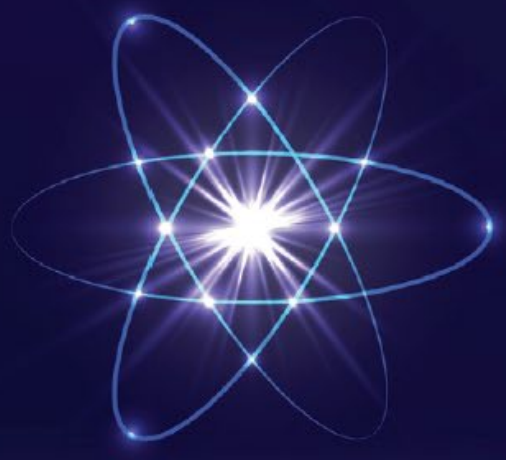
Five Year Execution Plan –
for the
Mission and Vision
of the
United States Department of Energy Nuclear Criticality Safety Program

September 2022, Revision 3

FY 2022 through FY 2026



Department of Energy Nuclear Criticality Safety Program Five-Year Execution Plan for Fiscal Years 2022 through 2026, dated August 2021.

Approved:

Dr. Angela Chambers
Manager
Nuclear Criticality Safety Program

Revision History

Modification	Section	Date
Revision 0 – initial issue	All	August 10, 2021
Revision 1 – Include ORNL ND4 (Thermal Neutron Total Cross Section Measurements for Improvement of Criticality Calculations and Propagation of Scattering Kernel Uncertainties) which is a continuing FY22 task using FY21 carryover funding	Main Plan, ND section	March 2022
Revision 1 – Include ORNL ND10 (Monte Carlo Evaluation of Differential and Integral Data) which is a continuing FY22 task using FY21 carryover funding	Main Plan, ND section	March 2022
Revision 1 – Transfer $150K from LLNL IE1 to LANL IE33	Main Plan, IE section	March 2022
Revision 1 – Add ORNL-ND11 (Thermal neutron scattering measurements and evaluations for DHS applications at temperature) is a new task approved by NCSP Manager. This task is funded using carryover funding.	Main Plan, ND Section	March 2022
Revision 2 – Transfer $50K from LLNL-IE33 to PNNL-IE1 for PNNL to support activation foil analysis for IER 557 and analysis methods for IER 153	Main Plan, IE sections	May 2022
Revision 2 – Changed the lead lab on IER 518 on the Make It Happen List from SNL to LLNL	Main Plan	May 2022
Revision 3 – Added $250K in new funding to SNL-IE1b to support FY23 IER 574 – Godiva Characterization. Received $87K from DOE NSR&D Hold for Projects and $163K from DOE Nuclear Safety Reserve.	Main Plan	September 2022
Revision 3 – Transfer $140K from ORNL IPD3 to NNSS IE1 to cover over charges	All	September 2022
Revision 3 – Transfer $96K from ORNL IE4 to NNSS IE1 to cover over charges	All	September 2022
Revision 3 – Transfer $450K from LANL AM1 to NNSS IE1 to cover over charges	All	September 2022

TABLE OF CONTENTS

TABLE OF CONTENTS i
TABLE OF FIGURES iii
TABLE OF TABLES iv
ACRONYMS AND DEFINITIONS v
1.0 Nuclear Criticality Safety Program Mission and Vision 1
2.0 Technical Program Elements 4
2.1 NCSP FY2022 "Make-It-Happen" List 9
2.2 Analytical Methods Technical Program Element 11
2.2.1 Description 11
2.2.2 Approved Tasks 11
2.2.2.1 Brookhaven National Laboratory (BNL) 13
2.2.2.2 Los Alamos National Laboratory (LANL) 14
2.2.2.3 Lawrence Livermore National Laboratory (LLNL) 18
2.2.2.4 Oak Ridge National Laboratory (ORNL) 21
2.2.2.5 Pacific Northwest National Laboratory (PNNL) 26
2.3 Information Preservation and Dissemination (IPD) 27
2.3.1 Program Element Description 27
2.3.2 Approved Tasks 29
2.3.2.1 Lawrence Livermore National Laboratory (LLNL) 29
2.3.2.2 Oak Ridge National Laboratory (ORNL) 32
2.3.2.3 Savannah River Site (SRS) 35
2.4 Integral Experiments (IE) 37
2.4.1 Program Element Description 37
2.5 Nuclear Data (ND) 39
2.5.1 Program Element Description 39
2.5.2 Approved Tasks 41
2.5.2.1 Brookhaven National Laboratory (BNL) 41
2.5.2.2 Los Alamos National Laboratory (LANL) 43
2.5.2.3 Lawrence Livermore National Laboratory (LLNL) 46
2.5.2.4 Oak Ridge National Laboratory (ORNL) 50
2.5.2.5 Rensselaer Polytechnic Institute (RPI) 54
2.5.2.6 Y-12 National Security Complex 56
2.6 Training and Education (TE) 57
2.6.1 Program Element Description 57
2.6.2 Approved Tasks 59
2.6.2.1 Los Alamos National Laboratory (LANL) 59
2.6.2.2 Lawrence Livermore National Laboratory (LLNL) 61
2.6.2.3 Oak Ridge National Laboratory (ORNL) 63
2.6.2.4 Sandia National Laboratories (SNL) 66
2.6.2.5 Y-12 National Security Complex 67
3.0 NCSP Technical Support 68
APPENDIX A: Work Authorization Statements for Nuclear Criticality Safety Program Funding for Execution Year FY2021 75
APPENDIX B: Nuclear Data Priorities, Basis Statements, and Milestones 78
APPENDIX C: Fiscal Year 2022 Projected Foreign Travel 108

APPENDIX D: Baseline Budget Needs for Execution Year FY2022-FY2024 113
APPENDIX E: International Collaboration with the Institut de Radioprotection et de Sûreté Nucléaire (IRSN) for FY2022 116
APPENDIX F: International Collaboration with the Atomic Weapons Establishment (AWE) for FY2022 119

TABLE OF FIGURES

Figure 1.1 Summary of NCSP Mission and Vision Program Element Goals 2
Figure 2.0-1 NCSP Funding Overview (FY2022-FY2026) – Total 4
Figure 2.0-2 NCSP Funding Overview (FY2022) – By Technical Program Element 5
Figure 2.0-3 NCSP Funding Overview (FY2022-FY2026) – By Technical Program Element..... 6
Figure 2.0-4 NCSP Funding Overview (FY2022-FY2026) – By Site..... 7
Figure 2.0-5 NCSP Funding Overview (FY2022) – By Site 8
Figure 2.2-1 NCSP AM Budget (FY2022-FY2026)..... 11
Figure 2.2-2 NCSP AM Budget (FY2022) 12
Figure 2.2-3 BNL AM Budget Trend (FY2022-FY2026) 13
Figure 2.2-4 LANL AM Budget Trend (FY2022-FY2026) 17
Figure 2.2-5 LLNL AM Budget Trend (FY2022-FY2026)..... 20
Figure 2.2-6 ORNL AM Budget Trend (FY2022-FY2026) 25
Figure 2.2-7 PNNL AM Budget Trend (FY2022-FY2026)..... 26
Figure 2.3-1 IPD Budget (FY2022-FY2026)..... 27
Figure 2.3-2 IPD Budget (FY2022) 28
Figure 2.3-3 LLNL IPD Budget Trend (FY2022-FY2026)..... 31
Figure 2.3-4 ORNL IPD Budget Trend (FY2022-FY2026) 33
Figure 2.3-5 SRS IPD Budget Trend (FY2022-FY2026)..... 36
Figure 2.4-1 NCERC Availability FY2019 & FY2020 37
Figure 2.4-2 IE Budget (FY2022-FY2026) 37
Figure 2.5-1 ND Budget (FY2022-FY2026) 39
Figure 2.5-2 ND Budget (FY2022)..... 39
Figure 2.5-3 BNL ND Budget Trend (FY2022-FY2026)..... 41
Figure 2.5-4 LANL ND Budget Trend (FY2022-FY2026) 45
Figure 2.5-5 LLNL ND Budget Trend (FY2022-FY2026) 49
Figure 2.5-6 ORNL ND Budget Trend (FY2022-FY2026)..... 53
Figure 2.5-7 RPI ND Budget Trend (FY2022-FY2026) 55
Figure 2.5-8 Y-12 ND Budget Trend (FY2022-FY2026) 56
Figure 2.6-1 TE Budget (FY2022-FY2026) 57
Figure 2.6-2 TE Budget (FY2022)..... 57
Figure 2.6-3 LANL TE Budget Trend (FY2022-FY2026)..... 60
Figure 2.6-4 LLNL TE Budget Trend (FY2022-FY2026) 62
Figure 2.6-5 ORNL TE Budget Trend (FY2022-FY2026)..... 65
Figure 2.6-6 SNL TE Budget Trend (FY2022-FY2026)..... 66
Figure 2.6-7 Y12 TE Budget Trend (FY2022-FY2026)..... 67
Figure 3.1 NCSP Technical Support (FY2022-FY2026) - by Laboratory 68
Figure 3.2 NCSP Technical Support (FY2021) - by Laboratory..... 68

TABLE OF TABLES

Table 2.1 NCSP Final Site Splits (FY2022 – FY2026)** 9
Table 2.2 NCSP "Make-It-Happen" List for FY2022 9

ACRONYMS AND DEFINITIONS

ACE	"A Compact ENDF" file
ADVANCE	Automated Data Verification and Assurance for Nuclear Calculations Enhancement
AM	Analytical Methods
AMPX	Nuclear cross-section processing code
ARH	Atlantic Richfield Hanford
AWE	Atomic Weapons Establishment
BNL	Brookhaven National Laboratory
CAAS	Criticality Accident Alarm System
CEA	Commissariat à l'Énergie Atomique
CED	Critical Experiment Decision
C_EdT	Critical & Subcritical Experiment Design Team
COG[1]	Lawrence Livermore National Laboratory Monte Carlo Computer Code
CritView	A plotting and interpolation software program designed to display criticality data from the ARH-600 Criticality Handbook
CRP	Coordinated Research Projects
CSEWG	Cross Section Evaluation Working Group
CSSG	Criticality Safety Support Group
DAF	Device Assembly Facility
DOE	Department of Energy
ENDF	Evaluated Nuclear Data File
EOC	Explanation of Change (for out-year peaks and dips in budget plots)
FLATTOP	Highly-Reflected Spherical Benchmark Assembly
FUDGE	Lawrence Livermore National Laboratory nuclear data management infrastructure
FY	Fiscal Year
GELINA	Linear Accelerator in Geel, Belgium
IAEA	International Atomic Energy Agency
ICSBEP	International Criticality Safety Benchmark Evaluation Project
IE	Integral Experiments
IER	Integral Experiment Request

INL	Idaho National Laboratory
IPD	Information Preservation and Dissemination
IRMM	Institute for Reference Materials and Measurements
IRSN	Institut De Radioprotection et De Sûreté Nucléaire
KENO[2]	Monte Carlo Criticality Computer Code
LA	Los Alamos (report)
LANL	Los Alamos National Laboratory
LINAC	Linear Accelerator
LLNL	Lawrence Livermore National Laboratory
MCNP®[3]	Monte Carlo N-Particle Computer Code
MSTS	Mission Support and Test Services
NCERC	National Criticality Experiments Research Center
NCS	Nuclear Criticality Safety
NCSET	Nuclear Criticality Safety Engineer Training
NCSP	Nuclear Criticality Safety Program
NCSU	North Carolina State University
ND	Nuclear Data
NDA	non-destructive assay
NDAG	Nuclear Data Advisory Group
NJOY	Nuclear cross-section processing code
NNDC	National Nuclear Data Center
NNL	Naval Nuclear Laboratory
NNSA	National Nuclear Security Administration
NNSS	Nevada National Security Site
OECD/NEA	Organization for Economic Cooperation and Development/Nuclear Energy Agency
ORNL	Oak Ridge National Laboratory
PNNL	Pacific Northwest National Laboratory
POC	Point of Contact
RPI	Rensselaer Polytechnic Institute
RSICC	Radiation Safety Information Computational Center
SAMMY[4]	R-matrix nuclear data evaluation computer code

SCALE[5]	A modular modeling and simulation system for nuclear safety analysis and design
SNL	Sandia National Laboratories
SQA	Software Quality Assurance
SRS	Savannah River Site
S/U	Sensitivity/Uncertainty
TACS	Training Assembly for Criticality Safety
TE	Training and Education
TSUNAMI	Tool for Sensitivity and Uncertainty Analysis Methodology Implementation
US	United States of America
UT	University of Tennessee
V&V	Verification and Validation
WPEC	Working Party on International Nuclear Data Evaluation Corporation
WPNCS	Working Party on Nuclear Criticality Safety
Y-12	Y-12 National Security Complex

[1]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.

[2]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.

[3]MCNP® and Monte Carlo N-Particle® are registered trademarks owned by Triad National Security, LLC, manager and operator of Los Alamos National Laboratory. Any third-party use of such registered marks should be properly attributed to Triad National Security, LLC, including the use of the '®' designation as appropriate. Any questions regarding licensing, proper use, and/or proper attribution of Triad National Security, LLC, marks should be directed to trademarks@lanl.gov.

[4]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.

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

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 2019-2028 (https://ncsp.llnl.gov/docs/NCSP_MISSION_VISION.pdf), are the following:

- The NCSP mission is to provide sustainable expert leadership, direction, and the technical infrastructure necessary to develop, maintain, and disseminate 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.

