analysis method used in recent subcritical benchmarks) require the data to be specifically binned before performing Fourier transforms and other mathematical operations. The software produced will provide the means to fully utilize acquired data in future experiments.

#### **Milestones:**

- Develop software that can: (Q3)
  - a) Read in list-mode data for very large file sizes (at least 1 GB).
  - b) Bin data in unique ways for multiple measurement techniques.
  - c) Has the capability to perform Fourier transforms and other mathematical operations for frequency domain techniques.
  - d) Utilize system parameters input by the user as well as provide reasonable defaults for systems that are not fully characterized.

- Analyze data collected from PATRM/PMC measurements with a  $^{252}\text{Cf}$  source as well as SNM measurements and compare acquired data with previous benchmark evaluations (Q4).
- A manual to use the software will be produced and a separate document will compare the results to previous measurements (Q4).

## **FY 2011**

### **LANL IE Subtask 1 (\$3400K)**

The scope and milestones are the same as in FY 2010.

### **LANL IE Subtask 2 (\$400K)**

The scope and milestones are the same as in FY 2010.

### **LANL IE Subtask 3 (\$110K)**

The scope and milestones are reduced from FY 2010 to a maintenance of capability level as CEF startup is completed.

#### **Milestones:**

- Execute training and proficiency programs necessary to maintain certification of operators (Q4).
- Provide status in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

### **LANL IE Subtask 4 (\$1200K)**

The scope and milestones are the same as in FY 2010.

### **LANL IE Subtask 5 (\$100K)**

The scope is the same as FY 2010. This Subtask will be completed during this fiscal year.

#### **Milestone:**

- Assess the PATRM/PMC data acquisition system functionality by performing californium source driven measurements as well as measurements with SNM and comparing results with previous sub-critical benchmark experiments (Q1, Q2, Q3, Q4).
- Certify the PATRM/PMC data acquisition system for use by the ICSBEP (Q4).

### **LANL IE Subtask 7 (\$300K)**

The scope and milestones are the same as in FY 2010.

### **LANL IE Subtask 8 (\$150K)**

The scope is the same as in FY 2010. This Subtask will be completed during this fiscal year.

#### **Milestone:**

- Procure a fission chamber assembly-and-test stand (Q3).
- Procure a flux wire counter (Q3).

### **LANL IE Subtask 9 (\$100K)**

The scope and milestones are the same as in FY 2010.

### **FY 2012**

### **LANL IE Subtask 1 (\$3600K)**

The scope and milestones are the same as in FY 2010.

### **LANL IE Subtask 2 (\$400K)**

The scope and milestones are the same as in FY 2010.

### **LANL IE Subtask 3 (\$150K)**

The scope and milestones are the same as in FY 2011.

### **LANL IE Subtask 4 (\$1400K)**

The scope and milestones are the same as in FY 2010.

### **LANL IE Subtask 7 (\$300K)**

The scope and milestones are the same as in FY 2010. This Subtask will be completed during this fiscal year.

### **LANL IE Subtask 9 (\$100K)**

The scope and milestones are the same as in FY 2010. This Subtask will be completed during this fiscal year.

### **FY 2013**

### **LANL IE Subtask 1 (\$3600K)**

The scope and milestones are the same as in FY 2010.

### **LANL IE Subtask 2 (\$400K)**

The scope and milestones are the same as in FY 2010.

### **LANL IE Subtask 3 (\$150K)**

The scope and milestones are the same as in FY 2011.

### **LANL IE Subtask 4 (\$1800K)**

The scope and milestones are the same as in FY 2010.

## **FY 2014**

### **LANL IE Subtask 1 (\$3600K)**

The scope and milestones are the same as in FY 2010.

### **LANL IE Subtask 2 (\$400K)**

The scope and milestones are the same as in FY 2010.

### **LANL IE Subtask 3 (\$150K)**

The scope and milestones are the same as in FY 2011.

### **LANL IE Subtask 4 (\$1900K)**

The scope and milestones are the same as in FY 2010.

## **LLNL IE Subtasks**

The LLNL IE Subtasks are for FY 2010 only to allow LLNL and Nuclear Security Technologies (NSTec) criticality and dosimetry specialists to travel and participate in a Nuclear Accident Dosimeter (NAD) exercise in Valduc, France. Actual LLNL-designed NADs that are currently installed in both the DAF and the Plutonium Facility (B332) will be used. Personal Nuclear Accident Dosimeters (PNADs) will also be tested.

## **FY 2010**

### **LLNL IE Subtask 1 (\$80K)**

Procure an ISOCS portable  $\gamma$ -spectroscopy system.

#### **Milestones:**

- Procure ISOCS system (Q1).

### **LLNL IE Subtask 2 (\$60K)**

Develop a plan for participating in the exercise.

#### **Milestones:**

- Complete the plan for participating in the exercise. The plan will include specific LLNL procedures and resource requirements. (Q1).

### **LLNL IE Subtask 3 (\$36K)**

Execute logistics plans necessary for LLNL and NSTec participants to support the SILENE 2010 exercise, participate in the exercise, and publish the results.

#### **Milestones:**

- Execute logistics plans necessary for participants and equipment to arrive in France for the exercise (Q1).
- Participate in the actual exercise (Q1)
- Provide input, as requested, to assist the host laboratory in completion of their final report (Q1).
- Publish an LLNL report of the results of LLNL participation in the exercise (Q4).
- Provide status reports on all activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

### **ORNL IE Subtasks**

**FY 2010**

### **ORNL IE Subtask 1 (\$105K)**

Integration of TSUNAMI tools with the C<sub>e</sub>dT process: Experiment designs designated by NCSP Program manager will be optimized within known constraints to maximize similarity to targeted applications. Benefits of modifying designs beyond known constraints will be identified as they are revealed by utilization of TSUNAMI in the optimization process.

#### **Milestones:**

- Provide a report documenting TSUNAMI analysis for requested preliminary experiment designs to the NCSP Manager (Q3).
- Provide a report documenting TSUNAMI analysis of final experiment designs to assure intended applicability to the NCSP Manager (Q4).
- Provide status reports on all C<sub>e</sub>dT related activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

## **FY 2011**

### **ORNL IE Subtask 1 (\$110K)**

The scope and milestones are the same as in FY 2010.

## **FY 2012**

### **ORNL IE Subtask 1 (\$110K)**

The scope and milestones are the same as in FY 2010.

## **FY 2013**

### **ORNL IE Subtask 1 (\$120K)**

The scope and milestones are the same as in FY 2010.

## **FY 2014**

### **ORNL IE Subtask 1 (\$120K)**

The scope and milestones are the same as in FY 2010.

## **SNL IE Subtasks**

### **FY 2010**

#### **SNL IE Subtask 1 (\$821K)**

Maintain the capability to perform water-moderated low-enriched lattice critical experiments in the Sandia Critical Experiments Facility. The initial focus will be on the Seven Percent Critical Experiment (7uPCX) and later will shift to other experiments as directed by the NCSP manager. All critical experiments will be proposed, designed and executed in accordance with the guidelines promulgated in the C<sub>ED</sub>T process, and will be documented in accordance with the requirements of Section 1 of a standard ICSBEP benchmark.

#### **Milestones:**

- Maintain the SPRF/CX facility authorization and operator proficiency by performing critical experiment operations (Q4)
- Prepare and submit benchmark evaluations of completed critical experiment series as necessary (Q4)
- Provide status reports on all critical experiment activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

**FY 2011**

**SNL IE Subtask 1 (\$830K)**

The scope and milestones are the same as in FY 2010.

**FY 2012**

**SNL IE Subtask 1 (\$830K)**

The scope and milestones are the same as in FY 2010.

**FY 2013**

**SNL IE Subtask 1 (\$850K)**

The scope and milestones are the same as in FY 2010.

**FY 2014**

**SNL IE Subtask 1 (\$850K)**

The scope and milestones are the same as in FY 2010.

**2.3.3 Integral Experiments Budget**

**Integral Experiments Budget (Fiscal Years 2010 – 2014)**

<b>LABORATORY</b>	<b>FY 2010 (\$K)</b>	<b>FY 2011 (\$K)</b>	<b>FY 2012 (\$K)</b>	<b>FY 2013 (\$K)</b>	<b>FY 2014 (\$K)</b>
<b>INL</b>	\$250	\$550	\$500	\$500	\$500
<b>LANL</b>	\$5,620	\$5,760	\$5,950	\$5,950	\$6,050
<b>LLNL</b>	\$176	\$0	\$0	\$0	\$0
<b>ORNL</b>	\$105	\$110	\$110	\$120	\$120
<b>SNL</b>	\$821	\$830	\$830	\$850	\$850
<b>TOTAL</b>	\$6,972	\$7,250	\$7,390	\$7,420	\$7,520

## **2.4 International Criticality Safety Benchmark Evaluation Project**

### **2.4.1 Program Element Description**

The purpose of International Criticality Safety Benchmark Evaluation Project (ICSBEP) is to: (1) identify and evaluate a comprehensive set of criticality safety related experimental benchmark data; (2) verify the data, to the extent possible, by reviewing original and subsequently revised documentation, and by talking with the experimenters or individuals who are familiar with the experiments or the experimental facility; (3) evaluate the data and quantify overall uncertainties through various types of sensitivity analyses; (4) compile the data into a standardized format; (5) perform sample calculations using standard criticality safety codes and data; and (6) formally document the work into a single source of verified, extensively peer reviewed benchmark data. Additional information about the ICSBEP vision and strategy can be found in the *Mission and Vision of the U.S. Department of Energy, Nuclear Criticality Safety Program*, March 2008 document. A funding table is provided at the end of this program element section.

A small group (six to eight members) of criticality safety, integral measurement, and nuclear data experts was established (June 2008) to review available experimental data and, based on community needs, set future benchmark priorities. The group planned and prioritized U.S. funded benchmarks for five years. Specific data are considered “high-priority” and are included in the plan if they fill immediate criticality safety needs, fill gaps in the ICSBEP integral benchmark database, are recently generated U.S. funded data (including data generated outside the U.S.), continue or enhance foreign collaboration, are expected to be of benchmark quality, or maintain U.S. capability by fostering next-generation participation. The result of this effort, a prioritized list of benchmarks, is given in Appendix C. The actual number of evaluated experiments will ultimately depend on the cost of each evaluation. Appendix C is reviewed and updated at least once per year. The prioritization process is an integral part of the ICSBEP planning effort.

A funding table is provided at the end of this program element section. The status of all milestones will be reported to the NCSP Manager in quarterly reports that are due no later than the last day of the month following the end of the quarter.

### **2.4.2 Approved Subtasks**

#### **INL ICSBEP Subtasks**

##### **FY 2010**

#### **INL ICSBEP Subtask 1 (\$1,025K)**

Maintain the ICSBEP Infrastructure: ICSBEP Infrastructure includes project management, project administration, independent peer review and technical editing, graphic arts, project meeting organization, publication costs, travel for selected participants who are contributing

evaluations, internet site updates and maintenance, minimal support for the Russian Federation and others, and participation in other NCSP activities.

**Milestones:**

- Hold Benchmark Prioritization Meeting (Q1).
- Conduct annual ICSBEP Technical Review Group Meeting (Q3).
- Publish the *International Handbook of Evaluated Criticality Safety Benchmark Experiments* (Q4).

**INL ICSBEP Subtask 2 (\$825K)**

Support National Laboratory/Site/Institute Participation: Laboratory participation includes data evaluation; internal peer review; limited independent peer review; and ICSBEP meeting preparation, participation, and travel by participants at each of seven national laboratories or sites: INL, LANL, LLNL, ORNL, ANL, SRNL, and the Hanford Site. SNL and Bettis Laboratory also participate at their own expense. Participation by non-U.S. institutes that are funded through the ICSBEP is included in this task.

**Milestones:**

- Milestones are the same as INL ICSBEP Subtask 1.

**FY 2011**

**INL ICSBEP Subtask 1 (\$1,050K)**

The scope and milestones are the same as in FY 2010.

**INL ICSBEP Subtask 2 (\$850K)**

The scope and milestones are the same as in FY 2010.

**FY 2012**

**INL ICSBEP Subtask 1 (\$1,050K)**

The scope and milestones are the same as in FY 2010.

**INL ICSBEP Subtask 2 (\$850K)**

The scope and milestones are the same as in FY 2010.

**FY 2013**

**INL ICSBEP Subtask 1 (\$1,100K)**

The scope and milestones are the same as in FY 2010.

### **INL ICSBEP Subtask 2 (\$900K)**

The scope and milestones are the same as in FY 2010.

### **FY 2014**

### **INL ICSBEP Subtask 1 (\$1,100K)**

The scope and milestones are the same as in FY 2010.

### **INL ICSBEP Subtask 2 (\$900K)**

The scope and milestones are the same as in FY 2010.