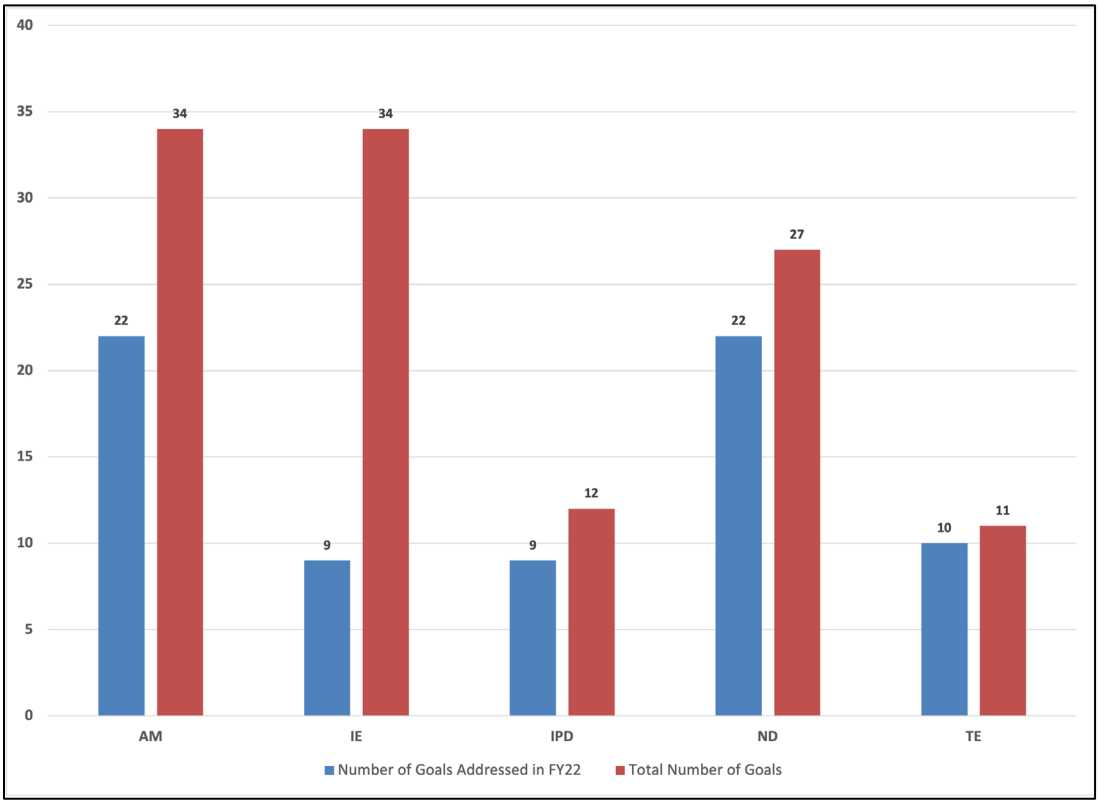
The NCSP is funded by the National Nuclear Security Administration (NNSA). Dr. Angela Chambers (NA-511) is the NCSP Manager. She is supported by the Criticality Safety Support Group (CSSG) and the Nuclear Data Advisory Group (NDAG), regarding technical matters, and by the Criticality Safety Coordinating 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/).

The NCSP Mission and Vision is achieved by identifying and accomplishing a set of five-year programmatic goals in five broad technical program elements that support identified ten-year goals. The NCSP Five-Year Plan defines tasks that are designed to accomplish specific goals identified in the NCSP Mission and Vision. The current Five-Year Plan has been developed to accomplish these Mission and Vision goals with the advice and assistance of experts appointed by the NCSP manager or working under charters approved by the NCSP manager. The five technical program elements are:

- Analytical Methods (AM)
- Information Preservation and Dissemination (IPD)
- Integral Experiments (IE)
- Nuclear Data (ND)
- Training and Education (TE)

The NCSP Mission and Vision provides specific goals for each program element. Each task in the current Five-Year Plan aligns with a specific NCSP Mission and Vision goal. The number of goals addressed by the current Five-Year Plan is provided in Figure 1.1. Figure 1.1 indicates the NCSP is on track to accomplish a significant number of Mission and Vision goals in FY22. The subsequent discussion provides a summary of the projected task accomplishments and technical gaps for each program element. In FY22, a limited budget is available to initiate new tasks.

Figure 1.1 Summary of NCSP Mission and Vision Program Element Goals



The Analytical Methods (AM) program element provides for the development and maintenance of state-of-the-art analytical capabilities for the processing of nuclear data from the Evaluated Nuclear Data File (ENDF) and the radiation transport analysis capabilities needed to perform nuclear criticality safety analyses. The Five-Year Plan tasks specifically supports 22 of 34 AM goals (65%) required to develop and sustain state-of-the-art cross-section processing and radiation transport modeling capabilities and expertise needed for criticality safety analyses. Regarding the overall AM technical gap over the next 5 years, the NCSP is continuing to make a modest investment at each site for succession planning efforts. University tasks were envisioned to assist in these goals; however, few university tasks are currently in progress, e.g., LANL-AM3 "Development of an Adaptive-in-temperature Method for fast on-the-fly Sampling of Thermal Neutron Scattering Data in MCNP6" at Rensselaer Polytechnic Institute, and ORNL-AM15, "The Effects of Temperature on the Propagation of Nuclear Data Uncertainty in Nuclear Criticality Safety Calculations is at the Massachusetts Institute of Technology. Technical gaps still exist for thermal scattering law data covariance evaluations, coupling NCS radiation transport software with Computer Aided Drawing (CAD) packages, developing and maintaining time-dependent radiation transport accident analysis capabilities, developing and deploying methods to provide integral experiment correlation data, and providing correlation data for integral benchmark experiments, to name a few.

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, to address site-specific needs on a prioritized basis, and this program element also supports maintaining a fundamental nuclear material handling capability, which enables hands-on NCS training programs and various other programs for the DOE NCSP and other Government Agencies. The Five-Year Plan tasks specifically support 9 of 34 (26%) IE goals to assess, design, perform, and document integral experiments. The NCERC small sample Rabbit Transfer System will be completed without NCSP funding. There are some IE goals that cannot be addressed within the current five-year budget targets. Examples of goals not addressed include: expansion of the radiochemistry laboratory capabilities at NNSS; standup "hot"/"cold" machine shops at NCERC; design and deploy low scatter capabilities at NCERC; acquisition of Np metal at NCERC; and the construction of new critical assemblies (solution reactor and Np burst reactor). Task proposals have been

submitted for these goals, and these proposals will be considered pending increased NCSP IE budget targets.

The Information Preservation & Dissemination (IPD) program element preserves primary documentation supporting criticality safety [e.g., benchmark critical experiments from the International Criticality Safety Benchmark Evaluation Project (ICSBEP)] and makes this information available for the benefit of the technical community including international partners (e.g., IRSN, AWE, CEA and OECD) through the NCSP website. The Five-Year Plan tasks specifically support 9 of 12 (75%) IPD goals for preserving and disseminating technical, programmatic, and operational information important for nuclear criticality safety. There are some IPD goals that cannot be addressed based on current budget targets. Examples of goals not addressed include operating and maintaining a classified IPD database and searchable NCS engineer database. These goals should be reconsidered considering the difficulties in implementing a classified database. A "practitioner" database was implemented in the past but was not included in the new NCSP website design. This database was difficult to maintain with correct information. Further, the NCSP may not be the best program through which information can be quickly disseminated through the NCS community. The US DOE's Energy Facility Contractors Group (EFCOG) and American Nuclear Society (ANS) Collaborate system can quickly send information to the community via video teleconference or email and precludes the need for the NCSP to provide similar capabilities.

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 Five-Year Plan tasks specifically support 22 of 27 (81%) ND goals to improve and disseminate measured and evaluated differential cross-section and covariance data needed by the AM element to support NCS analyses. Examples of goals not addressed in FY22 but are addressed in the out years include identify and prioritize differential measurements beyond the next five years; identify and prioritize differential evaluations beyond the next five years. Overall, many goals are addressed within the current ND budget targets; however, technical gaps do exist, and some ND goals cannot be addressed. Examples of goals not addressed include developing new analysis tools to fully utilize new experimental capabilities such as the time project chamber (TPC), Chi-nu, and correlated data.

The Training and Education (TE) program element identifies, develops, and facilitates training needs and educational resources (including hands-on training with fissionable material systems) in areas where no suitable alternative exists. The primary purpose of the TE element is to maintain and enhance the technical abilities and knowledge of those who impact or are impacted directly by the practice of criticality safety. The Five-Year Plan tasks specifically support 10 of 11 (91%) TE goals in FY22. The tasks primarily support the development and maintenance of the classroom and "hands-on" training courses at the Nevada Field Office, SNL and NNSS. The NCSP Manager's Course has been modified because of CSSG tasking report 2018-01 to include content for Criticality Safety Officers. This course was piloted in FY21 at the NCERC. In FY20, ORNL published a feasibility study for a new subcritical assembly to be located at ORNL to provide hands-on training for fissile material handlers, criticality safety practitioners, university students and those with responsibilities in nuclear criticality safety. Work on this task will continue in FY21. FY22 work tasks will not address the Mission and Vision goal to provide a gap analysis of training needs based on an assessment of available training and education resources in the national and international community. New NCS staff are being sought via implementation of NCS engineer university pipeline programs at LANL and LLNL. Other pipeline programs have been proposed with the Georgia Institute of Technology and Texas A&M University working with ORNL. The only goal not addressed with FY22 work tasks is the goal of developing best practices through a review of training and qualification programs throughout the DOE complex.

Although some technical gaps exist in each program element, execution of the NCSP Five-Year Plan will support and accomplish a significant number of Mission and Vision goals (72 of 118 or 61%) in FY22. As a result, the NCSP will be able to accomplish the overall mission to provide sustainable expert leadership, direction, and technical infrastructure needed to support safe, efficient fissionable material operations within the DOE.

2.0 Technical Program Elements

As mentioned above, the NCSP includes the following five technical program elements:

- Analytical Methods
- Integral Experiments
- Information Preservation and Dissemination
- 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 five technical program elements, including a budget, tasks, and milestones for completing the work and achieving the NCSP Vision. All tasks are approved based on their contribution to the achievement of the five- and ten-year goals in the Mission and Vision document. Funding figures are provided for each program element section. The status of all milestones will be reported to the NCSP Manager in quarterly reports that are due no later than three weeks from the last day of the month following the end of the quarter.

Funding for NCSP activities for FY2022-2026 are shown in Figures 2.0-1 – 2.0-5.

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/.

Figure 2.0-1 NCSP Funding Overview (FY2022-FY2026) – Total

Figure 2.0-2 NCSP Funding Overview (FY2022) – By Technical Program Element

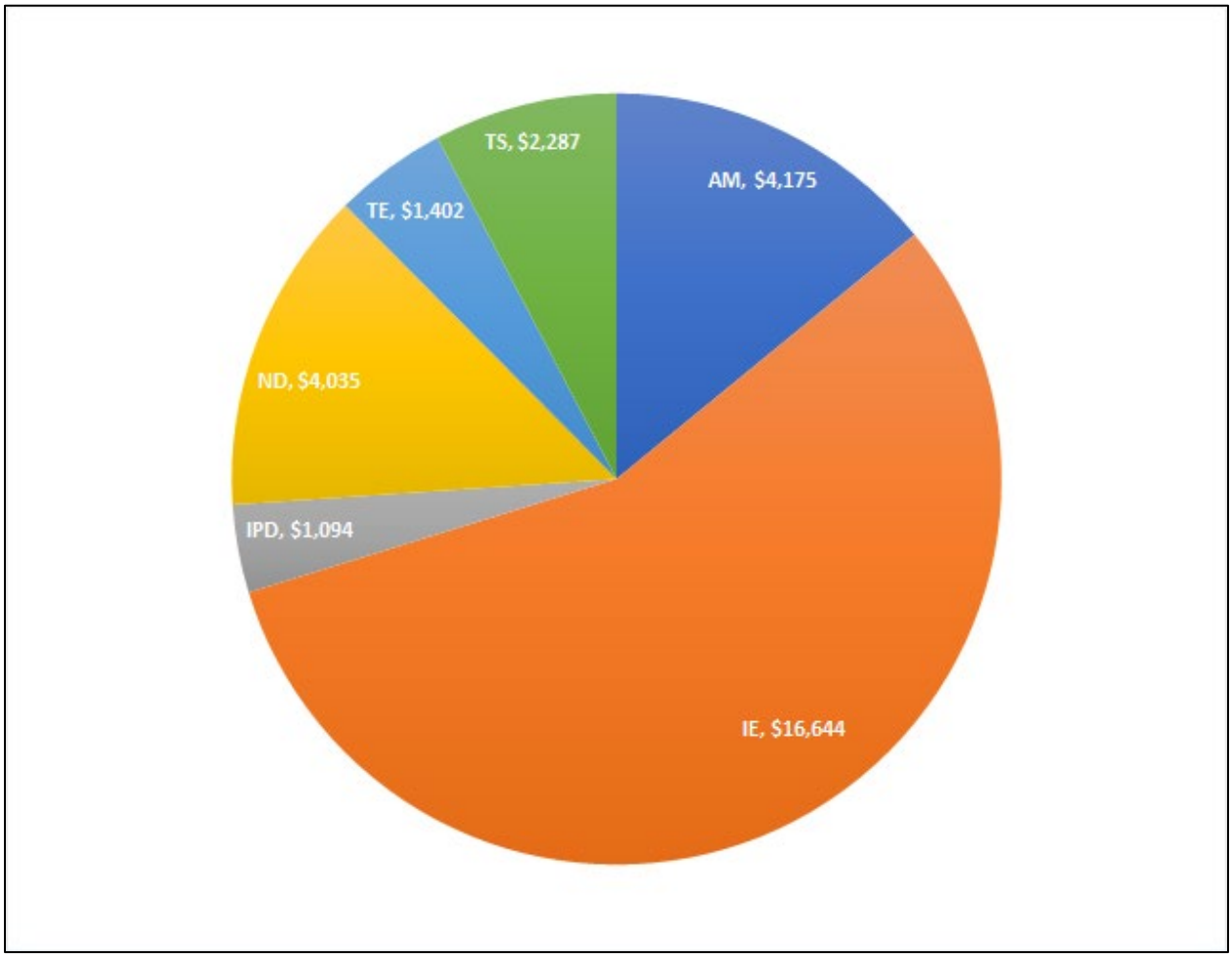


Figure 2.0-3 NCSP Funding Overview (FY2022-FY2026) – By Technical Program Element