## **2.4.3 International Criticality Safety Benchmark Evaluation Project Budget**

<b>International Criticality Safety Benchmark Evaluation Project Budget (Fiscal Years 2010 – 2014)</b>
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<b>LABORATORY</b>	<b>FY 2010 (\$K)</b>	<b>FY 2011 (\$K)</b>	<b>FY 2012 (\$K)</b>	<b>FY 2013 (\$K)</b>	<b>FY 2014 (\$K)</b>
<b>INL</b>	\$1,850	\$1,900	\$1,900	\$2,000	\$2,000

## **2.5 Nuclear Data**

### **2.5.1 Program Element Description**

The Nuclear Data (ND) program element includes the measurement, evaluation, testing, and publication of neutron cross-section data for nuclides of high importance to nuclear criticality safety analyses. The NCSP continues to improve coordination of Nuclear Data (ND) activities by fostering a strong collaborative effort among all of our national and international resources in this highly-technical area. The objective is to solve the highest priority ND problems relevant to criticality safety in a timely manner. This program element is essential for the NCSP because it provides the nuclear cross-section data required by the AM program element. Additional information about the ND vision and strategy can be found in the *Mission and Vision of the U.S. Department of Energy, Nuclear Criticality Safety Program*, March 2008 document. Refer to Appendix D for the FY 2010 through 2014 schedule, milestones and deliverables associated with specific nuclear data measurement, evaluation, and publication. Milestones not contained in Appendix D are delineated below. A funding table is provided at the end of this program element section. The status of all milestones will be reported to the NCSP Manager in quarterly reports that are due no later than the last day of the month following the end of the quarter.

## 2.5.2 Approved Subtasks

### ANL ND Subtasks

#### FY 2010

##### ANL ND Subtask 1 (\$225K)

Perform data testing in support of the data validation effort for Evaluated Nuclear Data File (ENDF)/B-VII and new evaluated nuclear data that are of interest to the criticality safety community. Emphasis will be on testing and reporting performance of priority evaluations identified by the Nuclear Data Advisory Group (NDAG). Support the NCSP website initiatives for addressing both integral and differential nuclear data needs. Participate in nuclear data international expert groups and working groups.

##### Milestones:

- Provide reports to NDAG and Cross Section Evaluation Working Group (CSEWG) documenting results of NCSP data testing and validation (Q1, Q3).
- Participate as ENDF representative in the OECD/NEA WPEC annual meeting and various subgroup activities, including the High-Priority Request List (Q3).
- Participate in nuclear data meetings, including CSEWG, CSEWG Executive Committee, and chair of the CSEWG Covariance Committee (Q4).
- Participate in Expert Groups related to nuclear data that is important to criticality safety, including the OECD-NEA Expert Groups on Uncertainty Analyses for Criticality Safety Assessment (UACSA) and Assay Data for Spent Nuclear Fuel (ASSNF) for burn up credit (Q4).
- Document support of NCSP website for both integral and differential nuclear data needs (Q4).
- Document additional capability to produce quality covariance evaluations for ENDF (Q4).
- Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

##### ANL ND Subtask 2 (\$25K)

Support the C<sub>e</sub>dT process to ensure proper planning and execution of integral experiments.

##### Milestone:

- Report status in NCSP Quarterly Status Reports (Q1, Q2, Q3, Q4).

#### FY 2011

##### ANL ND Subtask 1 (\$225K)

The scope and milestones are the same as in FY 2010.

**ANL ND Subtask 2 (\$25K)**

The scope and milestones are the same as in FY 2010.

**FY 2012**

**ANL ND Subtask 1 (\$225K)**

The scope and milestones are the same as in FY 2010.

**ANL ND Subtask 2 (\$25K)**

The scope and milestones are the same as in FY 2010.

**FY 2013**

**ANL ND Subtask 1 (\$230K)**

The scope and milestones are the same as in FY 2010.

**ANL ND Subtask 2 (\$30K)**

The scope and milestones are the same as in FY 2010.

**FY 2014**

**ANL ND Subtask 1 (\$230K)**

The scope and milestones are the same as in FY 2010.

**ANL ND Subtask 2 (\$30K)**

The scope and milestones are the same as in FY 2010.

**BNL ND Subtasks**

**FY 2010**

**BNL ND Subtask 1 (\$150K)**

Provide technical support to the NCSP through the application of National Nuclear Data Center (NNDC) assets. The NNDC provides a link to CSEWG data community and ensures that NCSP cross section evaluations are duly checked, processed, visualized, reviewed and archived in ENDF/A as candidate evaluations for the new ENDF/B-VII.1 library. The NNDC also provides a link to CSEWG covariance community and ensures quality of new NCSP covariance evaluations by performing in-depth analysis of these data using suitable quality assurance

procedures and providing timely feedback to evaluators. Finally, the NNDC maintains the Atlas of Neutron Resonances as a unique resource of thermal and resonance data with uncertainties.

**Milestones:**

- Ensure that NCSP produced nuclear data are processed, reviewed and included in the ENDF (Q1, Q2, Q3, Q4).
- Perform quality assurance of new NCSP covariance data (Q2, Q4).
- Update Atlas of Neutron Resonances (Q4).
- Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

**FY 2011**

**BNL ND Subtask 1 (\$150K)**

The scope and milestones are the same as in FY 2010.

**FY 2012**

**BNL ND Subtask 1 (\$160K)**

The scope and milestones are the same as in FY 2010.

**FY 2013**

**BNL ND Subtask 1 (\$160K)**

The scope and milestones are the same as in FY 2010.

**FY 2014**

**BNL ND Subtask 1 (\$170K)**

The scope and milestones are the same as in FY 2010.

**LANL ND Subtasks**

**FY 2010**

**LANL ND Subtask 1 (\$440K)**

Provide nuclear data evaluation support as delineated in Appendix D.

**Milestones:**

- Make code improvements to McGNASH and KALMAN that address the methodology for assigning high-fidelity uncertainties (covariances) to cross-section calculations (Q4).
- Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

**FY 2011**

**LANL ND Subtask 1 (\$450K)**

The scope is the same as in FY 2010.

**Milestone:**

- Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

**FY 2012**

**LANL ND Subtask 1 (\$450K)**

The scope is the same as in FY 2010.

**Milestones:**

- Implement Monte Carlo particle decay spectra in a new code (Q4).
- Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

**FY 2013**

**LANL ND Subtask 1 (\$460K)**

The scope is the same as in FY 2010.

**Milestone:**

- Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

**FY 2014**

**LANL ND Subtask 1 (\$460K)**

The scope is the same as in FY 2010.

**Milestones:**

- Revise tabulated exclusive spectra for selected targets, using the new Monte Carlo treatment of particle emission spectra (Q4).
- Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

### **LLNL ND Subtasks**

LLNL N-Division has developed a first principles analytical method to determine the time-dependent emission of delayed gammas based on event-by-event modeling of the fission process and subsequent fission product decay resulting in a new ENDF-6 format for  $\beta$ -delayed post fission  $\gamma$ 's, which was accepted by CSEWG in November 2006. The time dependent data is implemented in COG11.

#### **FY 2010**

##### **LLNL ND Subtask 1 (\$75K)**

Utilize existing LLNL-developed analytical methods to calculate and test the corresponding time independent (or total) delayed gamma emission from thermal, fast, and 14-MeV neutron induced fission in  $^{235}\text{U}$ . This Subtask will be completed during this fiscal year.

##### **Milestones:**

- Issue an LLNL report documenting the technical basis of the  $^{235}\text{U}(n,f)\gamma$ d equilibrium multiplicity data and spectra (Q4).
- Issue an LLNL report documenting testing of the data for criticality safety applications (Q4).
- Submit the  $^{235}\text{U}$  data to the CSEWG/USNDP in ENDF-6 format (Q4).
- Present the testing results to the CSEWG Validation Subcommittee (Q4).
- Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

#### **FY 2011**

##### **LLNL ND Subtask 2 (\$75K)**

Utilize existing LLNL-developed analytical methods to calculate and test the corresponding time independent (or total) delayed gamma emission from thermal, fast, and 14-MeV neutron induced fission in  $^{239}\text{Pu}$ . This Subtask will be completed during this fiscal year.

##### **Milestones:**

- Issue an LLNL report documenting the technical basis of the  $^{239}\text{Pu}(n,f)\gamma$ d equilibrium multiplicity data and spectra (Q4).
- Issue an LLNL report documenting testing of the data for criticality safety applications (Q4).
- Submit the  $^{239}\text{Pu}$  data to the CSEWG/USNDP in ENDF-6 format (Q4).
- Present the testing results to the CSEWG Validation Subcommittee (Q4).

- Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

## **FY 2012**

### **LLNL ND Subtask 3 (\$100K)**

Generate time-dependent and equilibrium data for other nuclides as directed by the NCSP Manager.

#### **Milestone:**

- Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

## **FY 2013**

### **LLNL ND Subtask 3 (\$100K)**

The scope and milestone is the same as in FY 2012.

## **FY 2014**

### **LLNL ND Subtask 3 (\$100K)**

The scope and milestone is the same as in FY 2012.

## **ORNL ND Subtasks**

### **FY 2010**

#### **ORNL ND Subtask 1 (\$874K)**

Conduct nuclear data measurement and evaluation activities in support of the NCSP. This Subtask continues to primarily focus on the resonance-region and includes cross-section measurements and the production of new cross-section evaluations with covariance data. Development and maintenance of the SAMMY resonance analysis software will be performed as needed to meet the cross-section evaluation objectives for the NCSP. In addition, ORNL will continue to collaborate with other research institutions including LANL; ANL; Renssalaer Polytechnic Institute (RPI), the Institute for Reference Materials and Measurements (IRMM) in Geel, Belgium; the Argentina National Atomic Energy Commission (CNEA) in Bariloche, Argentina; and the Instituto de Pesquisas Energeticas Nuclear (IPEN) in Brazil to perform resonance-region cross-section measurements and obtain thermal scattering data, resonance integral data, and high-energy cross-section evaluations with covariance data that complement the ORNL resonance evaluations thereby addressing nuclear data needs for the criticality safety community.

**Milestones:**

- Through work with CNEA perform detailed assessment of NCSP-identified thermal moderator data needs and prepare report documenting measurement/evaluation recommendations for providing ENDF/B thermal evaluations (Q4)
- Through work with IPEN (Brazil), complete titanium capture resonance integral measurements to support cross-section evaluation effort (Q2)
- Complete draft recommendations for new unresolved resonance region (URR) methodology and implementation in ENDF/B (Q4)
- Chair WPEC subgroup to improve URR analysis methodology (Q4)
- Participate in CSEWG Meeting and Chair the ENDF/B formats committee (Q1)
- Participate in NDAG Meetings (Q1 and Q3)
- Participate in OECD/NEA WPEC nuclear subgroup activities, and annual meeting (Q3)
- Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

**ORNL (RPI) ND Subtask 2 (\$35K)**

Conduct data reduction and analysis of Gd and Dy capture measurements that were made at RPI during FY 2009. The measurements included  $^{155}\text{Gd}$ ,  $^{156}\text{Gd}$ ,  $^{157}\text{Gd}$ ,  $^{158}\text{Gd}$ ,  $^{160}\text{Gd}$ ,  $^{161}\text{Dy}$ ,  $^{162}\text{Dy}$ ,  $^{163}\text{Dy}$ , and  $^{164}\text{Dy}$ . The RPI SAMMY analysis will not result in an ENDF/B cross-section evaluation; rather the RPI analysis will produce resonance parameters specifically for the RPI-measured data. These measurement-specific resonance parameters and RPI data will be delivered to ORNL to use as initial estimates for new evaluations. ORNL will then use the RPI data in conjunction with other Gd and Dy isotopic datasets and perform a SAMMY evaluation of available datasets to produce new Gd and Dy cross-section evaluations with covariance data. This Subtask will be completed during this fiscal year. Additional work at RPI depends on success of FY 2010 through FY 2011 work and the outcome of alternative differential nuclear data measurement option studies.

**Milestones:**

- RPI Complete SAMMY analysis on Gd isotopes (FY 2010 Q1 and Q2)
- RPI Complete SAMMY analysis on Dy isotopes (FY 2010 Q3 and Q4)
- RPI Complete report (FY 2010 Q4)
- Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

**FY 2011****ORNL ND Subtask 1 (\$875K)**

The scope is the same as in FY 2010.

**Milestones:**

- Chair WPEC subgroup to improve URR analysis methodology and prepare final report for WPEC URR subgroup (Q4)
- Participate in NDAG, CSEWG, and WPEC meetings (Q4)
- Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

**FY 2012**

**ORNL ND Subtask 1 (\$875K)**

The scope is the same as in FY 2010. Milestones are the same as Milestones 2 and 3 from FY 2011.

**FY 2013**

**ORNL ND Subtask 1 (\$900K)**

The scope is the same as in FY 2010.

**Milestones:**

- Participate in NDAG, CSEWG, and WPEC meetings (Q4)
- Complete a plan to establish fission resonance region measurement capability to address NCSP nuclear data needs (FY 2013, Q4)
- Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

**FY 2014**

**ORNL ND Subtask 1 (\$900K)**

The scope is the same as in FY 2010.

**Milestones:**

- Participate in NDAG, CSEWG, and WPEC meetings (Q4).
- Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

### 2.5.3 Nuclear Data Budget

#### Nuclear Data Budget (Fiscal Years 2010 – 2014)

LABORATORY	FY 2010 (\$K)	FY 2011 (\$K)	FY 2012 (\$K)	FY 2013 (\$K)	FY 2014 (\$K)
ANL	\$250	\$255	\$255	\$260	\$260
BNL	\$150	\$150	\$160	\$160	\$170
LANL	\$440	\$450	\$450	\$460	\$460
LLNL	\$75	\$75	\$100	\$100	\$100
ORNL	\$909	\$875	\$875	\$900	\$900
<b>TOTAL</b>	<b>\$1,824</b>	<b>\$1,805</b>	<b>\$1,840</b>	<b>\$1,880</b>	<b>\$1,890</b>

## 2.6 Training and Education

### 2.6.1 Program Element Description

The Training and Education (T&E) program element will continue to offer hands-on training courses as needed by DOE and identify and develop training needs and resources in areas where no suitable materials exist. The primary purpose of the T&E element is to maintain the technical capabilities of criticality safety professionals and provide for the training and education of people entering the criticality safety discipline from related scientific fields. Additional information about the Training and Education vision and strategy can be found in the *Mission and Vision of the U.S. Department of Energy, Nuclear Criticality Safety Program*, March 2008 document. A funding table is provided at the end of this program element section. The status of all milestones will be reported to the NCSP Manager in quarterly reports that are due no later than the last day of the month following the end of the quarter.