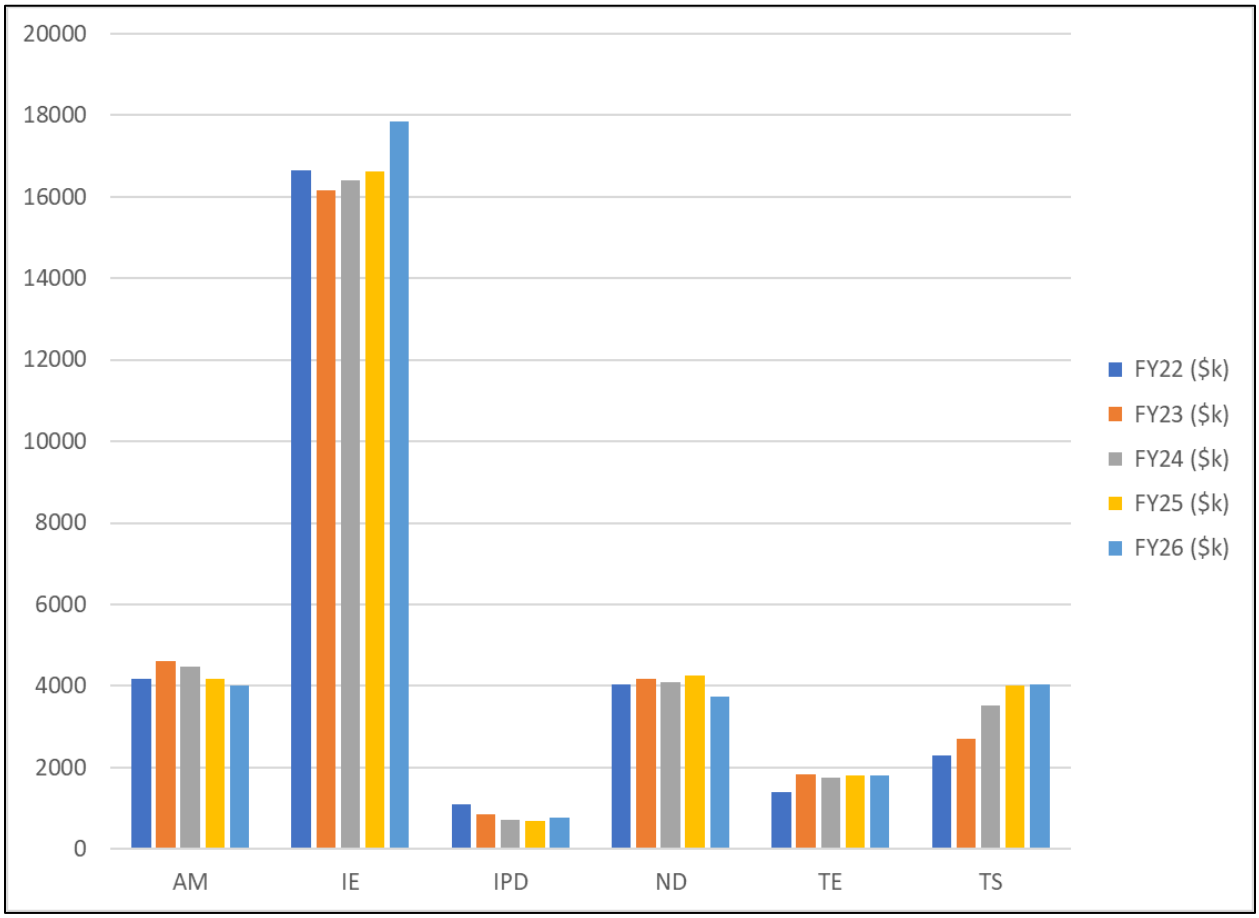


Figure 2.0-4 NCSP Funding Overview (FY2022-FY2026) – By Site

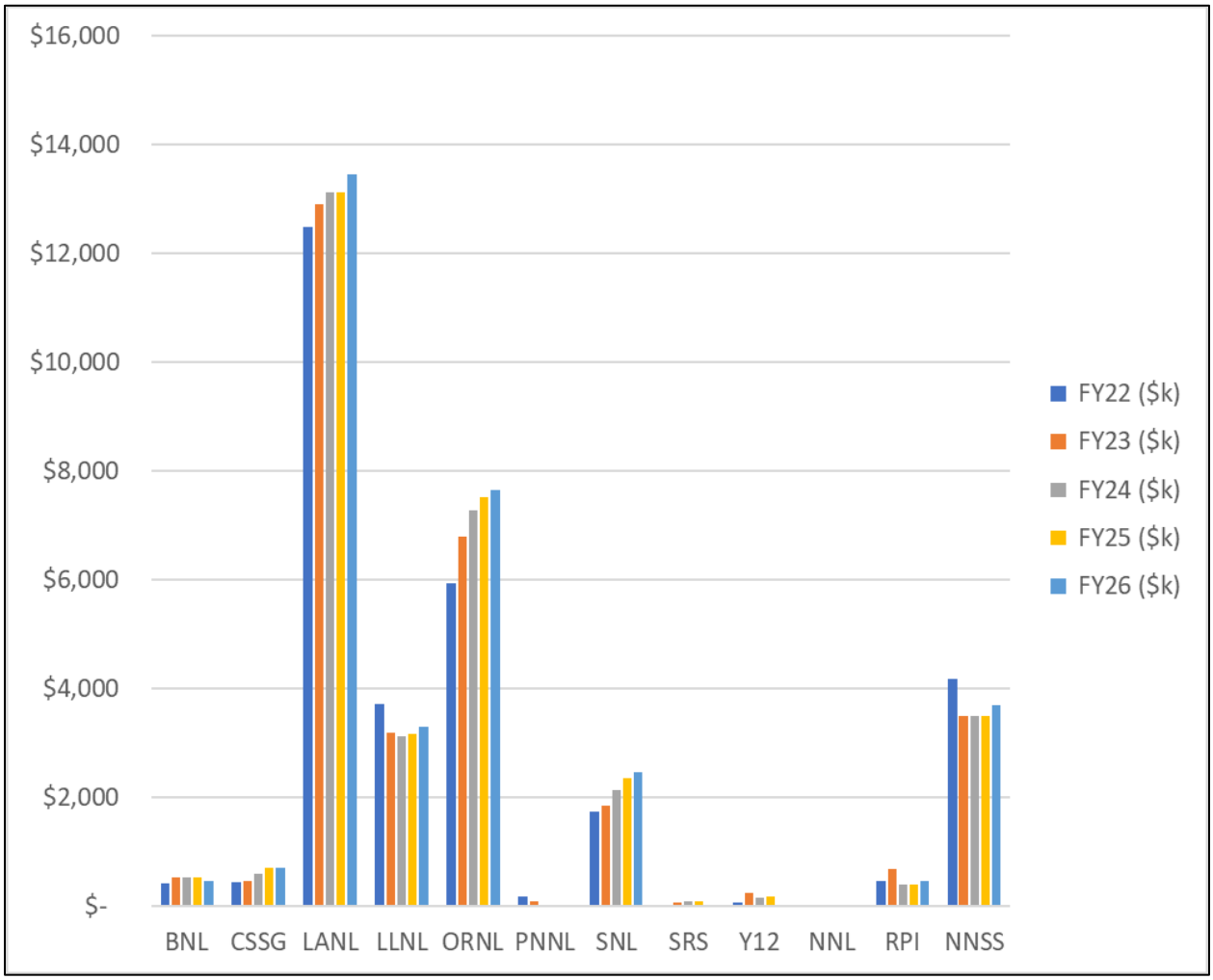


Figure 2.0-5 NCSP Funding Overview (FY2022) – By Site

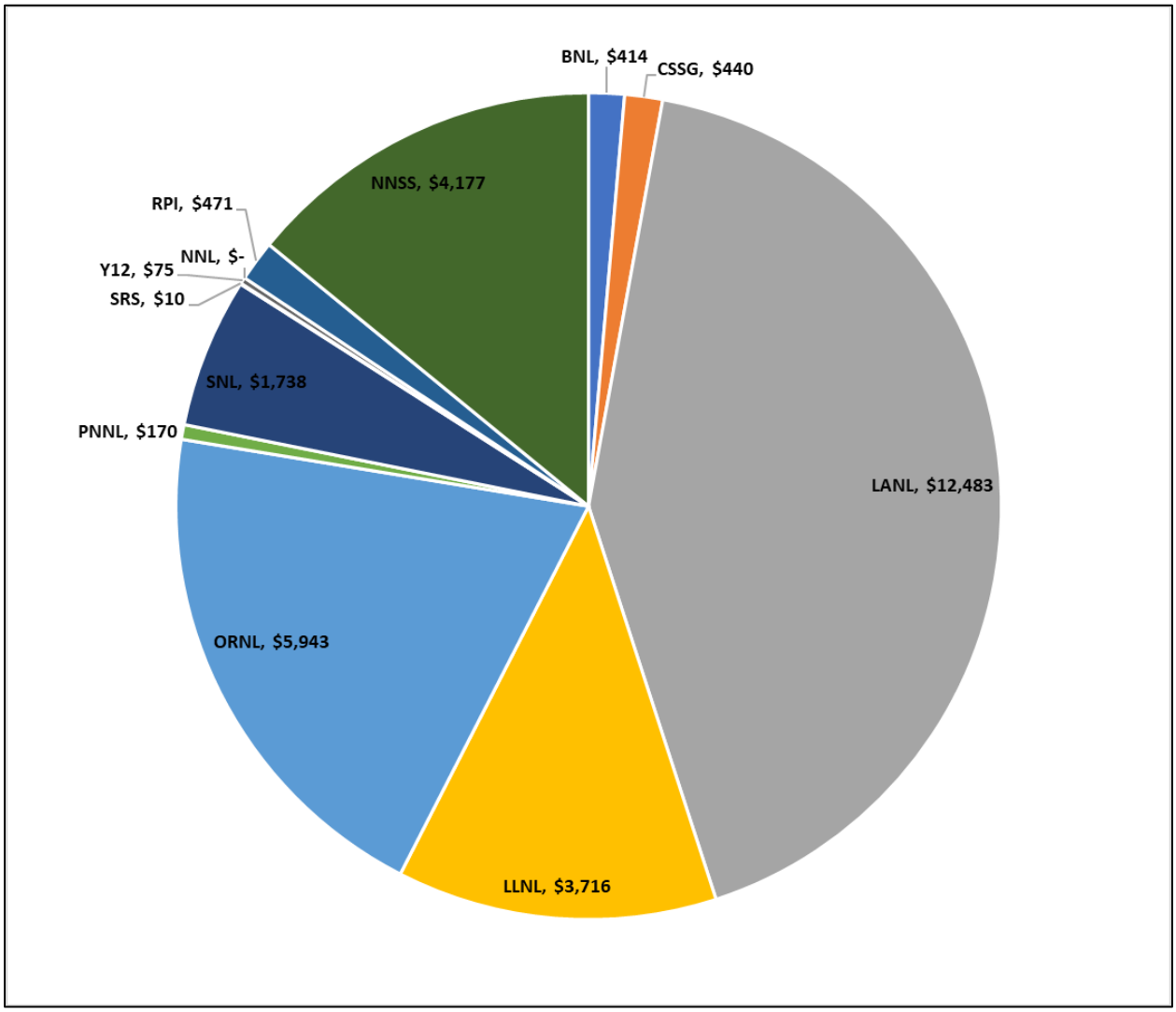


Table 2.1 NCSP Final Site Splits (FY2022 – FY2026)**

NCSP Site	FY 2022 ($k)**	FY 2023 ($k)	FY 2024 ($k)	FY 2025 ($k)	FY 2026 ($k)
Lawrence Livermore National Laboratory	3,766	3,368	3,439	3,534	3,605
Los Alamos National Laboratory	12,608	12,814	12,840	12,915	13,173
Nevada Nuclear Security Site	4,177	3,892	3,892	3,892	3,970
Sandia National Laboratory	1,738	1,845	2,120	2,350	2,397
Savanah River Site	60	75	85	90	92
Y-12 National Security Complex	105	150	162	167	170
Argonne National Laboratory	0	0	0	0	0
Brookhaven National Laboratory	414	525	530	530	541
Oak Ridge National Laboratory	6,128	6,629	6,850	6,959	7,098
National Nuclear Laboratory (Rensselaer Polytechnic Institute + NDAG Chair)	471	510	429	429	438
CSSG (Headquarters)	0	470	600	700	714
Pacific Northwest National Laboratory	170	40	0	0	0
Total	**29,637**	**30,318**	**30,947**	**31,566**	**32,197**

** CSSG funds for FY22 have been distributed to the NCSP sites. For the outyears, the CSSG funds and funds for NDAG chair use are in the "CSSG (Headquarters)" cell.

2.1 NCSP FY2022 "Make-It-Happen" List

The task milestones for FY2022 are listed in the task tables by site throughout this 5-year plan document. The NCSP Manager, working with the site task managers, has identified 15 milestones that are **high priority** for the program These are listed in Table 2.3, below, in no particular order. These tasks are slated to be completed by the end of FY2022 and progress will be tracked quarterly during the regular quarterly reporting process.

Table 2.2 NCSP "Make-It-Happen" List for FY2022

No.	Milestone	Technical Program Element	Lead Site
1	Production and delivery of hafnium to NCERC in support of TEX-Hf (IER 532)	IE	NNL
2	Conduct nuclear accident dosimetry exercise (IER 538)	IE	LLNL
3	Complete TEX low temperature DU surrogate testing (IER 547)	IE	LLNL
4	Submit TEX HEU benchmark report to the International Criticality Safety Benchmark Experiment Program (IER 297)	IE	LLNL
5	Complete critical experiments with UO_2 Rods and molybdenum foils (IER 305)	IE	SNL
6	Complete measurements for the Flattop benchmark (IER 423)	IE	LANL

No.	Milestone	Technical Program Element	Lead Site
7	Complete fabrication of lithium for critical experiment (IER 499)	IE	Y-12
8	Complete high multiplication neutron subcritical measurements (IER 518)	IE	LLNL
9	Measure the fission neutron spectrum shape using threshold activation detectors (IER 153)	IE	LANL
10	Promote use of MCNP Version 6.3 at DOE sites (Task LANL-AM1)	AM	LANL
11	Complete prompt fission neutron spectrum (PFNS) measurement of Plutonium-240 at LANSCE (Task LANL-ND2)	ND	LANL
12	Complete Zr-91 measurements at GELINA (Task ORNL-ND1)	ND	ORNL
13	Complete site acceptance tests for accelerator section #1 at RPI (Task RPI-ND3)	ND	NNL
14	Complete GELINA neutron production target (Task Y12-ND1)	ND	Y-12
15	Complete Sandia CSO/Manager course pilot course (Task ORNL-TE1, SNL-TE1)	TE	ORNL SNL
16	Publish updated CEDT manual.	IE	ORNL SNL

2.2 Analytical Methods Technical Program Element

2.2.1 Description

The Analytical Methods (AM) technical program element provides development and maintenance of state-of-the-art analytical capabilities for the processing of nuclear data from the ENDF, and the radiation transport analysis needed to support NCS evaluations for subcriticality and shielding. An essential aspect of the AM capabilities is the human expertise required to develop the analytical software, provide software configuration control, and train and assist the user community. Figures for each site provide information about the total budget for the approved tasks for each FY. Following this information, a table is provided with the following: task name, task title, description, budget, collaborators, and FY22 milestones. The list of collaborators may include IRSN, AWE, or another NCSP site. These international collaborators have provided a list of tasks of interest to each organization and are provided in Appendix E (IRSN) and Appendix F (AWE).

2.2.2 Approved Tasks

For each site, the following sections provide a task description, scope, budget, and milestones for each AM task approved by the NCSP manager.

Figure 2.2-1 NCSP AM Budget (FY2022-FY2026)

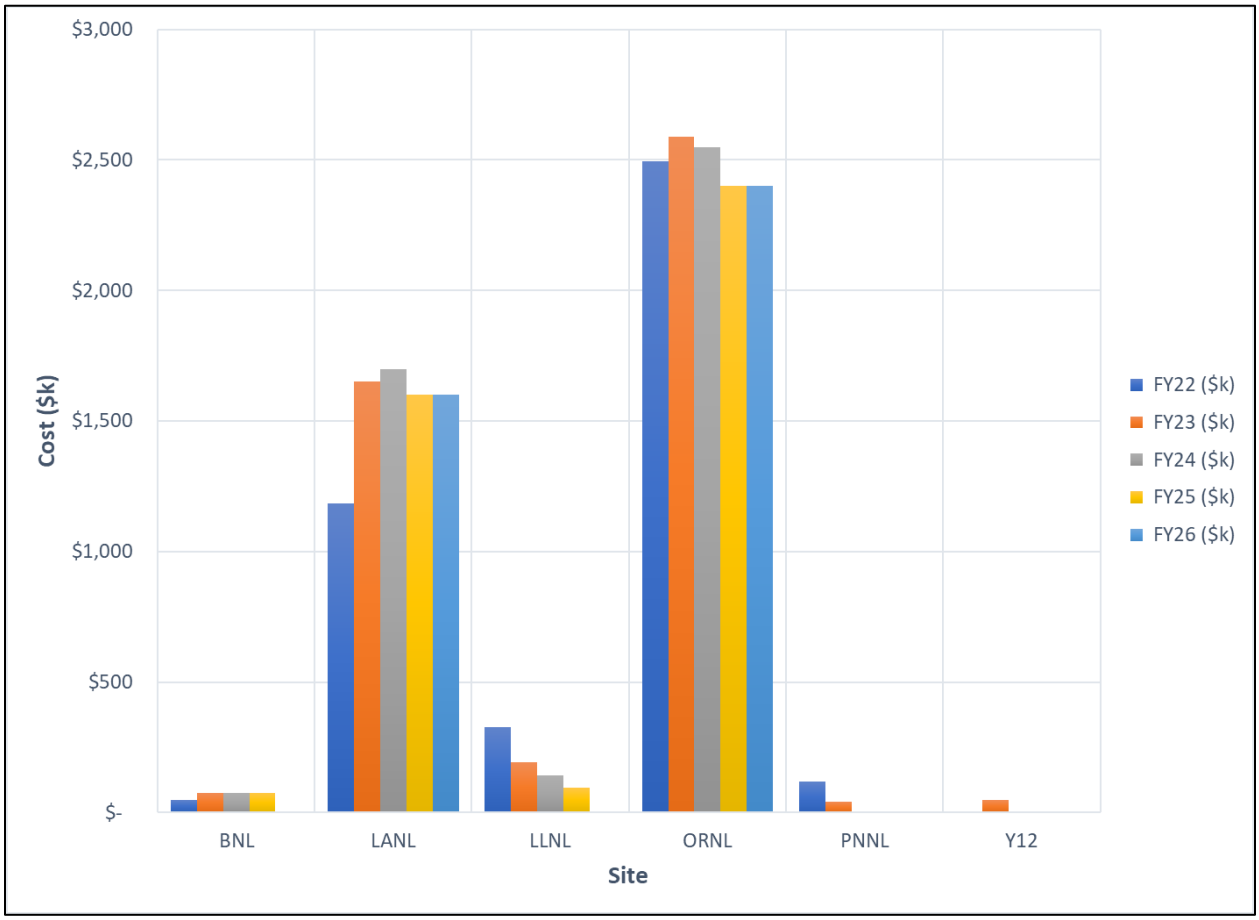
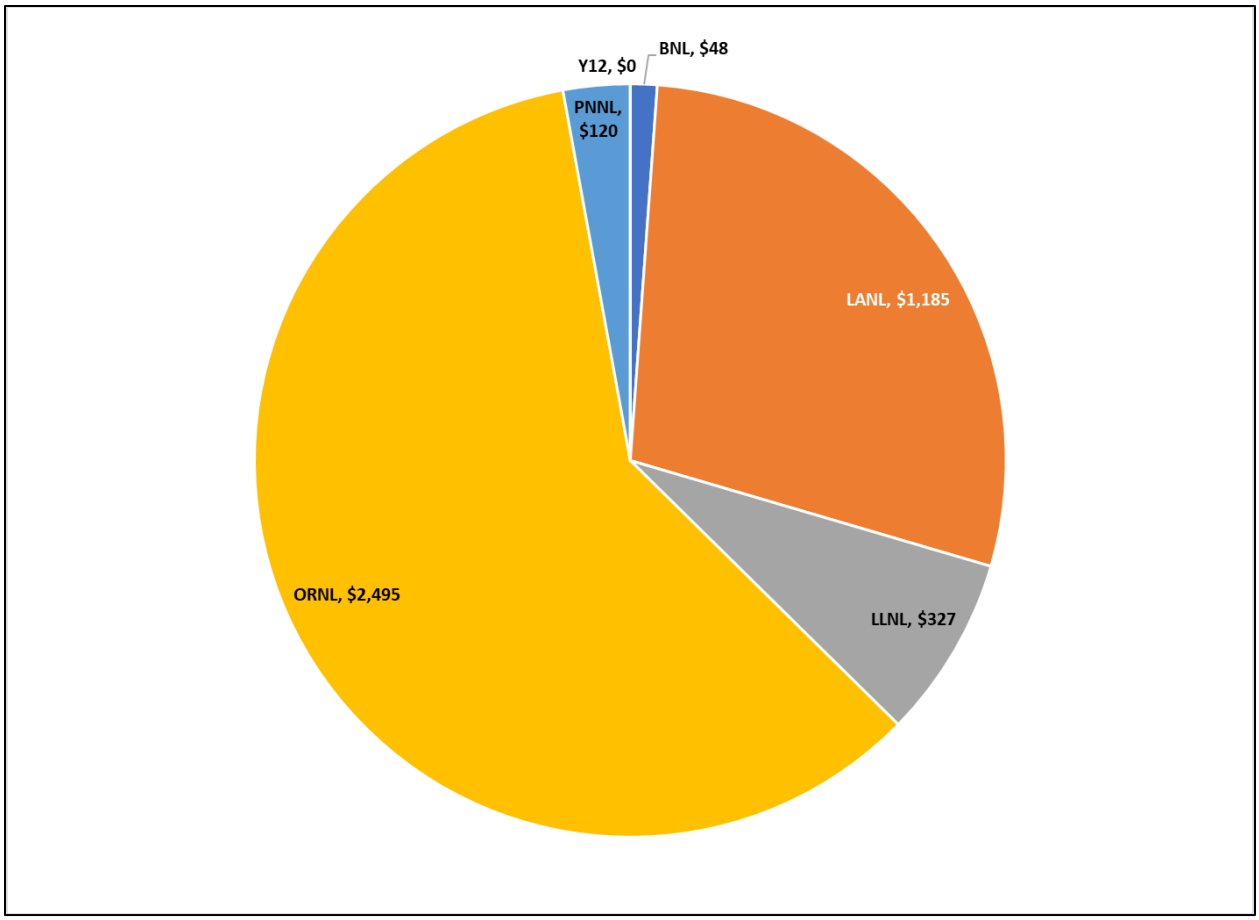


Figure 2.2-2 NCSP AM Budget (FY2022)

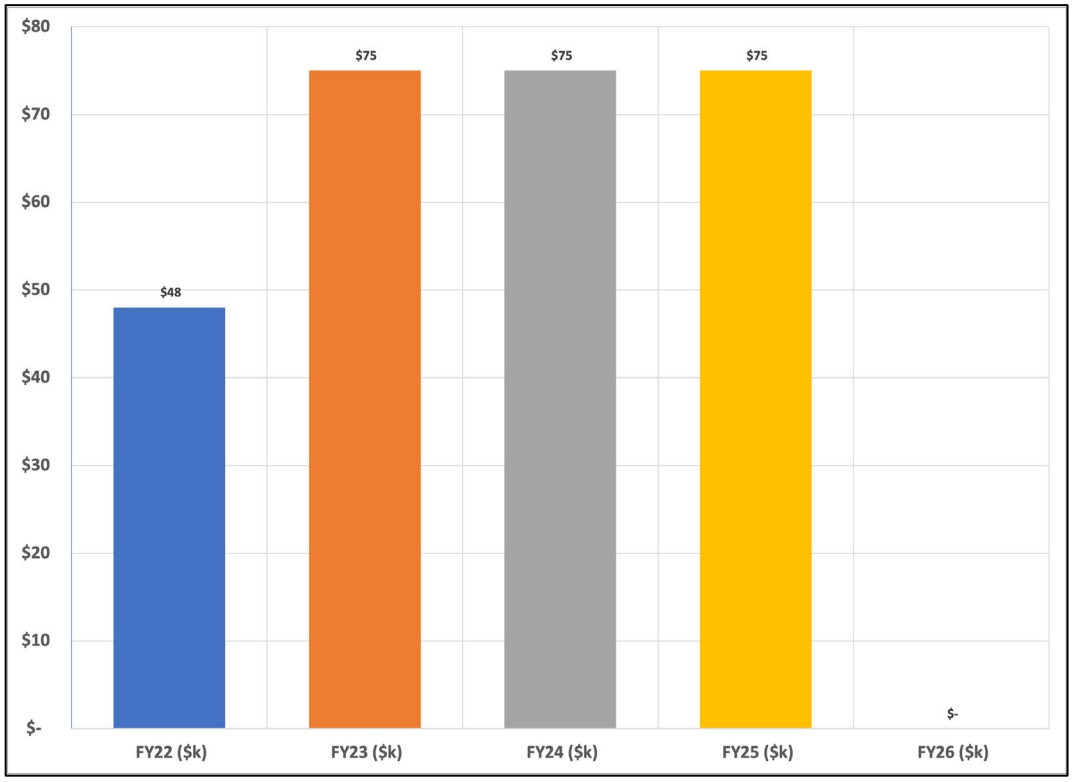
NCSP Site	FY22 ($k)
BNL	$48
LANL	$1,185
LLNL	$327
ORNL	$2,495
PNNL	$120
Grand Total	**$4,175**



2.2.2.1 Brookhaven National Laboratory (BNL)

Task Name	BNL AM4
Collaborators	LLNL (LLNL-AM4)
Task Title	Thermal Scattering and Self-Shielding in GNDS/FUDGE
Proposal Submitted	FY17 (5-yr task)
Task Budget (FY22)	$48K
Task Description	Add the Thermal Neutron Scattering Law (TNSL) formats to GNDS, including the underlying unprocessed parameters needed to generate and extend the TNSL data. LLNL and BNL will work with NCSU and members of WPEC SG42, which is a new subgroup on thermal scattering kernels S(α,β) focusing on measurement, evaluation and applications. Specifically, the proposal is to add TNSL formats to the next release (post 1.9) of GNDS, including the underlying unprocessed parameters needed to generate and extend the TNSL data. Additionally, this proposal is to update FUDGE to handle and process TNSL data. This latter effort includes collaboration with NCSU to implement the TNSL code they are developing directly into FUDGE or develop a suitable interface.
FY22 Milestones	**All 4 Quarters** o Provide a status report on generating a draft document defining the TNSL code or software interface in NCSP Quarterly Progress Report.

Figure 2.2-3 BNL AM Budget Trend (FY2022-FY2026)



EOC – for out-year peaks and dips in budget plots:
The increase in funding from FY22 to FY23 is due to an increase in BNL-AM4, "Thermal Scattering and Self-Shielding in GNDS/FUDGE" funding.

2.2.2.2 Los Alamos National Laboratory (LANL)

Task Name	LANL AM1
Collaborators	IRSN (IRSN-AM15)
Task Title	MCNP® Maintenance and Support, Uncertainty Analysis Development, and Modernization
Proposal Submitted	Ongoing task
Task Budget (FY22)	$738K
Task Description	This is a continuing task for the maintenance of the basic capabilities for performing Nuclear Criticality Safety calculations with the Monte Carlo N Particle (MCNP®) computer code, including general code maintenance, user support, improved nuclear data libraries, Verification and Validation (V&V), documentation, user training, and implementation of limited new capabilities; focus on modernizing MCNP for next-generation computing hardware; continue to develop MCNP-Whisper for continuous-energy sensitivity-uncertainty analysis, and contribute to the Organization for Economic Cooperation and Development/Nuclear Energy Agency (OECD/NEA) Working Party on Criticality Safety. For all tasks, LANL reports will be issued and posted on the MCNP website. **LANL AM1 was modified from $1188K to $738K ($450K moved to NNSS IE1) in FY22 5-year plan, Rev. 3)**
FY22 Milestones	All 4 Quarters o Provide a status report on MCNP6 user support in NCSP Quarterly Progress Reports. o Provide status reports on LANL participation in US and International analytical methods collaborations in NCSP Quarterly Progress Reports. Quarter 1 o Provide reports on summer intern work accomplished o Issue an MCNP V&V report, including MCNP6 automated acceleration and convergence Quarter 2 o Provide status of all MCNP6 and Whisper progress at the NCSP Technical Program Review Quarter 3 o Provide MCNP6 Criticality training course Quarter 4 o Issue an expanded MCNP V&V report, specifically targeting additional unstructured mesh models of criticality benchmarks o Create ENDF/B-VIII.0-based covariance data library for MCNP / Whisper o Obtain approval to open-source the Whisper code and release it on GitHub

Task Name	LANL AM2
Collaborators	None
Task Title	NJOY Development and Maintenance, Uncertainty Analysis Development, and Modernization
Proposal Submitted	Ongoing task
Task Budget (FY22)	$297K
Task Description	This is a continuing task to support development and maintenance of the NJOY nuclear data processing code system, implement capabilities as needed to process new general purpose nuclear data files in the continuously evolving ENDF-6 format, provide support to NJOY users, modernize NJOY to adapt to modern code practices, new data formats, and next-generation computing hardware, and contribute to the NDAG, the Cross Section Evaluation Working Group (CSEWG), the Working Party on International Nuclear Data Evaluation Corporation (WPEC) and the International Atomic Energy Agency (IAEA) Coordinated Research Projects (CRP) as approved by the NCSP Manager. All NJOY updates will be distributed to users through a LANL maintained website.
FY22 Milestones	All 4 Quarters o Provide a status report on NJOY maintenance and user support in NCSP Quarterly Progress Reports. o Provide status reports on LANL participation in US and International analytical methods collaborations in NCSP Quarterly Progress Reports. Quarter 1 - None Quarter 2 o Update NJOY2016 to process new ENDF/B formats for mixed coherent/incoherent elastic thermal scattering and to properly handle recent IAEA photo-nuclear libraries that specify anisotropic angular distributions. Quarter 3 - None Quarter 4 o Complete the GNDStk component of NJOY21 that will provide an interface (C++ and python) for GNDS 2.0 standard compliant files.