### 2.6.2 Approved Subtasks

#### LLNL T&E Subtasks

#### FY 2010

#### LLNL T&E Subtask 1 (\$585K)

Continue to offer a unique “hands-on” criticality safety training course for DOE practitioners and workers who handle SNM. These classes may be tailored to the interests of special groups with the concurrence of the NCSP Manager.

**Milestones:**

- Provide a class schedule for NCSP Manager approval (Q1).
- Provide a course transition plan (to DAF) to the NCSP Manager for approval (Q4).
- Conduct eight classes in accordance with the approved schedule and provide status reports on all training activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

**FY 2011**

**LLNL T&E Subtask 1 (\$200K)**

Contingent upon transfer of special nuclear materials, and start up of this activity in the DAF, continue to offer a unique “hands-on” criticality safety training course for DOE practitioners and workers who handle SNM either at LLNL or at the DAF. These classes may be tailored to the interests of special groups with the concurrence of the NCSP Manager.

**Milestones:**

- Provide a class schedule for NCSP Manager approval (Q1).
- Conduct classes in accordance with the approved schedule and provide status reports on all training activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

**LLNL T&E Subtask 2 (\$100K)**

Transfer TACS materials and associated equipment to DAF. Complete the certificate amendment to include the HEU shells as approved contents in the DPP-2. Depending on the shipment schedule, these parts may be retained for programmatic use at LLNL through FY 2011. This Subtask may be completed during this fiscal year. If not, it will be completed in FY 2012.

**Milestone:**

- Report status of transfer activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4)

**FY 2012 through 2014**

**LLNL T&E Subtask 1 (\$200K per year)**

Contingent upon transfer of special nuclear materials, and start up of this activity in the DAF, continue to offer a unique “hands-on” criticality safety training course for DOE practitioners and workers who handle SNM either at LLNL or at the DAF. These classes may be tailored to the interests of special groups with the concurrence of the NCSP Manager.

**Milestones:**

- Provide a class schedule for NCSP Manager approval (Q1).

- Conduct classes in accordance with the approved schedule and provide status reports on all training activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

## **ORNL T&E Subtasks**

### **FY 2010**

#### **ORNL T&E Subtask 1 (\$209K)**

Manage the collaborative development for the planning, designing, and suggested scheduling for the multi-faceted and phased NCSP training program and oversee the execution of the program.

##### **Milestones:**

- Publish a report on the preliminary program design including recommendations to the NCSP Manager on training activities that satisfy identified need (Q2).
- Based on NCSP Manager direction, provide an implementation plan to the NCSP Manager (Q4).
- Provide status reports on training program development activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

### **FY 2011 through 2014**

#### **ORNL T&E Subtask 1 (\$200K per year)**

Oversee the execution of the multi-faceted and phased NCSP training program.

##### **Milestone:**

- Oversee implementation of the training program and provide status reports in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

## **SNL T&E Subtasks**

### **FY 2010**

#### **SNL T&E Subtask 1 (\$100K)**

Develop a hands-on criticality safety training course that can be delivered to cleared or uncleared personnel. Develop the objectives, syllabus, and detailed outline for the classroom instruction. Develop hand-out materials for the class. Develop a plan for the laboratory training. Perform a dry run of the laboratory training. This Subtask will be completed during this fiscal year.

##### **Milestones:**

- Complete development of the classroom part of the hands-on training course (Q4).
- Complete development and testing of the laboratory part of the hands-on training course (Q4)

- Provide status reports on training program development activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

## **FY 2011**

### **SNL T&E Subtask 2 (\$200K)**

Complete critical assembly modifications to allow approach-to-critical experiments on water height. This Subtask will be completed during this fiscal year.

#### **Milestones:**

- Obtain Sandia Site Office approval for facility modifications (Q4).
- Design, fabricate, and install critical assembly modifications (Q4)
- Provide status reports on training program development activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

### **SNL T&E Subtask 3 (\$50K)**

Provide critical experiment collaboration opportunities with CEF personnel.

#### **Milestone:**

- Provide status reports on training program development activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

## **FY 2012**

### **SNL T&E Subtask 3 (\$50K)**

Scope and milestone are the same as in FY 2011.

### **SNL T&E Subtask 4 (\$300K)**

Conduct “hands-on” criticality safety training classes.

#### **Milestones:**

- Provide a class schedule for NCSP Manager approval (Q1).
- Conduct classes in accordance with the approved schedule and provide status reports on all training activities in NCSP Quarterly Progress Reports (Q1, Q2, Q3, Q4).

## **FY 2013**

### **SNL T&E Subtask 3 (\$60K)**

Scope and milestone are the same as in FY 2011.

### SNL T&E Subtask 4 (\$300K)

Scope and milestone are the same as in FY 2012.

### FY 2014

### SNL T&E Subtask 3 (\$60K)

Scope and milestone are the same as in FY 2011.

### SNL T&E Subtask 4 (\$400K)

Scope and milestone are the same as in FY 2012.

## 2.6.3 Training and Education Budget

**Training and Education Budget (Fiscal Years 2010 – 2014)**

LABORATORY	FY 2010 (\$K)	FY 2011 (\$K)	FY 2012 (\$K)	FY 2013 (\$K)	FY 2014 (\$K)
LLNL	\$585	\$300	\$200	\$200	\$200
ORNL	\$209	\$200	\$200	\$200	\$200
SNL	\$100	\$250	\$350	\$360	\$460
<b>TOTAL</b>	<b>\$894</b>	<b>\$750</b>	<b>\$750</b>	<b>\$760</b>	<b>\$860</b>

## 3.0 Nuclear Criticality Safety Program Support

The NCSP Manager is supported by several groups of criticality safety experts. These groups are described in this section. Complete information about these groups (membership, charter, taskings, etc.) can be found on the NCSP website. A funding table is provided at the end of this section.

### 3.1 Criticality Safety Support Group

The CSSG is comprised of recognized criticality safety experts from DOE offices and contractor organizations. The primary function of the CSSG is to provide operational and technical expertise to the DOE through the NCSP Manager. The CSSG also provides the NCSP Manager with technical reviews of orders, standards, rules and guides issued by DOE related to criticality safety. In addition, the CSSG responds to requests from the NCSP Manager for information, technical reviews, and evaluations of criticality safety issues throughout the complex. The

CSSG receives modest support for its contractor members (8 CSSG contractor members x \$45K/members + \$20K for the CSSG Chair + \$20K for the CSSG Deputy Chair).

### 3.2 Nuclear Data Advisory Group

The NDAG, through making recommendations to the NCSP Manager, enhances the coordination of the NCSP ND element work program with current and future DOE needs and promotes the integration of this work program with other elements of the NCSP. The NDAG Chair receives some funding (\$25K) to support his management of the NDAG.

### 3.3 Criticality Safety Coordinating Team

The CSCT is the group of federal staff providing line oversight for criticality safety at the field level. The NCSP Manager either chairs the group or designates the Chair of the CSCT. The CSCT members at the site offices ensure that the contractors implement DOE criticality safety orders and standards in their role as individual line management safety oversight. They also have a pivotal role to play in understanding the technical infrastructure needs at the site level that the NCSP provides. The primary function of the CSCT is to ensure uniformity of criticality safety programs and compliance throughout all the sites. They form the cadre of federal criticality safety subject matter experts and will also assist the site office managers and headquarters with monitoring criticality safety programs through site assistance visits.

### 3.5 Criticality Safety Program Support

**NCSP Support Activities (Fiscal Years 2010 – 2014)**

	<b>FY 2010 (\$K)</b>	<b>FY 2011 (\$K)</b>	<b>FY 2012 (\$K)</b>	<b>FY 2013 (\$K)</b>	<b>FY 2014 (\$K)</b>
<b>CSSG</b>	\$400	\$400	\$400	\$400	\$400
<b>NDAG Chair (ANL)</b>	\$25	\$26	\$27	\$28	\$29
<b>TOTAL</b>	\$425	\$426	\$427	\$428	\$429

## Appendix A

### Nuclear Criticality Safety Program Task Managers

#### ANL

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#### BNL

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**SNL**

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**Appendix B**  
**Work Authorization Statements for**  
**Nuclear Criticality Safety Program Funding for Execution Year (FY 2010)**  
**Provided to the NA-17 Budget Office in September 2009**

**Tasks: Nuclear Data, Information Preservation and Dissemination, and the Criticality Safety Support Group**  
Argonne National Laboratory (ANL): \$380K

Funds are provided to ANL to continue supporting Nuclear Data activities, including chairing the Nuclear Data Advisory Group, and cataloguing selected ZPR/ZPPR materials records as delineated in the Nuclear Criticality Safety Program (NCSP) Five-Year Plan dated October 2009, or as directed by the NCSP Manager. Funds are also provided for chairing the Criticality Safety Support Group (CSSG) as it provides technical support to the NCSP Manager regarding planning and execution of the NCSP. With approval of the NCSP Manager, the CSSG may also provide technical assistance to other Department of Energy (DOE) and DOE Contractor organizations. Quarterly reports on the status of all tasks shall be provided to the NCSP Manager no later than the last day of the month following the end of the quarter.

ANL POC: Richard McKnight (630-252-6088)  
DOE POC: Jerry McKamy, NNSA (202-586-8974)

**Task: Nuclear Data**  
Brookhaven National Laboratory (BNL): \$150K

Funds are provided to BNL to continue Nuclear Data support including shepherding new data evaluations through the Cross Section Evaluation Working Group process and subsequent publication of these data in the United States Evaluated Nuclear Data File as delineated in the Nuclear Criticality Safety Program (NCSP) Five-Year Plan dated October 2009, or as directed by the NCSP Manager. Quarterly reports on the status of all tasks shall be provided to the NCSP Manager no later than the last day of the month following the end of the quarter.

BNL POC: Pavel Oblozinsky (631-344-2814)  
DOE POC: Jerry McKamy, NNSA (202-586-8974)

**Task: Information Preservation and Dissemination**  
Hanford: \$65K

Funds are provided to Hanford for the continued revision of ARH-600 and development of a method for obtaining a method for actinides from empirical data as delineated in the Nuclear Criticality Safety Program (NCSP) Five-Year Plan dated October 2009 or as directed by the NCSP Manager. Quarterly reports on the status of all tasks shall be provided to the NCSP Manager no later than the last day of the month following the end of the quarter.

Hanford POC: Raymond Puigh (509-376-3766)  
DOE POC: Jerry McKamy, NNSA (202-586-8974)

**Tasks: Integral Experiments, International Criticality Safety Benchmark Evaluation Project and the Criticality Safety Support Group**  
Idaho National Laboratory (INL): \$2,190K

Funds are provided to the INL to oversee United States participation in the Institut de Radioprotection et de Sûreté Nucléaire (IRSN) Structural Materials Experiments Program (MIRTE), and to conduct the International Criticality Safety Benchmark Evaluation Project (ICSBEP) as delineated in the Nuclear Criticality Safety Program (NCSP) Five-Year Plan dated October 2009, or as directed by the NCSP Manager. Funds are also provided for Criticality Safety Support Group (CSSG) technical support to the NCSP Manager regarding planning and execution of the NCSP (\$45K for WSMS and \$45K for SRNS). With approval of the NCSP Manager, the CSSG may also provide technical assistance to other Department of Energy (DOE) and DOE Contractor organizations. Quarterly reports on the status of the ICSBEP and MIRTE tasks shall be provided to the NCSP Manager no later than the last day of the month following the end of the quarter.

INL POC: Blair Briggs (208-526-7628)  
DOE POC: Jerry McKamy, NNSA (202-586-8974)

**Tasks: Analytical Methods, Integral Experiments, Nuclear Data, and the Criticality Safety Support Group**  
Los Alamos National Laboratory (LANL): \$6,997K

Funds are provided to LANL to conduct nuclear criticality integral experiments, MCNP support, and Nuclear Data support as delineated in the Nuclear Criticality Safety Program (NCSP) Five-Year Plan dated October 2009, or as directed by the NCSP Manager. Funds are also provided for Criticality Safety Support Group (CSSG) technical support to the NCSP Manager regarding planning and execution of the NCSP. With approval of the NCSP Manager, the CSSG may also provide technical assistance to other Department of Energy (DOE) and DOE Contractor organizations. Quarterly reports on the status of all tasks shall be provided to the NCSP Manager no later than the last day of the month following the end of the quarter.