Task Name	LANL AM3
Collaborators	Rensselaer Polytechnic Institute
Task Title	Development of an Adaptive-in-temperature Method for fast on-the-fly Sampling of Thermal Neutron Scattering Data in MCNP6
Proposal Submitted	FY17
Task Budget (FY22)	$100K
Task Description	LANL will enhance the physics treatment in MCNP6 so that it can perform fast on-the-fly sampling of S(alpha, beta) data at arbitrary temperature. RPI will develop thermal data libraries for selected materials to support on-the-fly S(alpha, beta) sampling for temperature ranges applicable to NCS and will test the data with MCNP6.
FY22 Milestones	All 4 Quarters o Provide status and update of work in NCSP Quarterly Progress Reports. Quarter 1 – None

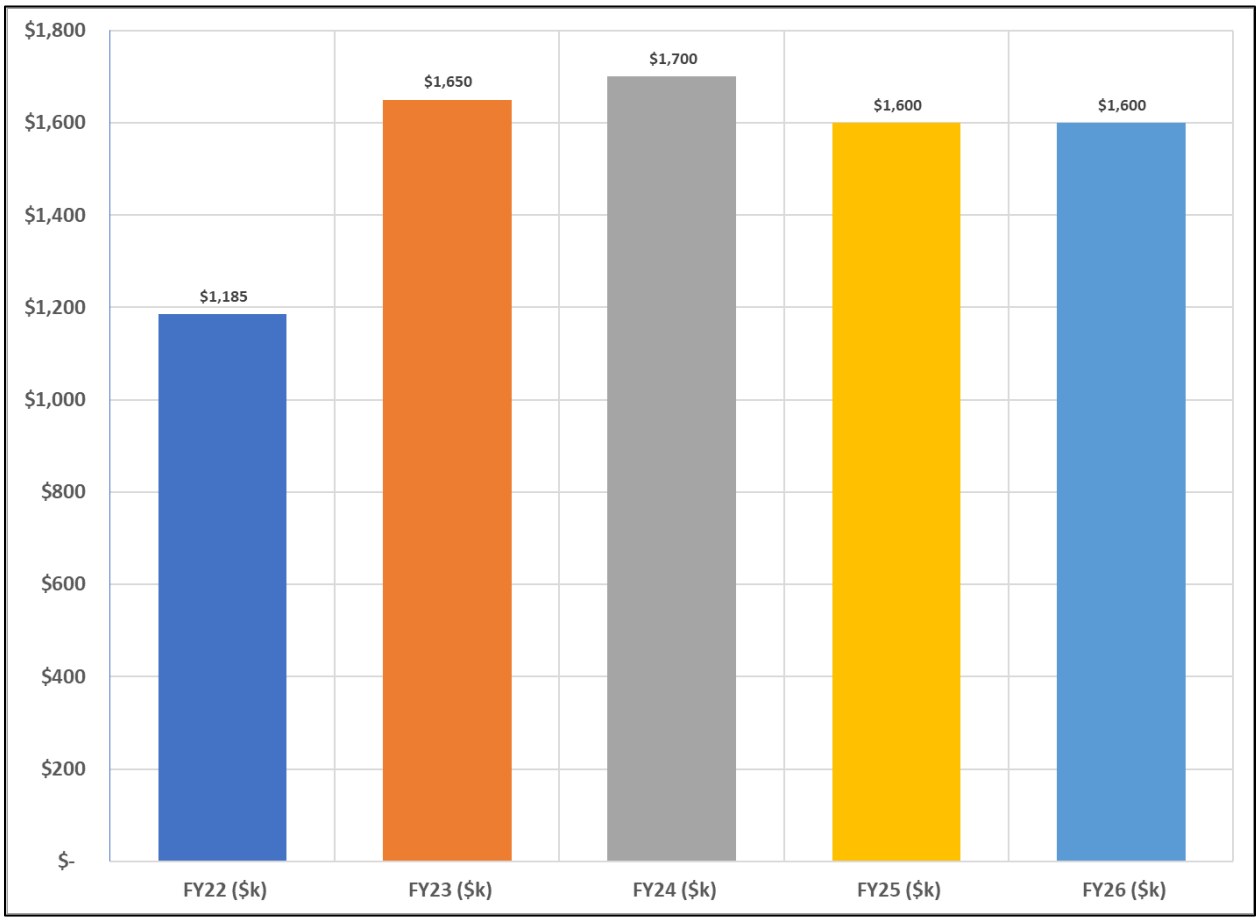
	Quarter 2 - None Quarter 3 – None Quarter 4 o Provide data files and report for h-h2o and graphite on-the-fly S(alpha,beta) temperature effects.

Task Name	LANL AM5
Collaborators	IRSN (IRSN-AM13), ORNL (ORNL-AM10), LLNL (LLNL-AM5)
Task Title	Proposed Benchmark Intercomparison Study
Proposal Submitted	FY17
Task Budget (FY21)	$50K
Task Description	CEA and IRSN published a summary of the results of an extensive benchmark Intercomparison study of French analytic methods using JEFF-3.1.1 nuclear data in the proceedings of the International Conference on Nuclear Criticality Safety (ICNC 2015). While JEFF data is available in many NCSP codes (e.g., COG, MCNP), due to resource limitations it has not been tested as rigorously as the US national database ENDF/B. The proposal is for IRSN to lead a new Intercomparison based on the MORET code with the latest JEFF-3.2 data and ENDF/B-VIII.0 data, when available, using their existing comprehensive selection of 2,714 benchmarks and collate their results together with those from LLNL (COG), LANL (MCNP) and ORNL (SCALE). Due to the large number of benchmarks involved, this effort is envisioned to take three years with an additional year for IRSN to complete a summary report. The benchmark development will be performed independently to minimize modeling errors through discovery and resolution of discrepant results. A summary report will be generated (led by IRSN) to document the results of this study.
FY21 Milestones	All 4 Quarters o Provide status reports on LANL participation in US and International analytical methods collaborations Quarter 1 – None Quarter 2 - None Quarter 3 – None Quarter 4 o Issue final report on all LANL results related to the ICSBEP Benchmark Comparison Study

Task Name	LANL AM7
Collaborators	University of Michigan
Task Title	Incorporation of Benchmark Experiment Correlations into the Whisper Nuclear Criticality Safety Software
Proposal Submitted	FY20
Task Budget (FY22)	$0K (Use carry over from FY21 budget - $50K)
Task Description	The proposed project will work with LANL to develop and implement methodologies for incorporating benchmark experiment correlations into the Whisper calculational margin sequence. The goal is to allow Whisper to obtain more defensible conservative estimates of baseline upper subcritical limits in cases where the selected benchmarks in the validation set are correlated.

FY21 Milestones	All 4 Quarters o Provide status report for this task. Quarter 1– None Quarter 2 – None Quarter 3 – None Quarter 4 o Deliver final modified version of Whisper to LANL with an ANS conference paper to disseminate the work

Figure 2.2-4 LANL AM Budget Trend (FY2022-FY2026)



EOC – for out-year peaks and dips in budget plots:
The LANL AM budget is relative flat over the 5-year period. The slight increases from FY22-FY24 are due to inflation and the reduction after FY24 is due to the completion of LANL AM5.

2.2.2.3 Lawrence Livermore National Laboratory (LLNL)

Task Name	LLNL AM2
Collaborators	
Task Title	Multi-Physics Methods for Simulation of Criticality Excursions
Proposal Submitted	FY14
Task Budget (FY22)	$133K
Task Description	This is an ongoing approved task to support and build upon existing LLNL state-of-the-art 3-D analytical and multi-physics methods. The funding from this task will be used to simulate the IER 268 dynamic Godiva IV excursions including surface motion and neutron and photon leakage. The simulations will feed into the IER 268 experimental report. This task is to support IER 268 (PDV), which is discussed in the IE section of the 5-year plan for FY2021.
FY22 Milestones	All 4 Quarters o Provide status on LLNL AM2 activities in NCSP Quarterly Progress Reports. Quarter 1– None Quarter 2 – None Quarter 3 – None Quarter 4 – None

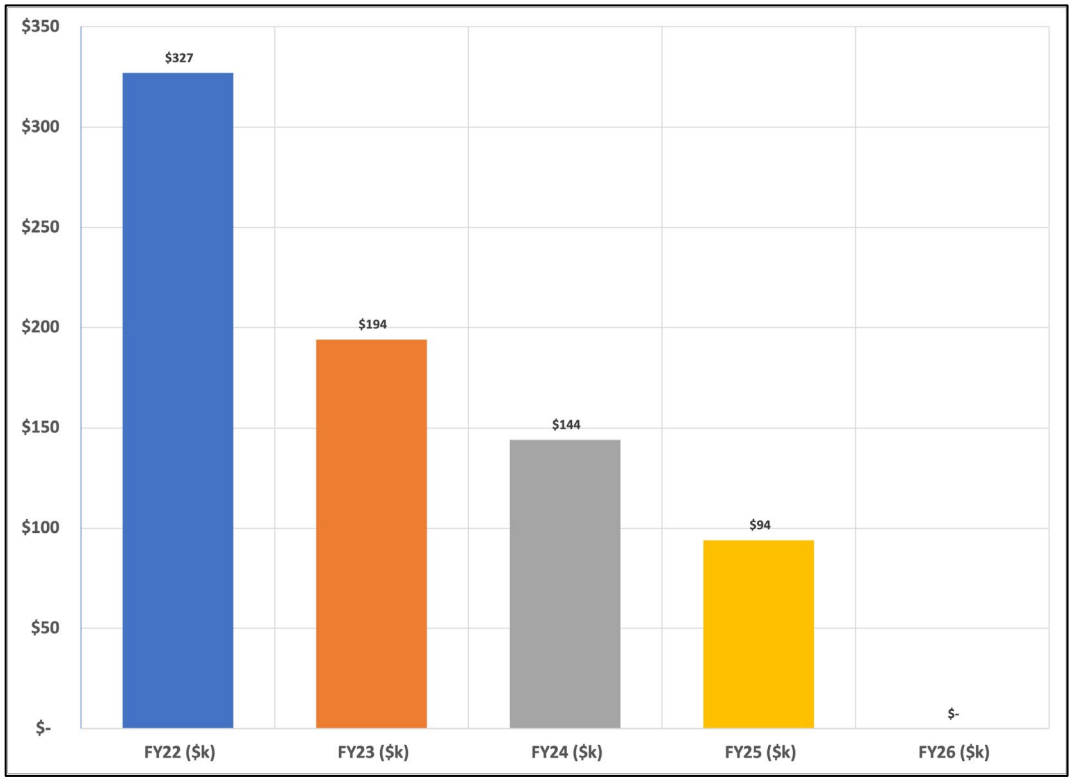
Task Name	LLNL AM3
Collaborators	IRSN (IRSN-AM5), (AWE-AM1), ORNL (ORNL-AM6)
Task Title	Slide Rule Application
Proposal Submitted	FY15
Task Budget (FY22)	$50K
Task Description	This is an ongoing task to support work to generate and update a criticality slide rule, including for plutonium systems. IRSN is the lead on this task.
FY22 Milestones	All 4 Quarters o Provide status on LLNL AM3 activities in NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	LLNL AM4
Collaborators	BNL (BNL AM4)
Task Title	Thermal Scattering and Self-Shielding in GNDS/FUDGE
Proposal Submitted	FY2017 (5-yr task)
Task Budget (FY22)	$94K
Task Description	Add the Thermal Neutron Scattering Law (TNSL) formats to GNDS, including the underlying unprocessed parameters needed to generate and extend the TNSL data. LLNL and BNL will work with NCSU and members of WPEC SG42, which is a new subgroup on thermal scattering kernels S(α,β) focusing on measurement, evaluation and applications. Specifically, the proposal is to add TNSL formats to GNDS, including the underlying unprocessed parameters needed to generate and

	extend the TNSL data. Additionally, this proposal is to update FUDGE to handle and process TNSL data. This latter effort includes collaboration with NCSU to implement the TNSL code they are developing directly into FUDGE or develop a suitable interface.
FY22 Milestones	**All 4 Quarters** o Provide a status report on generating a draft document defining the TNSL code or software interface in NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	LLNL-AM5
Collaborators	IRSN (IRSN-AM13), ORNL (ORNL-AM10), LANL (LANL-AM5)
Task Title	Proposed Benchmark Intercomparison Study
Proposal Submitted	FY17
Task Budget (FY21)	$50K
Task Description	CEA and IRSN published a summary of the results of an extensive benchmark Intercomparison study of French analytic methods using JEFF-3.1.1 nuclear data in the proceedings of the International Conference on Nuclear Criticality Safety (ICNC 2015). While JEFF data is available in many NCSP codes (e.g., COG, MCNP), due to resource limitations it has not been tested as rigorously as the US national database ENDF/B. The proposal is for IRSN to lead a new Intercomparison based on the MORET code with the latest JEFF-3.2 data and ENDF/B-VIII.0 data, when available, using their existing comprehensive selection of 2,714 benchmarks and collate their results together with those from LLNL (COG), LANL (MCNP) and ORNL (SCALE). Due to the large number of benchmarks involved, this effort is envisioned to take three years with an additional year for IRSN to complete a summary report. The benchmark development will be performed independently to minimize modeling errors through discovery and resolution of discrepant results. A summary report will be generated (led by IRSN) to document the results of this study.
FY21 Milestones	All 4 Quarters o Provide status on LLNL AM activities in NCSP Quarterly Progress Reports Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Figure 2.2-5 LLNL AM Budget Trend (FY2022-FY2026)



EOC – for out-year peaks and dips in budget plots:
The LLNL AM budgets gradually decrease due to the completion of LLNL-AM2, LLNL-AM3, LLNL-AM4 and LLNL-AM5 tasks through FY26.

2.2.2.4 Oak Ridge National Laboratory (ORNL)

Task Name	ORNL-AM1
Collaborators	None
Task Title	Radiation Safety Information Computational Center (RSICC)
Proposal Submitted	
Task Budget (FY22)	$700K
Task Description	RSICC ongoing approved task to collect, update, package, and distribute software and associated nuclear data libraries (i.e., SCALE, MCNP, VIM, and COG and nuclear data processing (i.e., NJOY, AMPX and SAMMY) to the NCS community. The NCS community includes DOE and NNSA M&O NCS staff, e.g., LANL, LLNL, SNL, SRNS, etc., DOE-EM M&O NCS staff, e.g., PGDP, PORTS, SRNL, etc. This does not include NRC-regulated NCS staff, M&O subcontractors, and independent consultants. University students in Nuclear Engineering programs performing NCS analysis is also included. Also, test and disseminate processed nuclear data associated with the software.
FY22 Milestones	All 4 Quarters o Continue distribution of available and newly packaged software to the NCS community requesters (at no direct cost to them) and provide distribution totals quarterly. o Provide status on RSICC activities in NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	ORNL-AM2
Collaborators	IRSN (IRSN-AM1)
Task Title	SCALE/KENO/TSUNAMI Maintenance and Support/Cross-Section and Generation/Modernization
Proposal Submitted	Ongoing
Task Budget (FY22)	$1188K
Task Description	Ongoing, approved task to provide SCALE/KENO/TSUNAMI maintenance and user support for performing Nuclear Criticality Safety (NCS) calculations with the SCALE package. Work tasks include 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, and training. The task also includes support for modernizing the software infrastructure and capabilities to improve quality and reliability and to ensure long-term sustainability of the NCS capabilities.
FY22 Milestones	All 4 Quarters o Provide status reports on ORNL participation in US and International Analytical Methods collaborations and provide brief trip summary report to NCSP Manager on items of NCSP interest. o Provide status on ORNL AM2 activities in NCSP Quarterly Progress Reports.