LANL POC: Robert Margevicious (505-606-0109)  
DOE POC: Jerry McKamy, NNSA (202-586-8974)

**Tasks: Analytical Methods, Information Preservation and Dissemination, Integral Experiments, Nuclear Data, Training and Education, and the Criticality Safety Support Group**

Lawrence Livermore National Laboratory (LLNL): \$1,543K

Funds are provided to LLNL to conduct hands-on criticality safety training, maintain the DOE Nuclear Criticality Safety Program (NCSP) website, provide analytical methods and nuclear data support, and lead the accident dosimetry exercise in Valduc, France as delineated in the NCSP Five-Year Plan dated October 2009, or as directed by the NCSP Manager. Funds are also provided for Criticality Safety Support Group (CSSG) technical support to the NCSP Manager regarding planning and execution of the NCSP. With approval of the NCSP Manager, the CSSG may also provide technical assistance to other Department of Energy (DOE) and DOE Contractor organizations. Quarterly reports on the status of all tasks shall be provided to the NCSP Manager no later than the last day of the month following the end of the quarter.

LLNL POC: David Heinrichs (925-424-5679)

DOE POC: Jerry McKamy, NNSA (202-586-8974)

**Tasks: Analytical Methods, Information Preservation and Dissemination, Integral Experiments, Nuclear Data, Training and Education, and the Criticality Safety Support Group**

Oak Ridge National Laboratory (ORNL): \$2,754K

Funds are provided to ORNL to conduct analytical methods and nuclear data support, including the acquisition of new differential nuclear data; to continue criticality safety related code distribution and user support through Radiation Safety Information Computational Center; to participate in the Critical and Subcritical Experiments Design Team (C<sub>e</sub>dT) process; and to coordinate the design of the future Nuclear Criticality Safety Program (NCSP) Training Program, as delineated in the NCSP Five-Year Plan dated October 2009, or as directed by the NCSP Manager. Funds are also provided for Criticality Safety Support Group (CSSG) technical support to the NCSP Manager regarding planning and execution of the NCSP. With approval of the NCSP Manager, the CSSG may also provide technical assistance to other Department of Energy (DOE) and DOE Contractor organizations. Quarterly reports on the status of all tasks shall be provided to the NCSP Manager no later than the last day of the month following the end of the quarter.

ORNL POC: Cecil Parks (865-574-5280)

DOE POC: Jerry McKamy, NNSA (202-586-8974)

**Tasks: Integral Experiments, Training and Education**

Sandia National Laboratories (SNL): \$921K

Funds are provided to SNL to conduct nuclear criticality integral experiments and prepare and conduct hands-on training as delineated in the Nuclear Criticality Safety Program (NCSP) Five-Year Execution Plan dated October 2009, or as directed by the NCSP Manager. Quarterly reports on the status of all tasks shall be provided to the NCSP Manager no later than the last day of the month following the end of the quarter.

SNL POC: Gary Harms (505-845-3244)

DOE POC: Jerry McKamy, NNSA (202-586-8974)

**Appendix C**  
**International Criticality Safety Benchmark Evaluation Project**  
**Planned Benchmarks**

<b>ICSBEP BENCHMARK PRIORITIES FOR FY-2010</b>		
<i><b>IDENTIFIER</b></i>	<i><b>DRAFT TITLE</b></i>	<i><b>JUSTIFICATION</b></i>
IEU-COMP-FAST-004	ZPR-3 Assembly 12: A Large, Clean, Cylindrical Uranium (21% <sup>235</sup> U) Carbide Benchmark Assembly Reflected by Depleted Uranium	This experiment is a CSEWG Benchmark that simulates a <sup>235</sup> U enrichment of 21% and helps fill the gap in intermediate enriched systems. These data may be irretrievable within a few years.
IEU-COMP-FAST-005	ZPR-3 Assembly 11: A Large, Clean, Cylindrical Uranium (12% <sup>235</sup> U) Carbide Benchmark Assembly Reflected by Depleted Uranium	This experiment is a CSEWG Benchmark that simulates a <sup>235</sup> U enrichment of 12% with a slightly softened spectrum and helps fill the gap in intermediate enriched systems. These data may be irretrievable within a few years.
PU-COMP-FAST-005	ZPR-3 Assembly 53: A Clean Cylindrical Pu Carbide Core, Reflected by DU	ZPR-3 Assembly 53 is a high-fidelity benchmark that serves as the reference case for Assembly 54. These data may be irretrievable within a few years.
HEU-MET-FAST-044	VNIITF Al/HEU Cylindrical Configurations (Experiments 2023-2027, 3005, 4008, 4014)	These experiments test the aluminum cross section. The data are needed for spent fuel shipping/disposal container analyses and are expected to be high-fidelity benchmarks.
HEU-MET-INTER-010	ORNL HEU Metal Annuli filled with Be	There are known deficiencies in the beryllium cross section. This series of experiments is expected to provide an excellent test of beryllium and should contribute significantly to the improvement of the Be cross section.
HEU-MET-THERM-020	SPADE – BeO Moderated Ox Experiments with Special Materials	Special materials (TBD) for which there is little or no data in the ICSBEP database will be systematically selected from the large SPADE series of integral experiments that test nuclear cross sections of these materials. — <b>Tungsten, Tantalum, and Gold will be completed first. The evaluation will be revised in 2011 to include the remaining materials.</b>

**ICSBEP BENCHMARK PRIORITIES FOR FY-2011**

<i>IDENTIFIER</i>	<i>DRAFT TITLE</i>	<i>JUSTIFICATION</i>
HEU-MET-FAST-046	HEU / Vanadium Critical Experiments	This experiment is a new CEF measurement that will complement the new vanadium data that were generated at VNIITF during FY-2008. Timely performance and evaluation of these data will enable cross section evaluators to work with all available data in an effort to establish the accuracy and, if necessary, improve the V cross sections.
HEU-MET-FAST-045	Borabond Experiment	This experiment is a new CEF measurement and fills a gap in the ICSBEP database for Borabond and satisfies a specific user need.
PU-COMP-FAST-006	ZPR-3 Assembly 54: A Clean Cylindrical Pu Carbide Core, Reflected by Iron	This experiment provides unique, high-fidelity data for iron as a reflector and the data may be irretrievable within a few years.
HEU-COMP-FAST-004	ZPR-3 Assembly 14: A Clean HEU (93% <sup>235</sup> U) Carbide Core Reflected by Depleted Uranium	This is a very clean assembly and provides a test of the uranium (~92% enriched) data in a slightly softened spectrum. This assembly was part of a U-graphite series. These data may be irretrievable within a few years.
IEU-COMP-FAST-003	ZPR-6 Assembly 5: A Large, Clean, Cylindrical Uranium Carbide Benchmark Assembly Reflected by Depleted Uranium	This is a very clean assembly and provides a test of the uranium (~14% enriched) data in a slightly softened spectrum. The U/graphite ratio is representative of uranium carbide fuel. These data may be irretrievable within a few years.
HEU-MET-THERM-020 (Rev 1)	SPADE – BeO Moderated Oy Experiments with Special Materials	Special materials (TBD) for which there is little or no data in the ICSBEP database will be systematically selected from the large SPADE series of integral experiments that test nuclear cross sections of these materials. — <b>Revised in 2011 to include all remaining materials.</b>
LEU-COMP-THERM-TBD	Four Low Enriched Fuel Rod Arrays Separated by Titanium Plates	Part of the French / US MIRTE Program. The experiments will provide integral benchmark data for thermal systems containing titanium. Needed at SRNL.

<b>ICSBEP BENCHMARK PRIORITIES FOR FY-2012</b>		
<i><b>IDENTIFIER</b></i>	<i><b>DRAFT TITLE</b></i>	<i><b>JUSTIFICATION</b></i>
HEU-MET-TBD-TBD	HEU Spherical Lattice	This experiment is a new CEF measurement and fills a gap in the ICSBEP database for the combination of materials and geometry and satisfies a specific user need.
PU-COMP-FAST-003	ZPR-9 Assembly 31: Plutonium Carbide Benchmark Assembly Reflected by DU	This experiment is a CSEWG Benchmark that has traditionally been used to test plutonium data in a slightly softened spectrum. These data may be irretrievable within a few years.
IEU-MET-FAST-011	ZPR6-1 All Aluminum - 14% Enriched	This experiment provides high-fidelity benchmark data that simulates a unique uranium enrichment of 14%. These data may be irretrievable within a few years.
LEU-MET-FAST-TBD	ZPR-3 Assembly 25:A Large, Clean, Cylindrical Uranium (9% <sup>235</sup> U) – Stainless Steel Assembly Reflected by Depleted Uranium	This assembly was a clean benchmark assembly with LEU (~9%)-SST core reflected by DU. These data may be irretrievable within a few years.
HEU-MET-MIXED-013	SNOOPY Experiments -- Graphite Moderated HEU Foils – Part II (C/U = 1200)	This experiment provides data for a unique carbon-to-uranium ratio.

<b>ICSBEP BENCHMARK PRIORITIES FOR FY-2013</b>		
<i><b>IDENTIFIER</b></i>	<i><b>DRAFT TITLE</b></i>	<i><b>JUSTIFICATION</b></i>
	New Experiments	
MIX-MET-FAST-TBD	ZPPR-15 Pu/U/Zr Metal Fuel Core Reflected by DU	This experiment is of high interest for validation of both design and reprocessing of metallic Zr-alloy fuel. These data may be irretrievable within a few years.
MIX-COMP-FAST-TBD	ZPPR-2: (Pu,U) Oxide Fueled Assembly Reflected by DU	This experiment is a CSEWG Benchmark that simulates a mixed (Pu,U) Oxide Fueled Two-Zone Demonstration Reactor Benchmark. These data may be irretrievable within a few years.
MIX-COMP-FAST-TBD	ZPR-9 Assembly 29: Normal and Flooded Configurations of Mixed (Pu/U)-fueled GCFR Assembly	This experiment emphasizes the high-leakage and streaming paths in GCFR assemblies and may be a valuable test of analytical methods as well as nuclear data. These data may be irretrievable within a few years.
HEU-MET-THERM-021	SNOOPY Experiments -- Graphite Moderated HEU Foils – Part III(C/U = 2340)	This experiment provides data for a unique carbon-to-uranium ratio.

**ICSBEP BENCHMARK PRIORITIES FOR FY-2014**

<i><b>IDENTIFIER</b></i>	<i><b>DRAFT TITLE</b></i>	<i><b>JUSTIFICATION</b></i>
TBD	Flat-Top Gap Experiments	This experiment is a new CEF measurement that will challenge current ability to calculate the effects of significant streaming paths.
TBD	New Experiments	New Experiments
U233-COMP-THERM-002	LWBR <sup>233</sup> UO <sub>2</sub> -ThO <sub>2</sub> Detailed Cell Experiments -- Work For Others	Last remaining U.S. U-233 benchmarks to be evaluated. These are believed to be very precisely measured experiments
U233-COMP-THERM-003	LWBR <sup>233</sup> UO <sub>2</sub> -ThO <sub>2</sub> BMU Experiments -- Work For Others	Last remaining U.S. U-233 benchmarks to be evaluated. These are believed to be very precisely measured experiments
PU-MET-FAST-TBD	Spherical Plutonium Metal Assembly with Reflected by Various Materials (U, Be, C, Li, Ti) --- From UCRL-4957	These experiments provide independent data for key reflector materials
PU-MET-FAST-TBD	Cylindrical Plutonium Metal Assembly with Reflected by Various Materials (U, Be, C, Steel, Polyethylene) --- From UCRL-4957	These experiments provide independent data for key reflector materials
HEU-MET-FAST-081	GROTESQUE: A U(93.2) Metal Assembly [Table 5, CAS23]	These experiments test computational capabilities for complex geometries

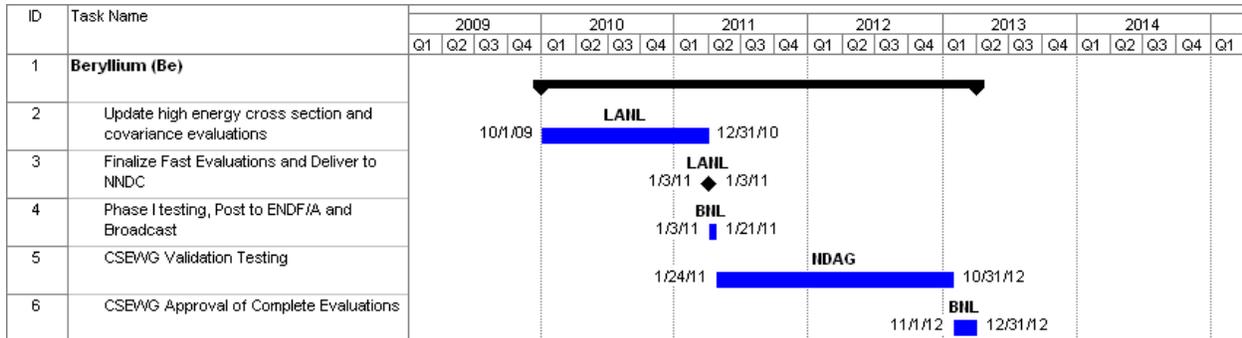
## Appendix D Nuclear Data

Differential Measurements and Evaluations – Elements	D-1
Beryllium (Be)	D-1.1
Calcium (Ca)	D-1.2
Carbon (C-12)	D-1.3
Cerium (Ce)	D-1.4
Chromium (Cr-50, 52, 53, 54)	D-1.5
Copper (Cu-63, 65)	D-1.6
Dysprosium (Dy-161,162,163,164)	D-1.7
Fluorine (F-19)	D-1.8
Gadolinium (Gd-155,156,157,158,160)	D-1.9
Manganese (Mn-55)	D-1.10
Neptunium (Np-237)	D-1.11
Nickel (Ni-58, 60, 61, 62, 64)	D-1.12
Oxygen (O-16)	D-1.13
Plutonium (Pu-239)	D-1.14
Plutonium (Pu-240)	D-1.15
Potassium (K-39, 40, 41)	D-1.16
Titanium (Ti-46, 47, 48, 49, 50)	D-1.17
Tungsten (W-182, 183, 184, 186)	D-1.18
Uranium (U-235)	D-1.19
Uranium (U-238)	D-1.20
Vanadium (V-51)	D-1.21
Zirconium (Zr)	D-1.22
Planning for Fission Measurements	D-1.23
 Differential Measurements and Evaluations – Compounds	 D-2
Silicon Dioxide (SiO <sub>2</sub> )	D-2.1
 Integral Measurements and Publication of Benchmark – Sub Critical	 D-3
Plutonium Reflected by Copper (Cu) [IER 111]	D-3.1
Plutonium Reflected by Lead (Pb) [IER 112]	D-3.2
Plutonium Reflected by Manganese (Mn) [IER 113]	D-3.3
Plutonium Reflected by Nickel (Ni) [IER 109]	D-3.4
Plutonium Reflected by Tungsten (W) [IER 110]	D-3.5
Water Reflected Metal with Neutron Absorbers	D-3.6
Neptunium	D-3.7

Integral Measurements and Publication of Benchmark – Critical	D-4
Planet (CEF Start-Up Plan)	D-4.1
Comet (CEF Start-Up Plan)	D-4.2
Flattop (CEF Start-Up Plan)	D-4.3
Godiva (CEF Start-Up Plan)	D-4.4
Vanadium [IER 104]	D-4.5
Borabond [IER 107]	D-4.6
Flattop Gap Experiment [No IER]	D-4.7
HEU Spherical Lattice [IER 105]	D-4.8
BRP Ball	D-4.9
Cadmium Reflected HEU	D-4.10
Daghlian	D-4.11
Cryogenic	D-4.12
NASA 1	D-4.13
NASA 2	D-4.14
Cross-Section Data Assessments (all on one chart)	D-5
Rhenium (Re-185, 187)	
Iron (Fe-56)	
Zirconium (Zr)	
Hafnium (Hf)	
Lanthanum (La)	
Neodymium (Nd)	
Strontium (Sr)	

## D-1 Differential Measurements and Evaluations – Elements

### D-1.1 Beryllium (Be)



## D-1 Differential Measurements and Evaluations – Elements

### D-1.2 Calcium (Ca)



## D-1 Differential Measurements and Evaluations – Elements

### D-1.3 Carbon (C-12)



## D-1 Differential Measurements and Evaluations – Elements

### D-1.4 Cerium (Ce)

ID	Task Name	2011				2012				2013				2014				2015				2016							
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4				
1	<b>Cerium (Ce)</b>																												
2	Transmission and Capture Measurements					11/1/11	ORIL			9/28/12																			
3	Resolved Resonance Region Evaluation													11/1/13	ORIL			9/30/14											

## D-1 Differential Measurements and Evaluations – Elements

### D-1.5 Chromium (Cr-50, 52, 53, 54)

ID	Task Name	2007			2008				2009				2010				2011				2012				20				
		Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2			
1	<b>Chromium(Cr52,53)</b>				11/1/07																								
2	Transmission and Capture Measurements				11/1/07	ORELA			5/1/08																				
3	Resolved Resonance Region Evaluation				2/1/08	ORIL			9/30/08																				
4	Assess data for Unresolved Resonance Region Evaluation								10/1/08	ORIL			9/30/09																
5	Finalize Resonance Evaluation and Deliver to NNDC												9/30/09	ORIL		9/30/09													
6	Phase I testing, Post to ENDF/A and Broadcast												10/5/09	BHL		10/16/09													
7	CSEWG Validation Testing												10/19/09	HDAG			10/29/10												
8	CSEWG Approval of Complete Evaluation(s)																11/1/10	BHL		12/31/10									

ID	Task Name	2008				2009				2010				2011				2012				2013							
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4				
1	<b>Chromium (Cr50,52,53,54)</b>																												
2	Update high energy cross section and covariance evaluations													10/4/10	LAIL			3/31/12											
3	Finalize Fast Evaluation and Deliver to NNDC																	3/31/12	LAIL		3/31/12								
4	Phase I testing, Post to ENDF/A and Broadcast																	4/2/12	BHL		4/13/12								
5	CSEWG Validation Testing																	4/16/12	HDAG			10/31/12							
6	CSEWG Approval of Complete Evaluation(s)																					11/1/12	BHL		12/31/12				

## D-1 Differential Measurements and Evaluations – Elements

### D-1.6 Copper (Cu-63, 65)

ID	Task Name	2009		2010				2011				2012				2013				2014				20	
		Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
1	<b>Copper (Cu 63,65)</b>																								
2	Transmission and Capture Measurements																								
3	Resolved Resonance Region Evaluation																								
4	Assess data for URR Evaluation; Complete Evaluation & Deliver to NNDC																								
5	Phase I testing, Post to ENDF/A and Broadcast																								
6	CSEWG Validation Testing																								
7	CSEWG Approval of Complete Evaluation(s)																								
8	Update high energy cross section and covariance evaluations																								
9	Finalize Fast Evaluations and Deliver to NNDC																								
10	Phase I testing, Post to ENDF/A and Broadcast																								
11	CSEWG Validation Testing																								
12	CSEWG Approval of Complete Evaluations																								

## D-1 Differential Measurements and Evaluations – Elements

### D-1.7 Dysprosium (Dy-161,162,163,164)

ID	Task Name	2009		2010				2011				2012				2013				2014					
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	<b>Dysprosium (Dy)</b>																								
2	Perform Capture Measurements																								
3	Perform SAMMY Analysis																								
4	Resolve Resonance Region Evaluation for DY-161,162,163,164																								
5	Finalize isotopic Evaluation Resonance Region Evaluation and Deliver to NNDC																								
6	Phase I testing, Post to ENDF/A and Broadcast																								
7	CSEWG Validation Testing																								
8	CSEWG Approval of Complete Evaluation																								

## D-1 Differential Measurements and Evaluations – Elements

### D-1.8 Fluorine (F-19)

ID	Task Name	2007				2008				2009				2010				2011			
		Q4	Q1	Q2	Q3	Q4	Q1	Q2													
1	<b>Fluorine (F 19)</b>																				
2	Evaluation with covariance data																				
3	Finalize Resonance Evaluation and Deliver to NNDC																				
4	Phase I testing, Post to ENDF/A and Broadcast																				
5	CSEWG Validation Testing																				
6	CSEWG approved of Complete Evaluation(s)																				

## D-1 Differential Measurements and Evaluations – Elements

### D-1.9 Gadolinium (Gd-155,156,157,158,160)

ID	Task Name	2008				2009				2010				2011				2012				2013			
		Q1	Q2	Q3	Q4																				
1	<b>Gadolinium (Gd)</b>																								
2	Perform Capture Measurements																								
3	Perform SAMMY Analysis																								
4	Resolve Resonance Region Evaluation for Gd-155,156,157,158,160																								
5	Finalize Resonance Region Evaluation and Deliver to NNDC																								
6	Phase I testing, Post to ENDF/A and Broadcast																								

## D-1 Differential Measurements and Evaluations – Elements

### D-1.10 Manganese (Mn-55)

ID	Task Name	2007			2008				2009				2010				2011				2012				
		Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
1	<b>Manganese (Mn 55)</b>																								
2	Resonance Evaluation with Covariance Data				10/1/07				3/31/08																
3	Finalize Resonance Evaluation and Deliver to NNDC								4/1/08				4/1/08												
4	Phase I testing, Post to ENDF/A and Broadcast								4/1/08				4/14/08												
5	CSEWG Validation Testing								4/15/08				10/1/08												
6	CSEWG Approval of Complete Evaluations								11/3/08				12/31/08												
7	Update high energy cross section and covariance evaluations												4/1/10				9/30/11								
8	Finalize Fast Evaluation and Deliver to NNDC																			9/30/11				9/30/11	
9	Phase I testing, Post to ENDF/A and Broadcast																			10/3/11				10/14/11	
10	CSEWG Validation Testing																			10/17/11				10/31/11	
11	CSEWG Approval of Complete Evaluations																			11/1/11				12/30/11	

## D-1 Differential Measurements and Evaluations – Elements

### D-1.11 Neptunium (Np-237)

ID	Task Name	2007		2008				2009				2010				2011				2012				20	
		Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4		
1	<b>Neptunium (Np 237)</b>																								
2	Update high energy cross section and covariance evaluations				4/1/08				9/30/09																
3	Finalize fast Evaluation and Deliver to NNDC																			10/1/09				10/1/09	
4	Phase I testing, Post to ENDF/A and Broadcast																			10/2/09				10/15/09	
5	CSEWG Validation Testing																			10/15/09				10/29/10	
6	CSEWG Approval of Fast Evaluations																			11/1/10				12/31/10	
7	Develop Measurement Plan and Cost Estimate				2/1/08				3/31/08																

## D-1 Differential Measurements and Evaluations – Elements

### D-1.12 Nickel (Ni-58, 60, 61, 62, 64)

ID	Task Name	2007		2008				2009				2010				2011				2012				20		
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
1	<b>Nickel (Ni 58,60)</b>																									
2	Transmission and Capture Measurements																									
3	Resolved Resonance Region Evaluation																									
4	Assess data for Unresolved Resonance Region Evaluation																									
5	Finalize Resonance Evaluation and Deliver to NNDC																									
6	Phase I testing, Post to ENDF/A and Broadcast																									
7	CSEWG Validation Testing																									
8	CSEWG Approval of Complete Evaluation(s)																									

ID	Task Name	2010				2011				2012				2013				2014				2015				
		Q4	Q1	Q2	Q3	Q4																				
1	<b>Nickel (Ni 58,60,61,62,64)</b>																									
2	Update high energy cross section and covariance evaluations																									
3	Finalize Fast Evaluation and Deliver to NNDC																									
4	Phase I testing, Post to ENDF/A and Broadcast																									
5	CSEWG Validation Testing																									
6	CSEWG Approval of Complete Evaluation(s)																									

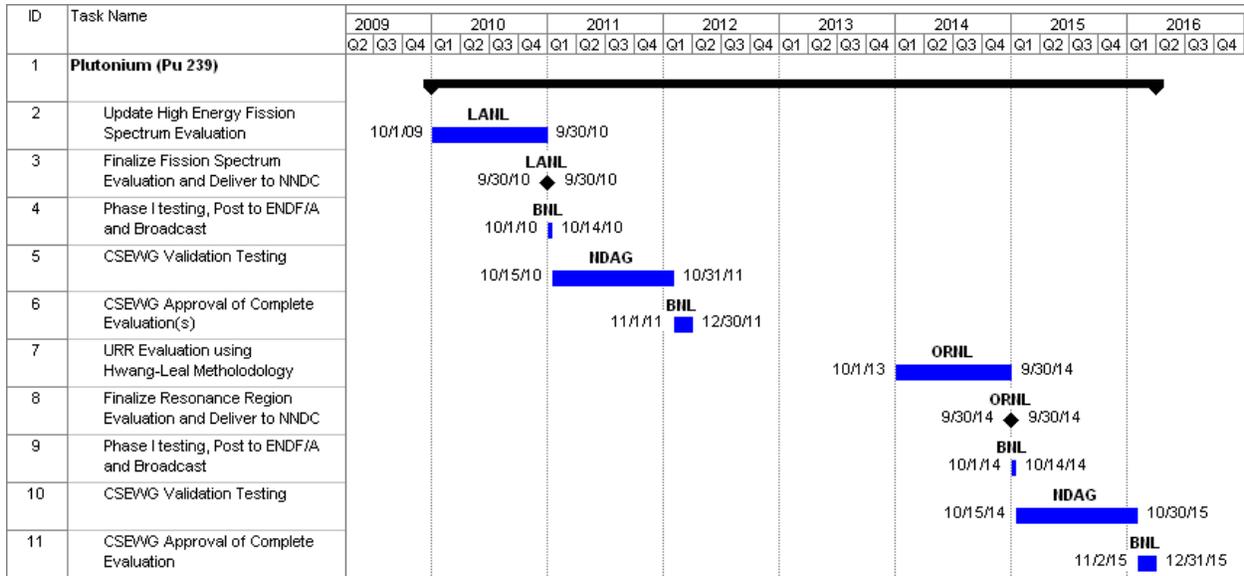
## D-1 Differential Measurements and Evaluations – Elements

### D-1.13 Oxygen (O-16)

ID	Task Name	2008				2009				2010				2011				2012				2013				
		Q4	Q1	Q2	Q3	Q4																				
1	<b>Oxygen (O16)</b>																									
2	Update high energy cross section and covariance evaluations																									
3	Finalize Fast Evaluation and Deliver to NNDC																									
4	Phase I testing, Post to ENDF/A and Broadcast																									
5	CSEWG Validation Testing																									
6	CSEWG Approval of Complete Evaluations																									