	Quarter 1 – None Quarter 2 – Issue an annual SCALE maintenance report to the NCSP Manager. Quarter 3 – None Quarter 4 o Publish annual newsletter to users to communicate software updates, user notices, generic technical advice, and training course announcements.

Task Name	ORNL-AM3
Collaborators	IRSN (IRSN-AM9)
Task Title	AMPX Maintenance and Modernization
Proposal Submitted	Ongoing
Task Budget (FY22)	$297K
Task Description	Ongoing, approved task to develop and maintain the AMPX nuclear data processing code system to provide cross-section and covariance data libraries for NCS radiation transport software such as SCALE. In addition, the task includes additional effort to implement new software enhancements needed to improve the quality and reliability of the nuclear data libraries that are produced by AMPX. The overall development and maintenance work effort will ensure the AMPX software is up-to-date and in conformance with ENDF/B formats and procedures. Moreover, the development and enhancements to the AMPX software will enable improved nuclear data processing capabilities needed to provide reliable nuclear data libraries to support radiation transport methods development and analyses.
FY22 Milestones	All 4 Quarters Provide status on ORNL AM3 activities in NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 o Document AMPX modernization and technical support for SCALE CE, multigroup, and covariance libraries and report status annually to the NCSP Manager.

Task Name	ORNL-AM6
Collaborators	IRSN (IRSN-AM5), AWE (AWE-AM1), LLNL (LLNL-AM3)
Task Title	Slide Rule Application
Proposal Submitted	FY15
Task Budget (FY22)	$50K
Task Description	This is a continuing task with IRSN, ORNL, and LLNL to modernize the existing SlideRule accident response tool. ORNL developed the initial SlideRule, and under this task, IRSN will update the SlideRule using modern radiation transport tools (e.g., SCALE, MCNP, COG, etc.) and expand the SlideRule capabilities. IRSN, ORNL, and LLNL on the SlideRule modernization effort and perform review tasks as needed to assess the performance of the updated SlideRule capability.
FY22 Milestones	All 4 Quarters o Provide status on ORNL AM6 activities in NCSP Quarterly Progress Reports. Quarter 1 – None

	Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	ORNL-AM10
Collaborators	IRSN (IRSN-AM13), LLNL (LLNL-AM5), LANL (LANL-AM5)
Task Title	Proposed Benchmark Intercomparison Study
Proposal Submitted	FY17
Task Budget (FY21)	$50K
Task Description	CEA and IRSN published a summary of the results of an extensive benchmark Intercomparison study of French analytic methods using JEFF-3.1.1 nuclear data in the proceedings of the International Conference on Nuclear Criticality Safety (ICNC 2015). While JEFF data is available in many NCSP codes (e.g., COG, MCNP), due to resource limitations it has not been tested as rigorously as the US national database ENDF/B. The proposal is for IRSN to lead a new Intercomparison based on the MORET code with the latest JEFF-3.2 data and ENDF/B-VIII.0 data, when available, using their existing comprehensive selection of 2,714 benchmarks and collate their results together with those from LLNL (COG), LANL (MCNP) and ORNL (SCALE). Due to the large number of benchmarks involved, this effort is envisioned to take three years with an additional year for IRSN to complete a summary report. The benchmark development will be performed independently to minimize modeling errors through discovery and resolution of discrepant results. A summary report will be generated (led by IRSN) to document the results of this study.
FY21 Milestones	All 4 Quarters o Provide status on ORNL AM10 activities in NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	ORNL-AM15
Collaborators	Massachusetts Institute of Technology
Task Title	The Effects of Temperature on the Propagation of Nuclear Data Uncertainty in Nuclear Criticality Safety Calculations
Proposal Submitted	FY18
Task Budget (FY22)	$0K (FY21 Carryover to be used)
Task Description	This is a new task to develop an analytic methodology and implement it in a module of the AMPX nuclear data processing code to allow the nuclear data covariance to accurately reflect the degree of knowledge of the cross section at different temperatures. This new capability will allow for investigating and demonstrating the effects of temperature on the propagation of nuclear data uncertainty in nuclear criticality safety applications.
FY22 Milestones	All 4 Quarters o Provide status on ORNL AM15 activities in NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None

	Quarter 3 – None Quarter 4 – None

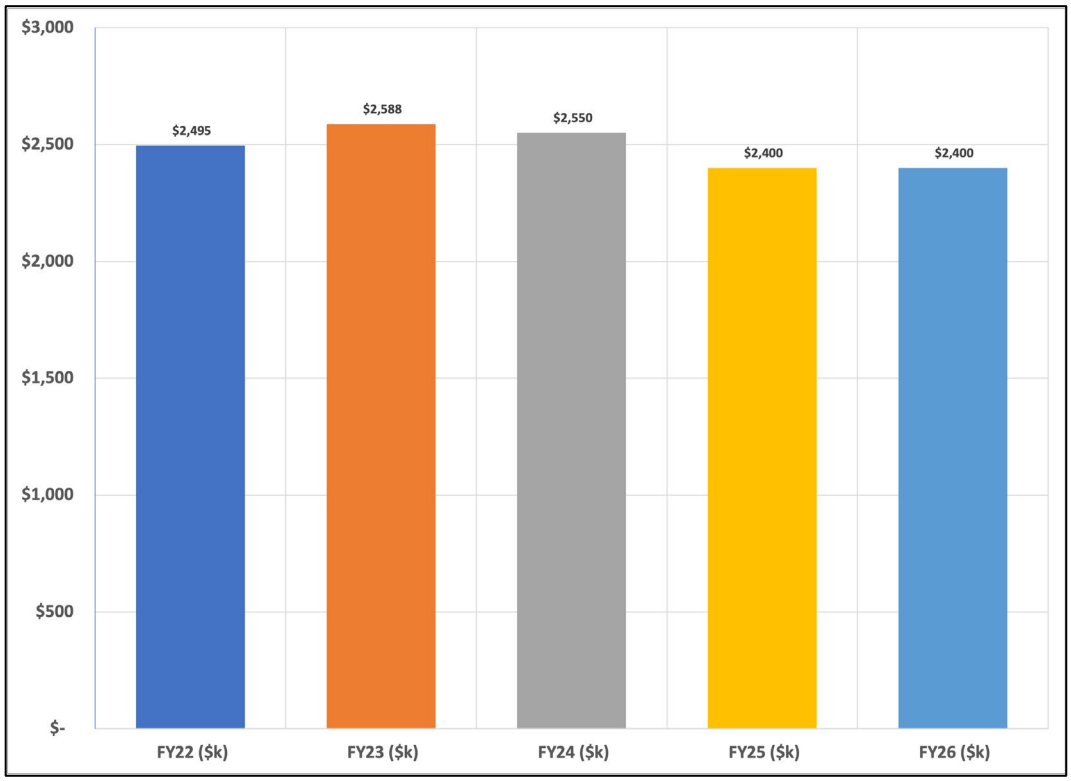
Task Name	ORNL-AM17
Collaborators	Expansion of the Verified, Archived, Library of Inputs and Data (VALID)
Task Title	Improve analytical methods and nuclear data tools for ensuring accurate criticality safety analyses that appropriately balance safety margins with operational flexibility. This task will generate TSUNAMI models for the 190 233U KENO models already in VALID, add deuterium-moderated models generated in FY18 University Task, and identify high-value benchmark experiments and add them to the library.
Proposal Submitted	FY20
Task Budget (FY22)	$50K
Task Description	Improve analytical methods and nuclear data tools for ensuring accurate criticality safety analyses that appropriately balance safety margins with operational flexibility
FY22 Milestones	All 4 Quarters o Provide status on ORNL AM17 activities in NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	ORNL-AM18
Collaborators	None
Task Title	Determination of Appropriate Integral Parameters for Critical Experiment
Proposal Submitted	FY20
Task Budget (FY22)	$100K
Task Description	Provide a Rigorous Technical Basis for Selecting Critical Experiment Benchmarks
FY22 Milestones	All 4 Quarters o Provide status on ORNL AM18 activities in NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	ORNL-AM19
Collaborators	PNNL-AM1
Task Title	Analysis of Sum-of-Fractions for Nuclide Mixtures
Proposal Submitted	FY20
Task Budget (FY22)	$60K
Task Description	Develop a technical foundation for the use of Sum-of-Fractions for nuclides in optimally moderated and fully reflected systems
FY22 Milestones	All 4 Quarters

	○ Provide status on ORNL AM19 activities in NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Figure 2.2-6 ORNL AM Budget Trend (FY2022-FY2026)

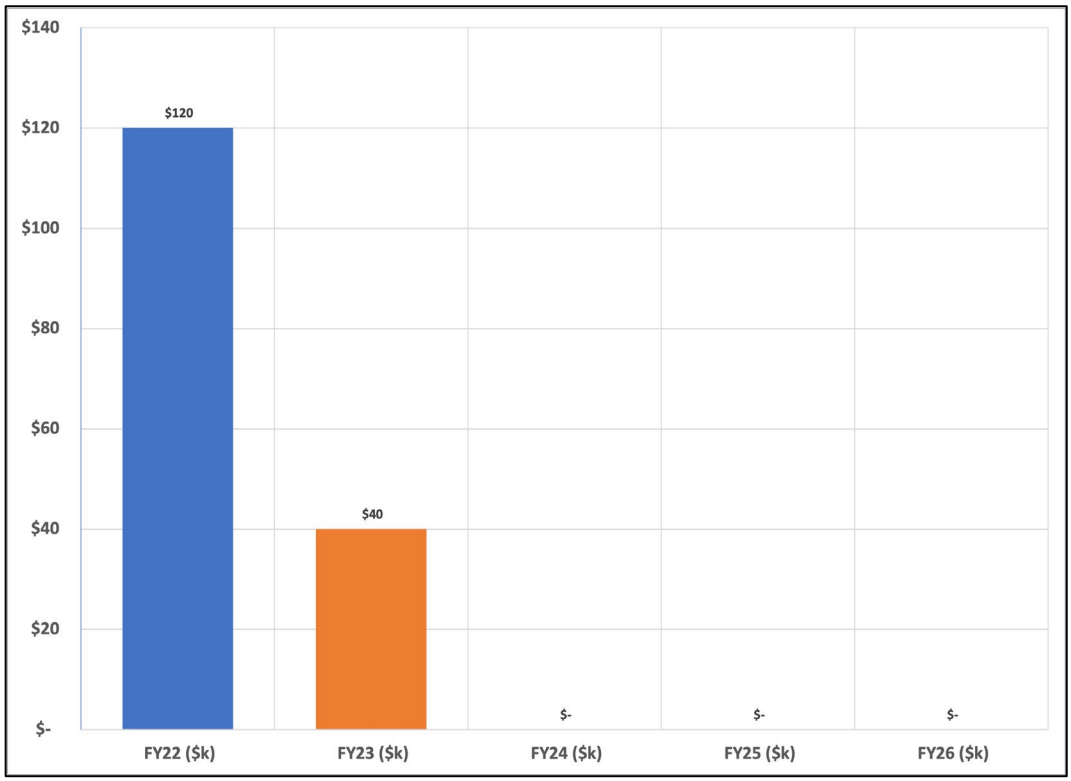


EOC – for out-year peaks and dips in budget plots:
The ORNL budgets are essentially flat from FY22-FY26 except for a modest increase in ORNL-AM3 funding, then the budgets decrease each year through FY26 due to the closeout of tasks ORNL-AM6, ORNL-AM10, ORNL-AM17, ORNL-AM18, and ORNL-AM19 tasks in FY23 and FY24.

2.2.2.5 Pacific Northwest National Laboratory (PNNL)

Task Name	PNNL-AM1
Collaborators	ORNL-AM19
Task Title	Analysis of Sum-of-Fractions for Nuclide Mixtures
Proposal Submitted	FY20
Task Budget (FY22)	$120K
Task Description	Develop a technical foundation for the use of Sum-of-Fractions for nuclides in optimally moderated and fully reflected systems
FY22 Milestones	All 4 Quarters o Provide status on ORNL AM19 activities in NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Figure 2.2-7 PNNL AM Budget Trend (FY2022-FY2026)



EOC – for out-year peaks and dips in budget plots:
The PNNL budget for FY22-FY23 is to support the PNNL-AM1 task in collaboration with ORNL (ORNL-AM19 task).

2.3 Information Preservation and Dissemination (IPD)

2.3.1 Program Element Description

The IPD program element preserves primary documentation supporting criticality safety and makes this information available for the benefit of the technical community. The NCSP 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.

Figure 2.3-1 IPD Budget (FY2022-FY2026)

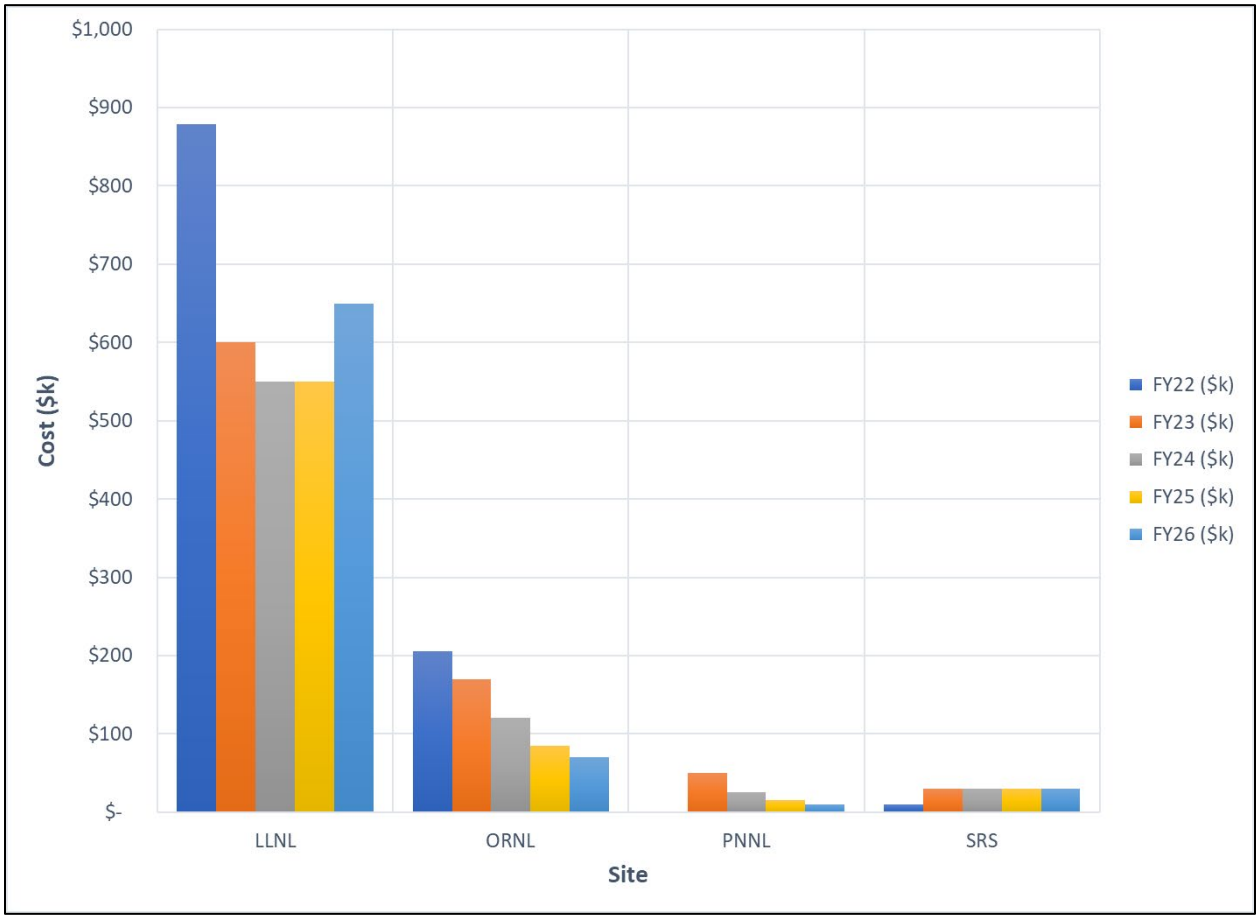
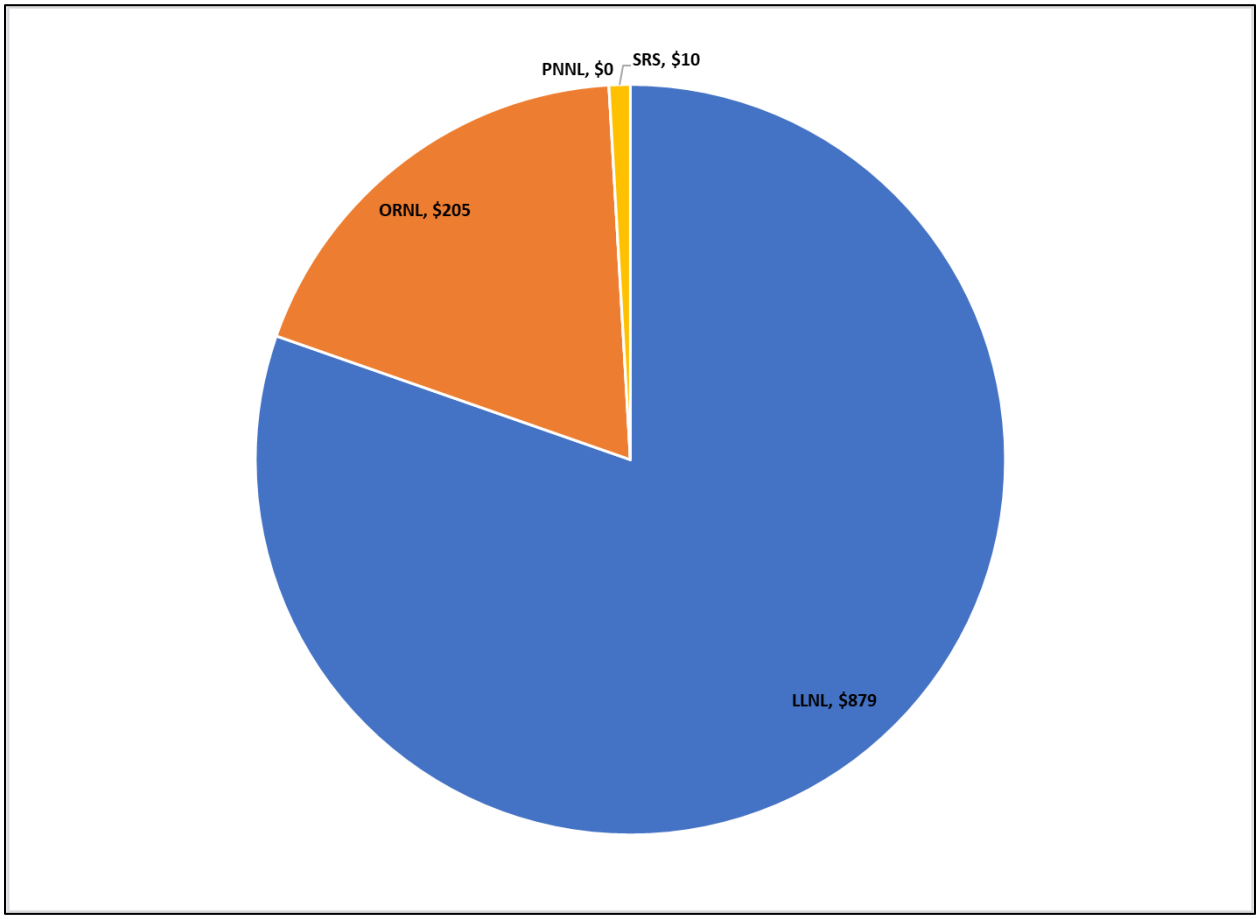


Figure 2.3-2 IPD Budget (FY2022)

NCSP Site	FY22 ($k)
LLNL	$879
ORNL	$205
SRS	$10
Grand Total	**$1,094**



2.3.2 Approved Tasks

2.3.2.1 Lawrence Livermore National Laboratory (LLNL)

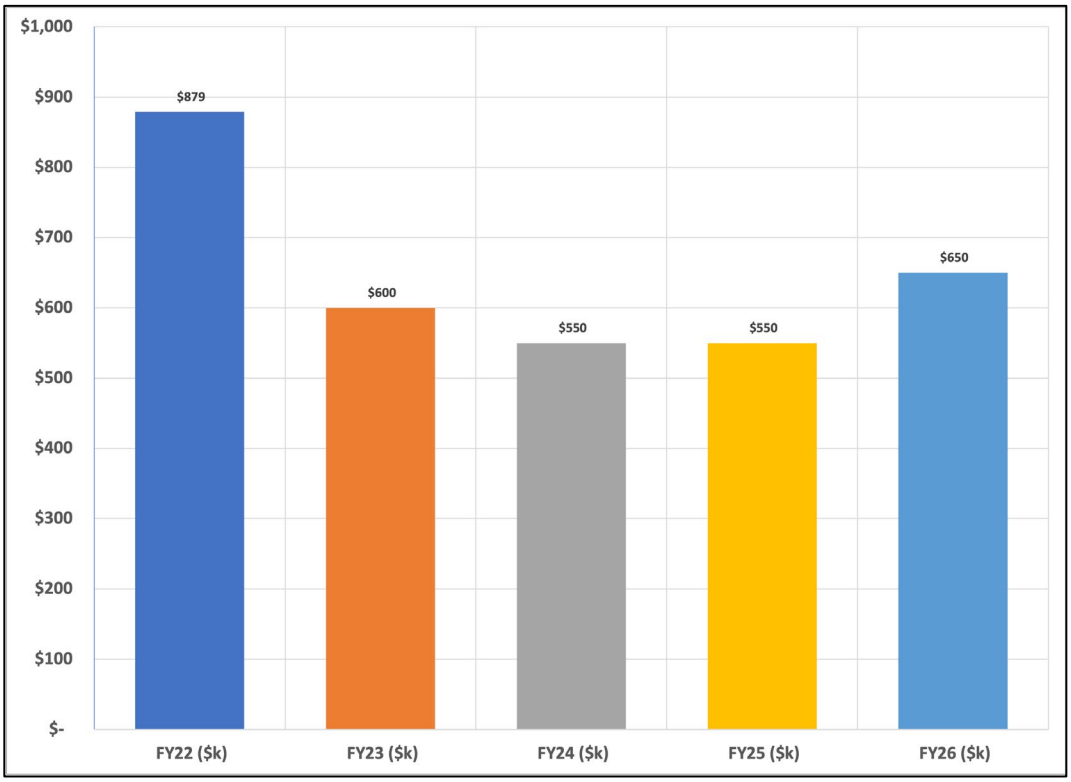
Task Name	LLNL IPD1
Collaborators	IRSN (IRSN-IPD1), AWE (AWE-IPD1)
Task Title	Conduct ICSBEP for Benchmarks of the 5-Year Plan and publish annual revision to the Handbook
Proposal Submitted	Ongoing
Task Budget (FY22)	$283K
Task Description	This is an ongoing approved task that provides independent and Technical Review Group (TRG) reviews for newly completed integral experiments for publication as NCSP contributions to the International Criticality Safety Benchmark Evaluation Project (ICSBEP). Priority historical experiments may also be evaluated and reviewed (internal, independent, and TRG) as resources allow. All NCSP funded experiments will be finalized and published on the NCSP website within two quarters of receipt of an Experiment Design Team reviewed and approved draft report (CED-4a). LLNL IPD1 will also provide leadership, coordination, and publication support for the OECD/NEA ICSBEP.
FY22 Milestones	All 4 Quarters o Manage all aspects of the DOE NCSP participation in the ICSBEP as required to ensure the finalizing and publishing ICSBEP evaluations per IE schedule. o Provide status reports on LLNL participation in US and International IPD collaborations (including ICSBEP) in the NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	LLNL IPD2
Collaborators	None
Task Title	Maintain the NCSP Website and Systems
Proposal Submitted	Ongoing
Task Budget (FY22)	$200K
Task Description	This is an ongoing approved task for operation, maintenance, and modernization of the NCSP website. The NCSP website is the central focal point for access to criticality safety information collected under the NCSP and is the gateway to a comprehensive set of hyperlinks to other sites containing criticality safety information resources.
FY22 Milestones	All 4 Quarters o Maintain, operate, and modernize the NCSP website, databases, and provide user assistance as required. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	LLNL IPD5
Collaborators	None
Task Title	IT Support at NNSS
Proposal Submitted	Ongoing
Task Budget (FY22)	$297K
Task Description	There are two LLNL IT staff (cyber security support and information technology support) that support JLON (laboratory) activities in NV, with NCSP covering half time for both (the equivalent of 1 FTE). In addition, they provide support to IERs by scanning and ensuring all electronic devices coming into DAF will meet the security requirements (computers, detectors, electronic equipment, etc.). These two staff provide classified (cyber security/system compliance and system administration) and unclassified system support.
FY22 Milestones	All 4 Quarters o Provide status report on progress for IPD5 activities in the NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	LLNL IPD6
Collaborators	None
Task Title	Benchmark Evaluation of LLNL 'Pulsed Spheres'
Proposal Submitted	FY20
Task Budget (FY22)	$99K
Task Description	This task for LLNL will involve formally evaluating the LLNL 'Pulse Sphere' experimental campaign for inclusion into the ICSBEP Handbook and/or SINBAD compendium. Dr. Luisa Hansen, the Principal Investigator (PI), is still available and willing to assist in this effort as the internal reviewer. LLNL is thus uniquely qualified to perform this task as we have access to the PI, data, drawings, interim reports, etc., and have state-of-the-art 'open' and 'closed' analytical methods capable of performing simulations from first principles starting with the charged particle deuteron beam. This is particularly important because the beam is not fully stopped in the tritiated target, and so must be more realistically Nuclear Criticality Safety Program Proposal Template for FY2020 – FY2024 simulated, which it appears has not been done prior to 2012 due to limitations in popular codes. Lastly, it should be noted that these experiments are unique and important in that they are especially sensitive to elastic and inelastic scattering whereas critical assembly experiments of all types are dominated by fission and capture.
FY22 Milestones	All 4 Quarters o Provide status report on progress for IPD6 activities in the NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Figure 2.3-3 LLNL IPD Budget Trend (FY2022-FY2026)

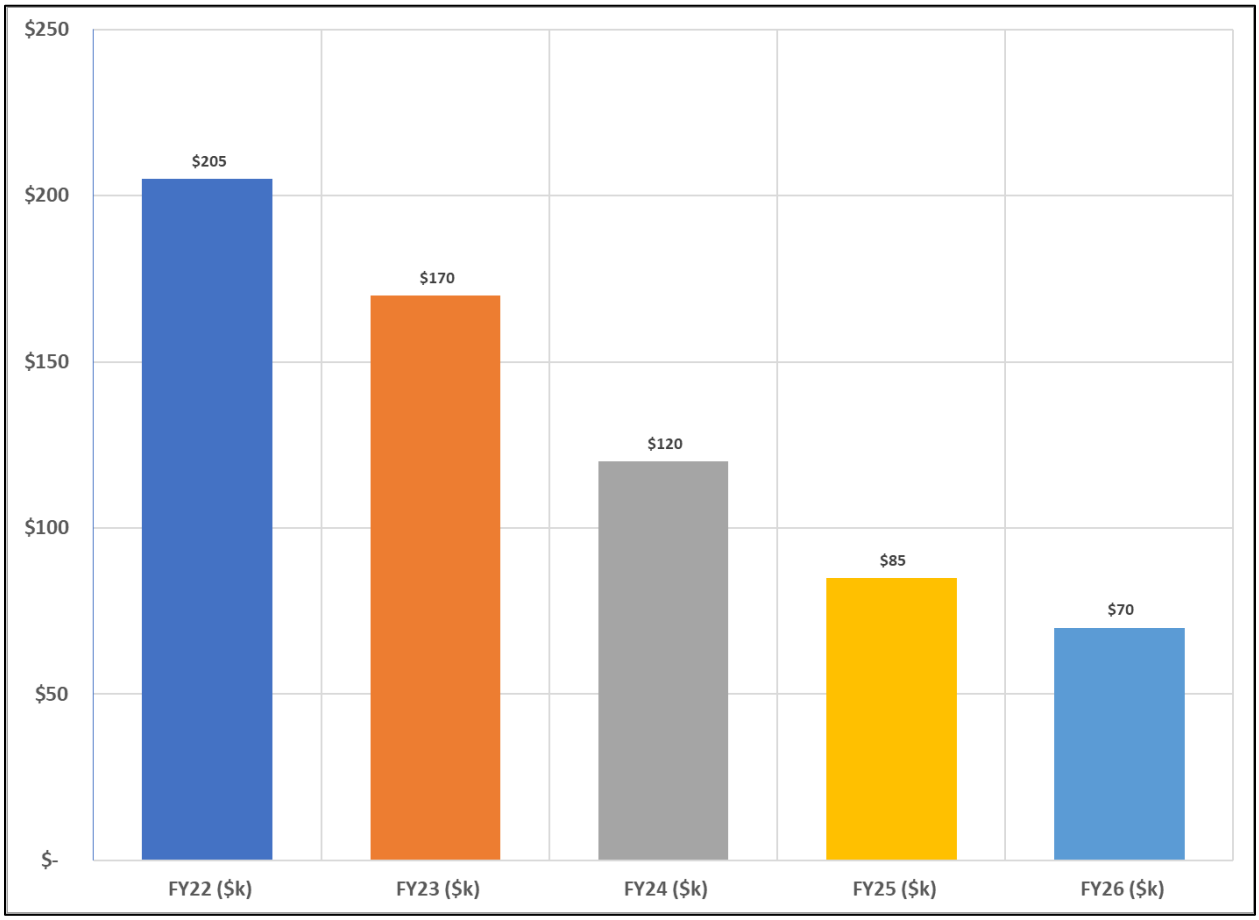


EOC – for out-year peaks and dips in budget plots:
The reduction in LLNL IPD funding from FY22 to FY24 is due to the potential elimination of the LLNL IPD5 task in the outyears. The increase in FY26 is due to an increase the LLNL-IPD1 task for ICSBEP support.