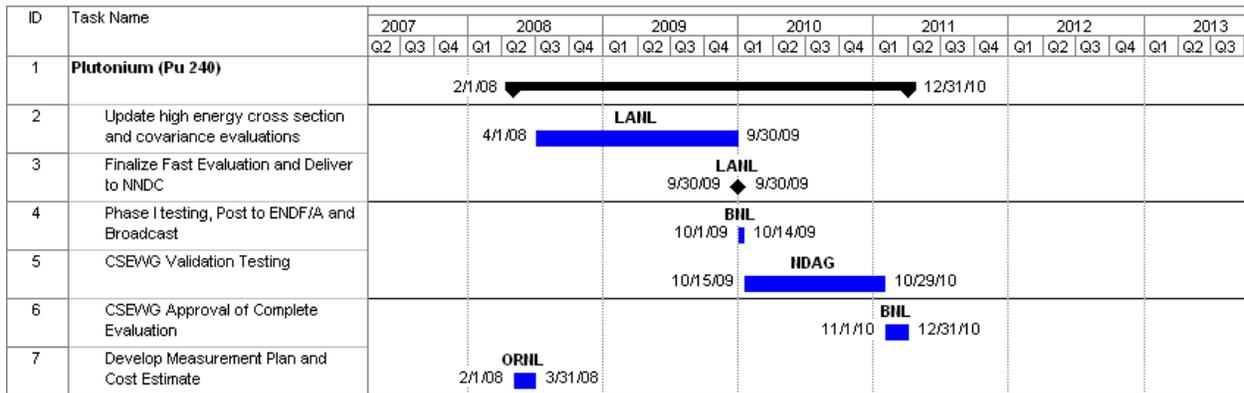
## D-1 Differential Measurements and Evaluations – Elements

### D-1.14 Plutonium (Pu-239)



## D-1 Differential Measurements and Evaluations – Elements

### D-1.15 Plutonium (Pu-240)



## D-1 Differential Measurements and Evaluations – Elements

### D-1.16 Potassium (K-39, 40, 41)

ID	Task Name	2007				2008				2009				2010				2011				2012			
		Q4	Q1	Q2	Q3																				
1	<b>Potassium (K 39,40,41)</b>																								
2	Resonance Evaluation with Covariance Data																								
3	Finalize Resonance Evaluation and Deliver to NNDC																								
4	Phase I testing, Post to ENDF/A and Broadcast																								
5	CSEWG Validation Testing																								
6	CSEWG Approval of Complete Evaluation(s)																								

## D-1 Differential Measurements and Evaluations – Elements

### D-1.17 Titanium (Ti-46, 47, 48, 49, 50)

ID	Task Name	2006		2007				2008				2009				2010				2011				2012		
		Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
1	<b>Titanium (Ti 46,47,48,49, 50)</b>																									
2	Update high energy cross section and covariance evaluations																									
3	Finalize Fast Evaluations and Deliver to NNDC																									
4	Phase I testing, Post to ENDF/A and Broadcast																									
5	CSEWG Validation Testing																									
6	CSEWG approval of Complete Evaluation(s)																									

ID	Task Name	2007				2008				2009				2010				2011				2012				
		Q1	Q2	Q3	Q4																					
1	<b>Titanium (Ti 48)</b>																									
2	Transmission and Capture Measurements																									
3	Covariance evaluation for Ti 46,47,49,50																									
4	Finalize Coverage Evaluation and Deliver to NNDC																									
5	Resolved Resonance Evaluation for Ti 48																									
6	Assess data for Unresolved Resonance Region Evaluations Ti 48																									
7	Finalize Resonance Evaluation and Deliver to NNDC																									
8	Phase I Testing, Post to ENDF/A and Broadcast																									
9	CSEWG Validation Testing																									
10	CSEWG Approved of Complete Evaluation(s)																									

## D-1 Differential Measurements and Evaluations – Elements

### D-1.18 Tungsten (W-182, 183, 184, 186)

ID	Task Name	2008				2009				2010				2011				2012				2013			
		Q1	Q2	Q3	Q4																				
1	<b>Tungsten (W 182,186)</b>																								
2	Transmission and Capture Measurements																								
3	Resolved Resonance Region Evaluation for W-182,183,184,186																								
4	Assess data for Unresolved Resonance Region Evaluation																								
5	Finalize URR Evaluation and Deliver to NNDC																								
6	Phase I testing, Oost to ENDF/A and Broadcast.																								
7	CSEWG Validation Testing																								
8	CSEWG Approval of Complete Evaluations																								

## D-1 Differential Measurements and Evaluations – Elements

### D-1.19 Uranium (U-235)

ID	Task Name	2010				2011				2012				2013				2014				2015			
		Q1	Q2	Q3	Q4																				
1	<b>Uranium (U 235)</b>																								
2	Update Fission Spectrum																								
3	Finalize Fission Spectrum Evaluation and Deliver to NNDC																								
4	Phase I testing, Post to ENDF/A and Broadcast																								
5	CSEWG Validation Testing																								
6	CSEWG Approval of Complete Evaluation(s)																								
7	Unresolved Resonance Region Evaluation using Hwang-Leal Methodology																								
8	Finalize Resonance Regional Evaluations and Deliver to NNDC																								
9	Phase I testing, Post to ENDF/A and Broadcast																								
10	CSEWG Validation Testing																								
11	CSEWG Approval of Complete Evaluation(s)																								

## D-1 Differential Measurements and Evaluations – Elements

### D-1.20 Uranium (U-238)

ID	Task Name	2011				2012				2013				2014				2015				2016		
		Q1	Q2	Q3	Q4	Q1	Q2	Q3																
1	<b>Uranium (U 238)</b>																							
2	Unresolved Resonance Region Evaluation Using the Hwang-Leal Methodology																							
3	Finalize URR Evaluation and Deliver to NNDCC																							
4	Phase I testing, Post to ENDF/A and Broadcast																							
5	CSEWVG Validation Testing																							
6	CSEWVG Approval of Complete Evaluation(s)																							

## D-1 Differential Measurements and Evaluations – Elements

### D-1.21 Vanadium (V-51)

ID	Task Name	2008				2009				2010				2011				2012				2013				2014	
		Q4	Q1	Q2	Q3	Q4	Q1																				
1	<b>Vanadium (V 51)</b>																										
2	Update high energy cross section and covariance																										
3	Finalize Fast Evaluation and Deliver to NNDCC																										
4	Phase I Testing, Post to ENDF/A and Broadcast																										
5	CSEWVG Validation Testing																										
6	CSEWVG Approval of Complete Evaluation(s)																										
7	Complete Resonance Region Measurements																										

## D-1 Differential Measurements and Evaluations – Elements

### D-1.22 Zirconium (Zr)

ID	Task Name	2010				2011				2012				2013				2014				2015				2016		
		Q1	Q2	Q3	Q4	Q1	Q2	Q3																				
1	<b>Zirconium (Zr)</b>																											
2	Complete Resonance Region Measurements																											

## D-1 Differential Measurements and Evaluations – Planning

### D-1.23 Planning for Fission Measurement Capability

ID	Task Name	2010				2011				2012				2013				2014				2015			
		Q1	Q2	Q3	Q4																				
1	<b>Differential Measurements Planning</b>																								
2	Complete a Plan to Establish Fission Measurement Capability																								



ANL/BHL/LAHL/LLNL/ORNL  
6/1/13 9/27/13

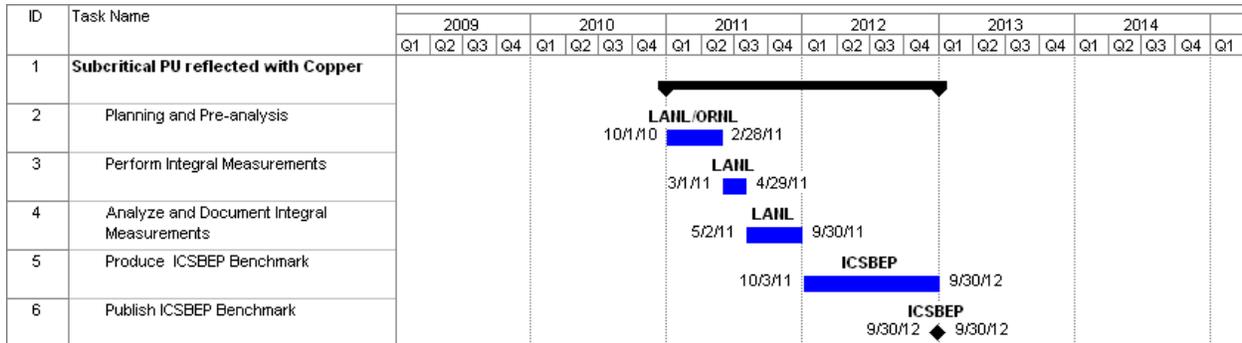
## D-2 Differential Measurements and Evaluations – Compounds

### D-2.1 Silicon Dioxide (SiO<sub>2</sub>)

ID	Task Name	2009				2010				2011				2012				2013				2014			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	<b>Silicon Dioxide</b>																								
2	Assess thermal scattering (CNEA/ORNL assessment of NCSP Thermal Moderators)					3/1/10																			
3	Thermal Scattering Measurement in SiO <sub>2</sub>																								
4	Thermal Scattering Evaluation																								
5	Finalize Thermal Scattering Evaluation; Deliver to NNDC																								
6	Phase I Testing. Post to ENDF/A and Broadcast																								
7	CSEWG Validation Testing																								
8	CSEWG Approval of Complete Evaluations																								

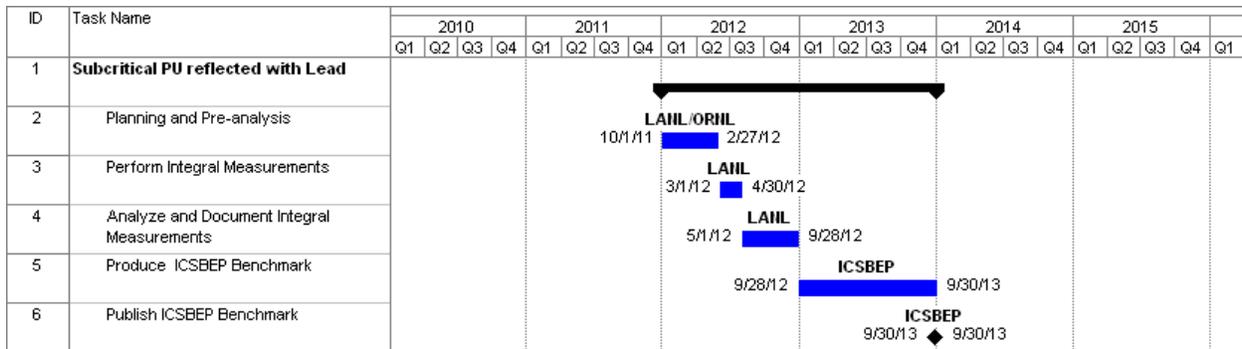
### D-3 Integral Measurements and Publication of Benchmark – Sub Critical

#### D-3.1 Plutonium Reflected by Copper (Cu) [IER 111]



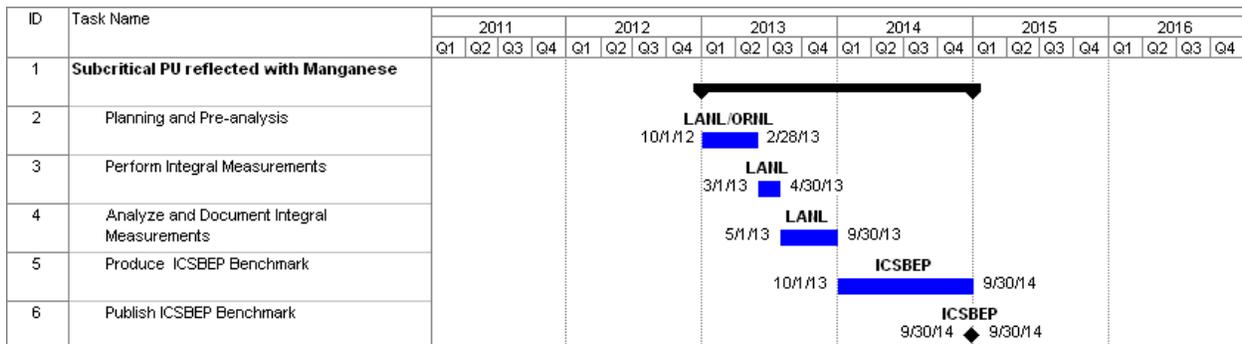
### D-3 Integral Measurements and Publication of Benchmark – Sub Critical

#### D-3.2 Plutonium Reflected by Lead (Pb) [IER 112]



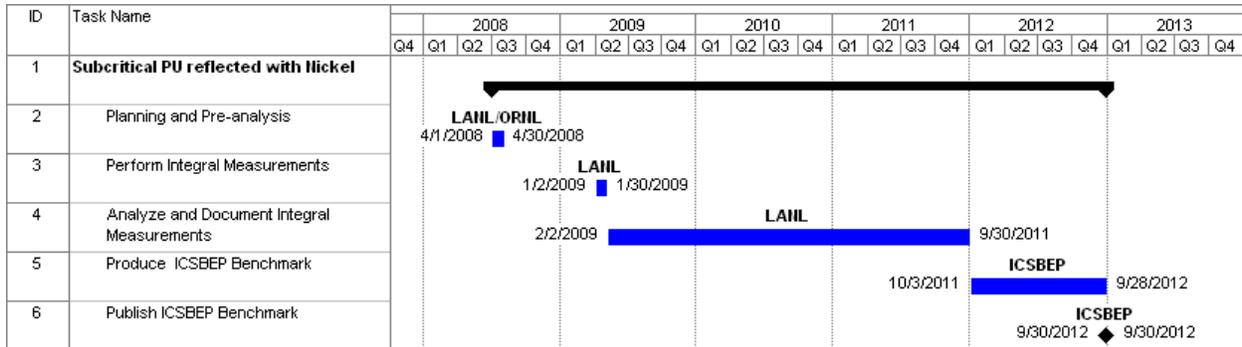
### D-3 Integral Measurements and Publication of Benchmark – Sub Critical

#### D-3.3 Plutonium Reflected by Manganese (Mn) [IER 113]



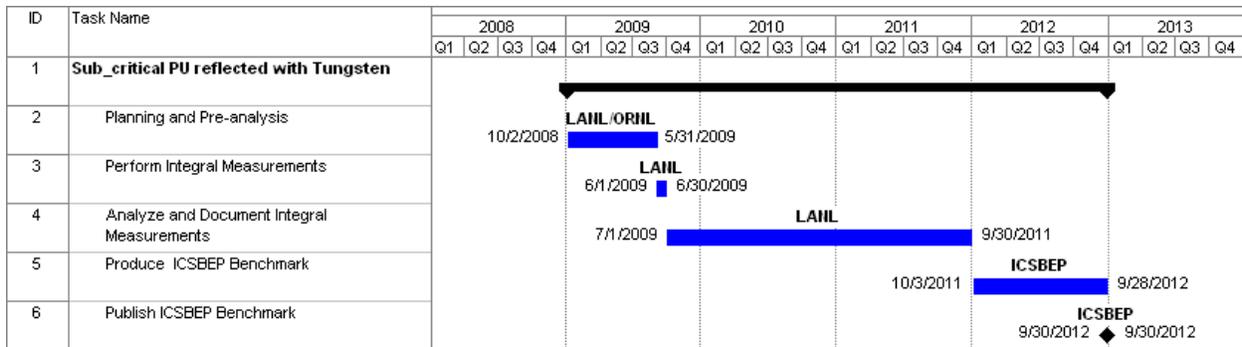
### D-3 Integral Measurements and Publication of Benchmark – Sub Critical

#### D-3.4 Plutonium Reflected by Nickel (Ni) [IER 109]



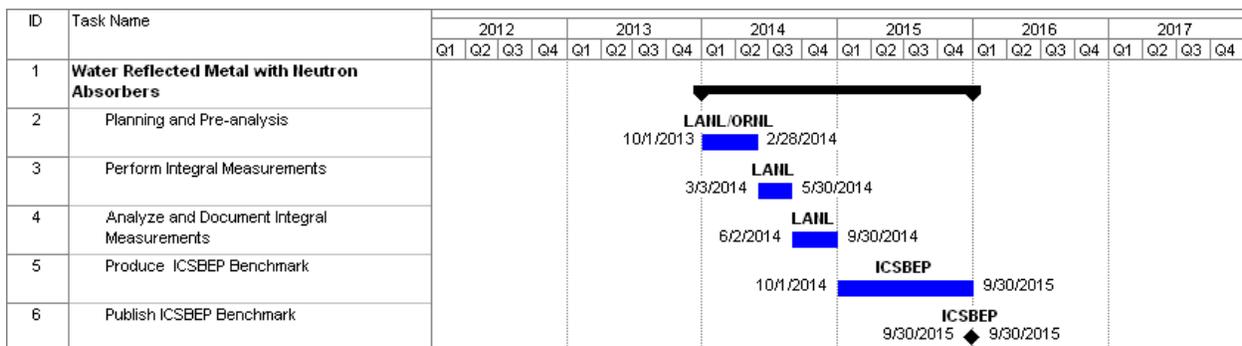
### D-3 Integral Measurements and Publication of Benchmark – Sub Critical

#### D-3.5 Plutonium Reflected by Tungsten (W) [IER 110]



### D-3 Integral Measurements and Publication of Benchmark – Sub Critical

#### D-3.6 Water Reflected Metal with Neutron Absorbers



### D-3 Integral Measurements and Publication of Benchmark – Sub Critical

#### D-3.7 Neptunium

ID	Task Name	2014				2015				2016				2017				2018				2019			
		Q1	Q2	Q3	Q4																				
1	<b>Neptunium</b>																								
2	Planning and Pre-analysis																								
3	Perform Integral Measurements																								
4	Analyze and Document Integral Measurements																								
5	Produce ICSBEP Benchmark																								
6	Publish ICSBEP Benchmark																								

### D-4 Integral Measurements and Publication of Benchmark – Critical

#### D-4.1 Planet (CEF Start-Up Plan)

ID	Task Name	2008				2009				2010				2011				2012				2013		
		Q4	Q1	Q2	Q3																			
1	<b>Planet (CEF Start-Up Plan)</b>																							
2	Planning and Pre-analysis																							
3	Perform Integral Measurements																							

### D-4 Integral Measurements and Publication of Benchmark – Critical

#### D-4.2 Comet (CEF Start-Up Plan)

ID	Task Name	2008				2009				2010				2011				2012				2013		
		Q4	Q1	Q2	Q3																			
1	<b>Comet (CEF Start-Up Plan)</b>																							
2	Planning and Pre-analysis																							
3	Perform Integral Measurements																							

## D-4 Integral Measurements and Publication of Benchmark – Critical

### D-4.3 Flattop (CEF Start-Up Plan)

ID	Task Name	2008				2009				2010				2011				2012				2013				2014			
		Q2	Q3	Q4	Q1																								
1	<b>Flattop (CEF Start-Up Plan)</b>																												
2	Planning and Pre-analysis																												
3	Perform Integral Measurements																												
4	Analyze and Document Integral Measurements																												

## D-4 Integral Measurements and Publication of Benchmark – Critical

### D-4.4 Godiva (CEF Start-Up Plan)

ID	Task Name	2008				2009				2010				2011				2012				2013				2014			
		Q2	Q3	Q4	Q1																								
1	<b>Godiva (CEF Start-Up Plan)</b>																												
2	Planning and Pre-analysis																												
3	Perform Integral Measurements																												
4	Analyze and Document Integral Measurements																												

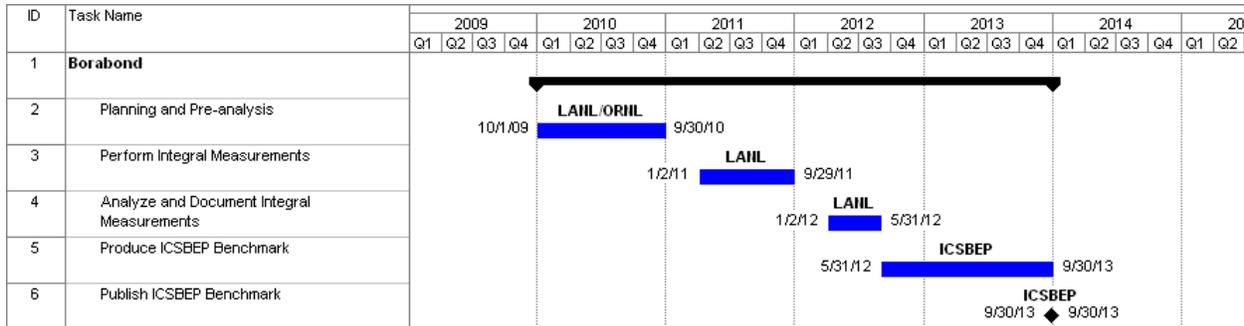
## D-4 Integral Measurements and Publication of Benchmark – Critical

### D-4.5 Vanadium [IER 104]

ID	Task Name	2008				2009				2010				2011				2012				2013				20	
		Q1	Q2	Q3	Q4	Q1	Q2																				
1	<b>Vanadium HEU Plates</b>																										
2	Planning and Pre-analysis																										
3	Perform Integral Measurements																										
4	Analyze and Document Integral Measurements																										
5	Produce ICSBEP Benchmark																										
6	Publish ICSBEP Benchmark																										

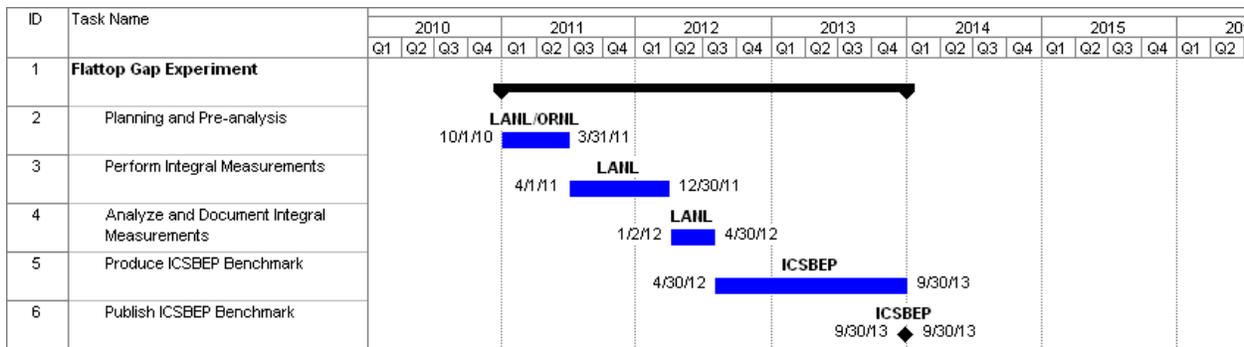
## D-4 Integral Measurements and Publication of Benchmark – Critical

### D-4.6 Borabond [IER 107]



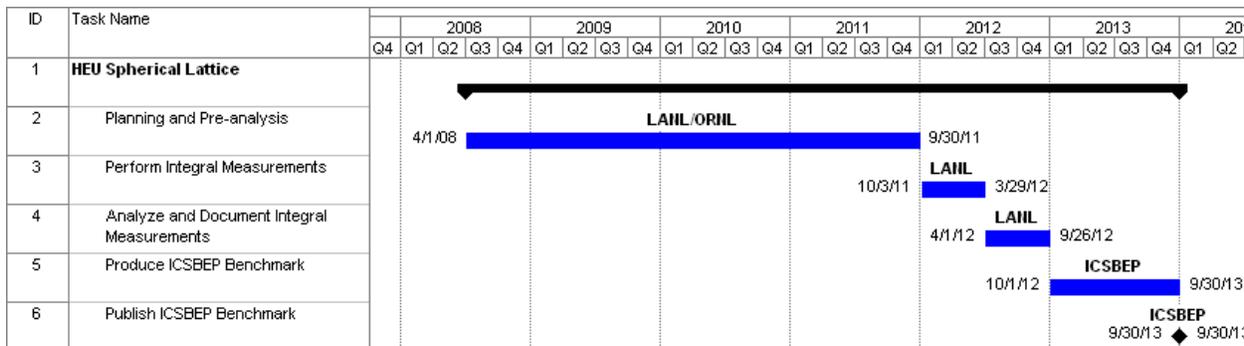
## D-4 Integral Measurements and Publication of Benchmark – Critical

### D-4.7 Flattop Gap Experiment [No IER]



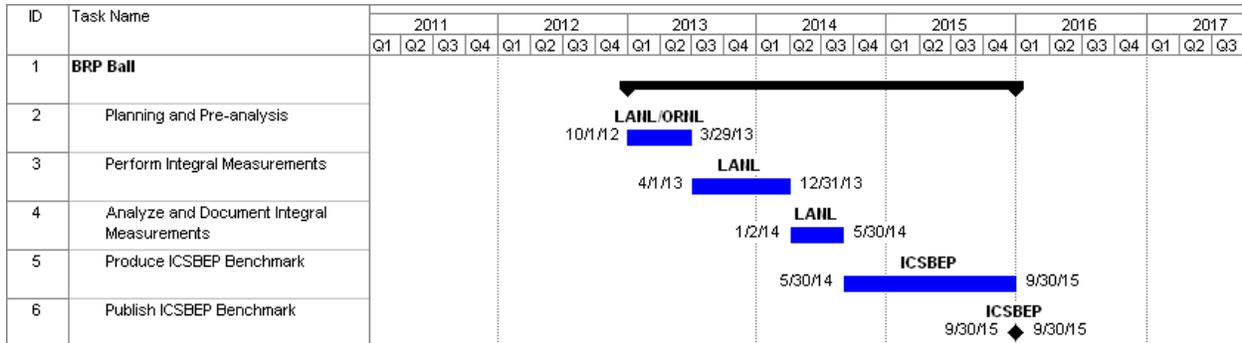
## D-4 Integral Measurements and Publication of Benchmark – Critical

### D-4.8 HEU Spherical Lattice [IER 105]



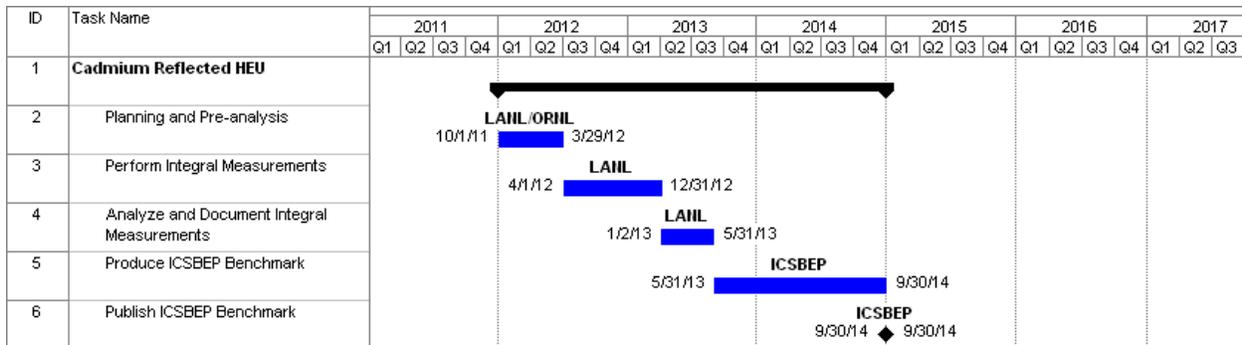
## D-4 Integral Measurements and Publication of Benchmark – Critical

### D-4.9 BRP Ball



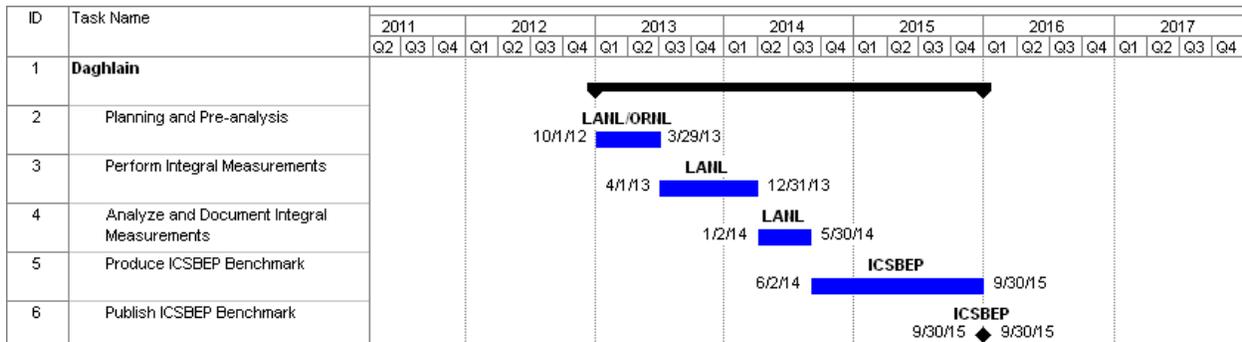
## D-4 Integral Measurements and Publication of Benchmark – Critical

### D-4.10 Cadmium Reflected HEU



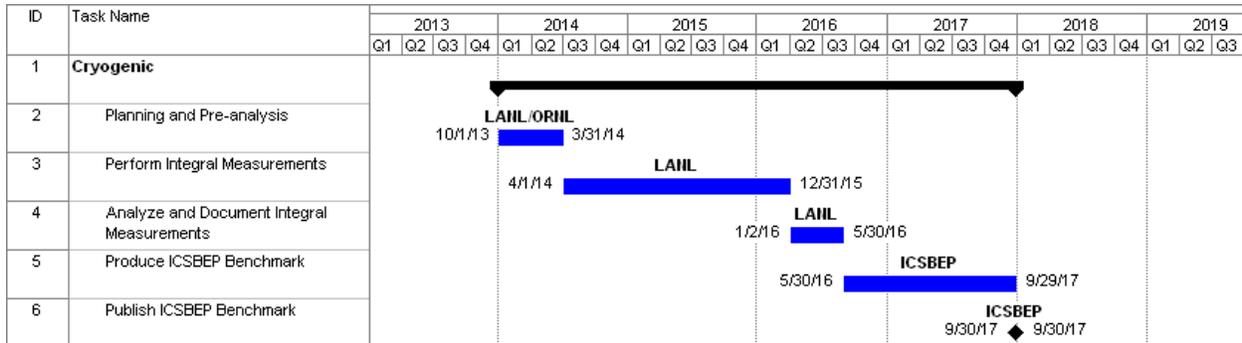
## D-4 Integral Measurements and Publication of Benchmark – Critical

### D-4.11 Daghlian



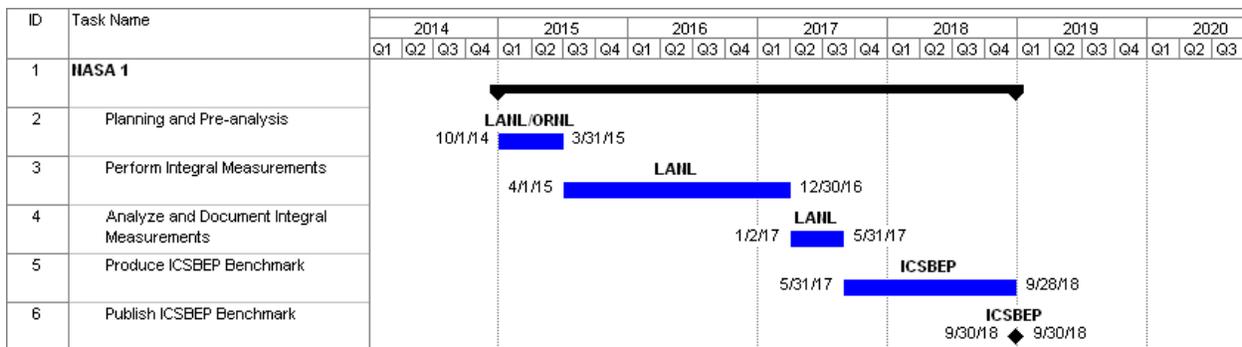
## D-4 Integral Measurements and Publication of Benchmark – Critical

### D-4.12 Cryogenic



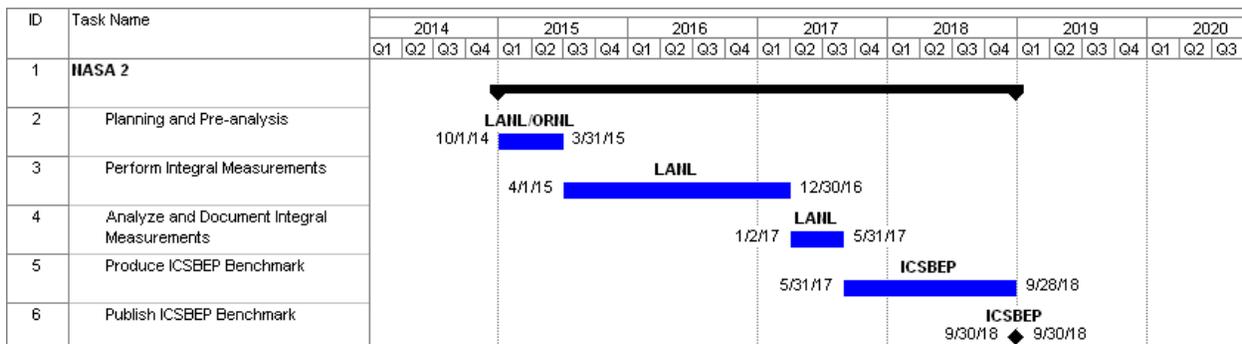
## D-4 Integral Measurements and Publication of Benchmark – Critical

### D-4.13 NASA 1



## D-4 Integral Measurements and Publication of Benchmark – Critical

### D-4.14 NASA 2



### D-5 Cross-Section Data Assessments (all in one chart)

Rhenium (Re-185, 187), Iron (Fe-56), Zirconium (Zr), Hafnium (Hf), Lanthanum (La), Neodymium (Nd), Strontium (Sr)

ID	Task Name	10		2011				2012				2013				2014				2015				2016		
		Q3	Q4	Q1	Q2	Q3																				
1	<b>Cross-section data assessment</b>																									
2	Cross-section data assessment for 185,187Re, 56Fe, Zr																									
3	Cross-section data assessment for Hf, La, Nd, and Sr																									

**Appendix E**  
**FY 2010 Projected Foreign Travel**

<b>Meeting or Conference</b>	<b>Date</b>	<b>Organization</b>	<b>No. of Travelers</b>	<b>One Sentence Justification</b>
IAEA Workshop on BUC (Spain)	10/2009	ANL	1	Participate in BUC Workshop, Session Chair (McKnight)
NEA Expert Group on Assay Data for SNF (NEA, Paris)	11/2009	ANL	1	Participate in Meeting of Expert Group on ADSNF and BUC Expert Groups (McKnight)
ND-2010 (Korea)	4/2010	ANL	1	Present Data Validation work, Session Chair, and NEA Expert Group Meeting (McKnight)
NEA WPEC Meeting (NEA, Paris)	5/2010	ANL	1	ENDF Representative to WPEC Meeting, HPRL and Data Adjustment Expert Groups (McKnight)
Programmatic Meeting with Host (Slovenia)	10/2009	INL	1	Arrange 2010 ICSBEP meeting (Scott) – Carried over from FY-2009
Programmatic Visit to IRSN/CEA (France)	11/2009	INL	1	Continuing collaboration on MIRTE (Briggs)
ND-2010 (Korea)	4/2010	INL	2	Represent ICSBEP, Identify Data Needs, & Distribute ICSBEP Handbook (Briggs, Scott)
Annual ICSBEP Programmatic Meeting (Slovenia)	5/2010	INL, ANL ORNL, LLNL LANL, BAPL*, SNL WSMS * To be approved by Navel Reactors	≤ 20	Hold annual ICSBEP Technical Review Mtg. (Briggs, Scott, Ellis, Dean, Bess, McKnight, Schaefer, Lell, Hopper, Blakeman, Heinrichs, Kim, Hayes, Kahler, Harms, Trumble, Zerkle & Students: Marshall, Gorham, Unidentified)
Programmatic Meeting with Host (France)	6/2010	INL	1	Arrange 2011 ICSBEP meeting (Scott)
Working Party on Nuclear Criticality Safety (France)	9/2010	INL	1	Represent ICSBEP on WPNCs and participate in Excursion Analysis Expert Groups (Briggs)
CEF Operator Training in Valduc (France)	3/2010 9/2010	LANL	2 2	Final year in the current contract with CEA Valduc for CEF Operator Training
Joint US/French Integral Experiments	1/2010	LANL SNL	5	Begin development of the future joint US/French integral

and Training Program Development Meeting (France)				experiments and training program at Valduc, CEF, and SNL
ND-2010 (Korea)	4/2010	LANL	2	Representing LANL ND Efforts Kawano or Talou and White or Little
Dosimetry Exercise in Valduc (France)	10/2009	LLNL, LANL, NCSP, PNNL, SRS, Y-12	$\leq 12$	Participate in an international intercomparison exercise of nuclear accident dosimetry (Heinrichs, Scorby, Wysong, Hickman, Wong, Gadd, Felty, Rathbone, Crase, Veinot, Unidentified)
ND-2010 (Korea)	4/2010	LLNL	$\leq 4$	Represent LLNL data processing and Monte Carlo methods (Heinrichs, Cullen, Unidentified)
Working Party on Criticality Safety (France)	9/2010	LANL	1	Presentation of MCNP results to Expert Group on Source Convergence (F. Brown)
ND-2010 (Korea)	4/2010	ORNL	3	Present ORNL ND measurement, evaluation, and data processing work (Guber, Dunn, Wiarda)
OECD/NEA WPEC Meeting (France)	5/2010	ORNL	2	ENDF/B Formats Chair; Data ORNL Chairs/participates in 3 data subgroups (Dunn and Leal)
WONDER-2010 (France)	9/2010	ORNL	1	Represent ORNL evaluation; measurement, and SAMMY analysis capabilities and obtain international differential data important for NCSP (Arbanas)
Resonance Region Differential Measurements at IRMM (Belgium)	11/2009 2/2010 5/2010 8/2010	ORNL	1 (4 trips)	Perform NCSP resonance region cross-section measurements at GELINA accelerator (Guber)
CNEA thermal scattering evaluation collaboration (Argentina)	2/2010	ORNL	1	ORNL work with CNEA to produce $S(\alpha,\beta)$ evaluation per FY10 milestone (Leal)
IPEN Resonance Integral Experiment Collaboration (Brazil)	2/2010	ORNL	1	ORNL work with IPEN to obtain resonance integral data needed to support NCSP differential data evaluation efforts (Guber)
CAAS-related Measurements at SILENE (France)	10/2009	ORNL	2	Initiate measurement planning and become familiar with SILENE characteristics and available materials (Wagner and Miller)
Planning for CAAS-	9/2010	ORNL	2	Finalize plans for SILENE

related Measurements at SILENE (France)				measurements that will take place in FY11 (Wagner and Miller)
OECD Working Party on Nuclear Criticality Safety (France)	9/2010	ORNL	1	Participate in NCS working party and expert groups (Wagner or Parks)
OECD/NEA Expert Group on Uncertainty Analyses for Criticality Safety Assessment (UACSA)	9/2010	ORNL	≤ 2	Participate in expert group meeting on advances in sensitivity/uncertainty methods and analyses that can benefit the NCSP (Rearden and Mueller)
SCALE/TSUNAMI Class at CEA (France)	10/2009	ORNL	2	Provide CEA SCALE/TSUNAMI training per NCSP PM request (Rearden and Mueller)
Coordination of DICE Activities (France)	5/2010	ORNL	2	Coordinate VIBE/DICE integration and distribution of SCALE/TSUNAMI data (Rearden and Lefebvre)
MCNEG Monte Carlo Users Group Meeting	3/2010	ORNL	1	Represent ORNL MC methods development in UK and international community and obtain information about emerging methods techniques for NCS (Rearden)
OECD/NEA Expert Group on Burnup Credit for Criticality Safety	10/2009	ORNL	1	Present paper on utilization of SCALE/TSUNAMI for criticality safety (Parks)