2.3.2.2 Oak Ridge National Laboratory (ORNL)

Task Name	ORNL IPD3
Collaborators	OSTI.gov
Task Title	Nuclear Criticality Safety Repository
Proposal Submitted	FY22
Task Budget (FY22)	$205K
Task Description	Create a front-end and document repository at OSTI.gov to archive all NCSP and, possibly, documents related to Nuclear Criticality Safety in the community for easy access. ORNL will work with OSTI.gov on the development of the front-end and metadata needed to ensure NCS document searches are accurate and efficient. In the long-term, ORNL will work with LLNL to begin to archive legacy NCS reports and other documents that may be important to the NCS community. **ORNL IPD3 was modified from $345K to $205K ($140K moved to NNSS IE1) in FY22 5-year plan, Rev. 3)**
FY22 Milestones	All 4 Quarters o Provide a status report about progress on the development of the NCSP repository at OSTI.gov in the NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Figure 2.3-4 ORNL IPD Budget Trend (FY2022-FY2026)

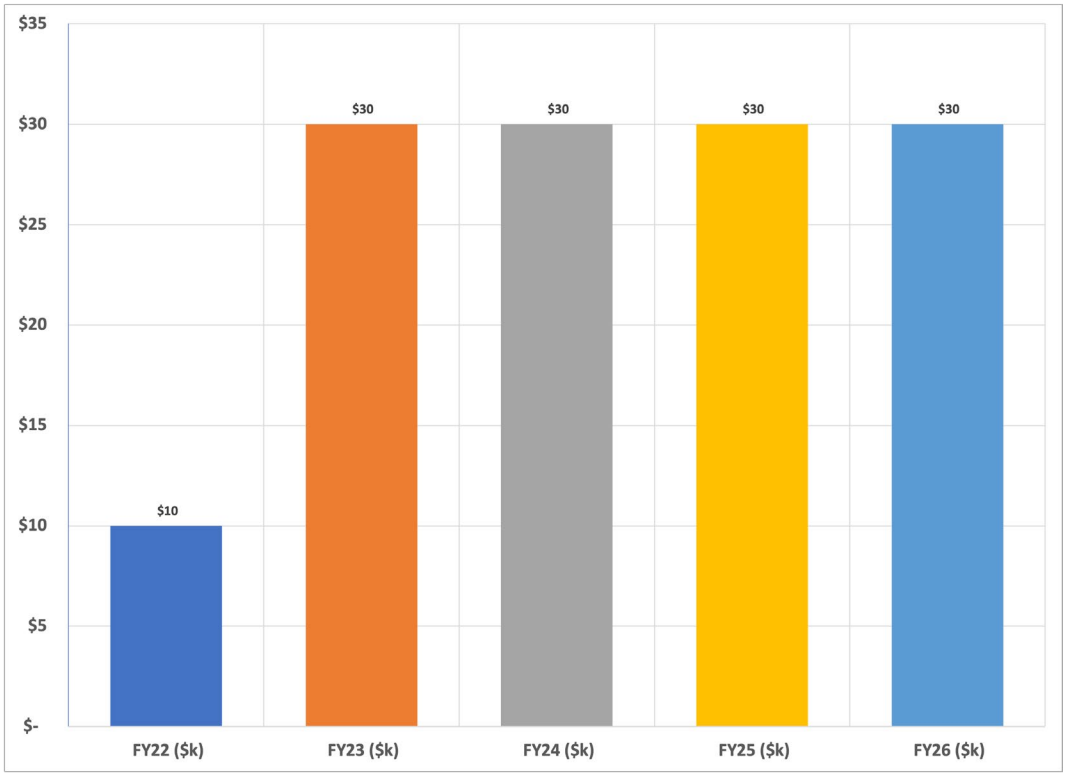


EOC – for out-year peaks and dips in budget plots:
The ORNL IPD budget is due entirely to two tasks ORNL-IPD3 and ORNL-IPD4 tasks. The ORNL-IPD3 task is due to the creation of an NCSP document repository at OSTI and costs for support will be needed in the outyears.

2.3.2.3 Savannah River Site (SRS)

Task Name	SRS IPD1
Collaborators	None
Task Title	ARH-600 Reissue (CritView)
Proposal Submitted	FY16/FY18
Task Budget (FY22)	$10K
Task Description	The following three tasks are identified for ongoing CritView development. Each could likely be performed by a summer intern, or other new CS engineer, with sufficient skills/knowledge. Each would be broken into stages as appropriate, and would proceed over the upcoming FYs, as annual funding and resources allow. A more detailed plan including appropriate FY milestones, and accounting for the upcoming FY funding including potential carryover, would be provided to NCSP Management for confirmation/approval prior to commencing on any specific task and/or stage, as appropriate. The timing of the detailed plan is TBD. 1. Update current MCNP calculations using a recent version of MCNP and cross sections. Document results, and update/distribute CritView database. 2. Digitize LA-10860 curves (like what was completed for ARH-600). Document results and incorporate into CritView database for distribution. 3. Develop SCALE calculations, like MCNP, using a recent version of SCALE and cross sections. Document results and incorporate into CritView database for distribution. In addition, as necessary, support the code users. It is expected that each of the tasks could encompass one FY, or more, depending on resources available to perform the work.
FY22 Milestones	All 4 Quarters o Provide status reports on SRS progress with CritView in the NCSP Quarterly Progress Reports. Quarter 1 o NCSP Approved Scope for FY21. Quarter 2 o TBD based on Approved Scope. Quarter 3 o TBD based on Approved Scope. Quarter 4 o Provide updated CritView database for user testing.

Figure 2.3-5 SRS IPD Budget Trend (FY2022-FY2026)



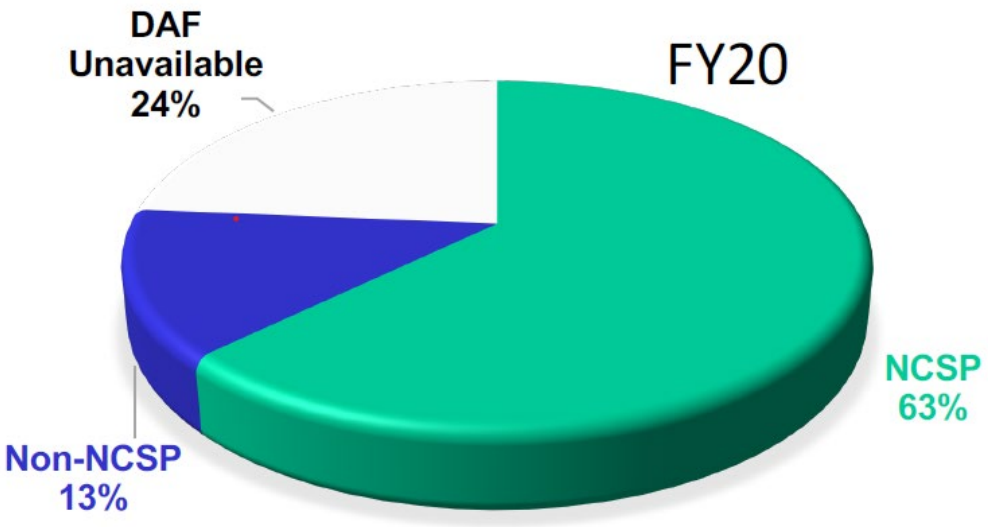
EOC – for out-year peaks and dips in budget plots:
There is a single IPD task for SRS (SRS-IPD1). The budget is lower in FY22 due to FY21 carryover. FY22-FY26 costs will return to typical funding levels for this task once the carryover is spent in FY22.

2.4 Integral Experiments (IE)

2.4.1 Program Element Description

The 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 criticality physics needs, emerging data improvement needs by DOE programs, and specific site needs on a prioritized basis. This program element supports the entire cost of the LANL NCERC permanent party staff and supports maintaining a fundamental nuclear material handling capability, which enables hands-on NCS training programs and various other programs for the DOE NCSP and other government agencies. Figure 2.3-1 shows NCERC availability in FY2019 and FY2020.

Figure 2.4-1 NCERC Availability FY2019 & FY2020
(Referenced from LA-UR-21-21485)



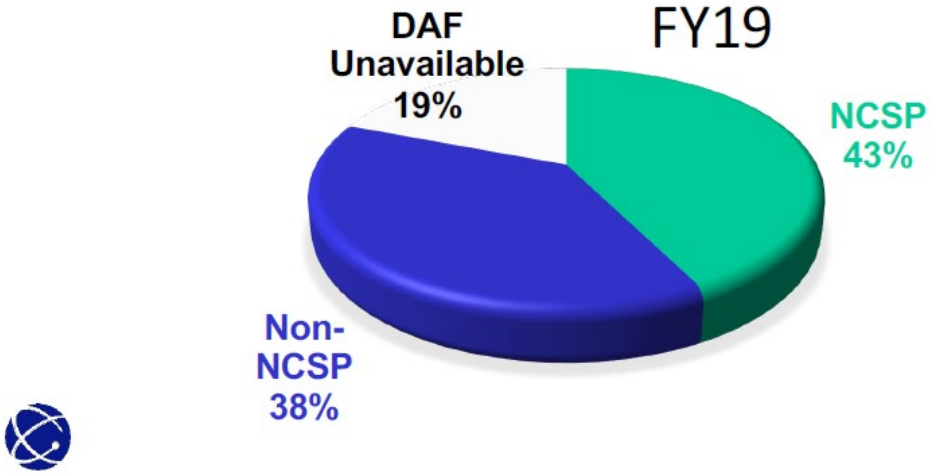
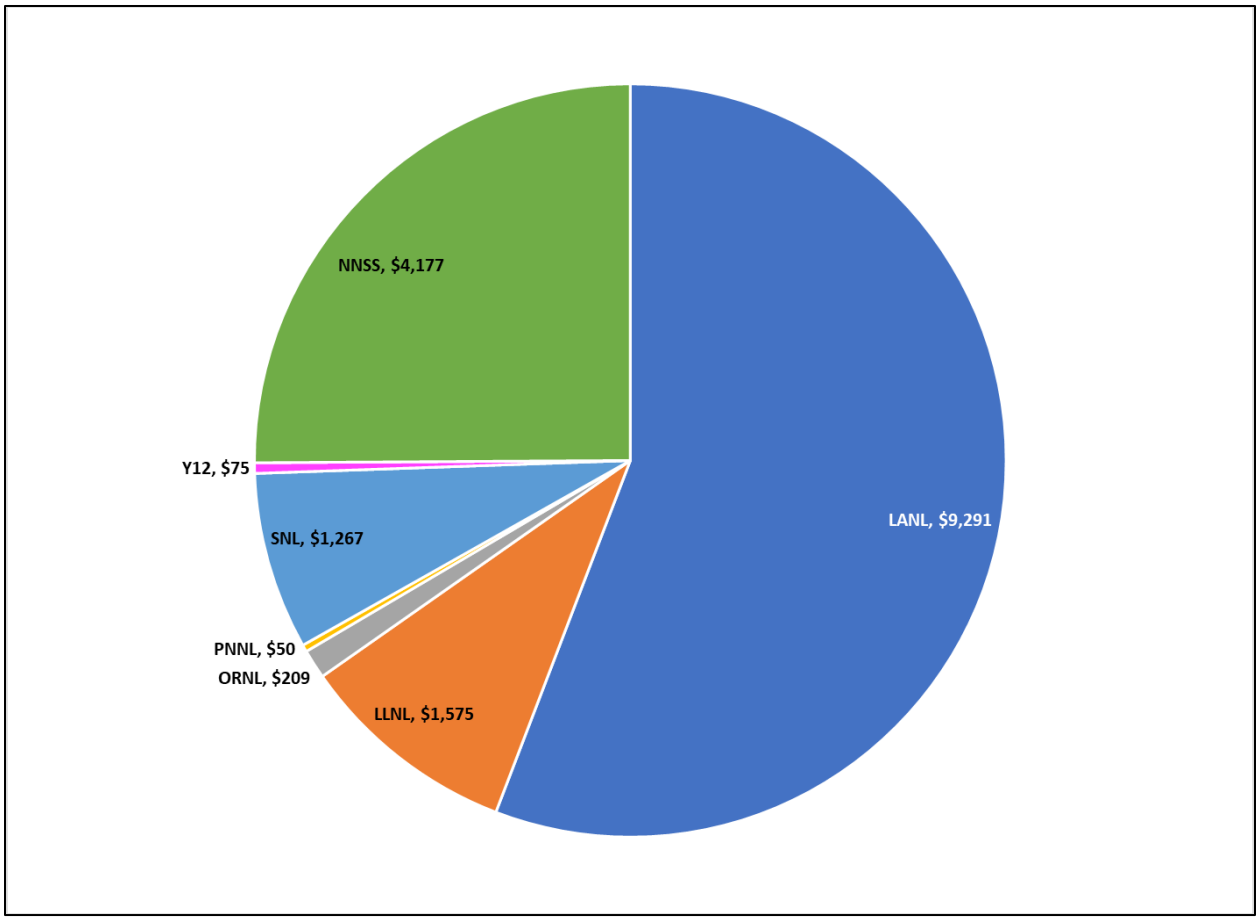


Figure 2.4-2 IE Budget (FY2022-FY2026)

Figure 2.4-3 IE Budget (FY2022)

NCSP Site	FY22 ($k)
LANL	$9291
LLNL	$1,575
NNSS	$4,177
ORNL	$209
PNNL	$50
SNL	$1,267
Y12	$75
Grand Total	**$16,644**



All Integral Experiment tasks and milestones are published as a standalone document. Contact the NCSP Program Manager, Dr. Angela Chambers, if you have a 'Need-to-Know.'

2.5 Nuclear Data (ND)

2.5.1 Program Element Description

The ND program element includes the measurement, evaluation, testing, and publication of neutron cross-section data for nuclides of high importance to NCS analyses. The NCSP continues to improve coordination of ND activities by fostering a strong collaborative effort among all of the 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. Refer to Appendix B for the FY2022 through FY2026 schedule, milestones, and deliverables associated with specific nuclear data measurement, evaluation, and publication. Milestones not contained in Appendix B are delineated below.

Figure 2.5-1 ND Budget (FY2022-FY2026)

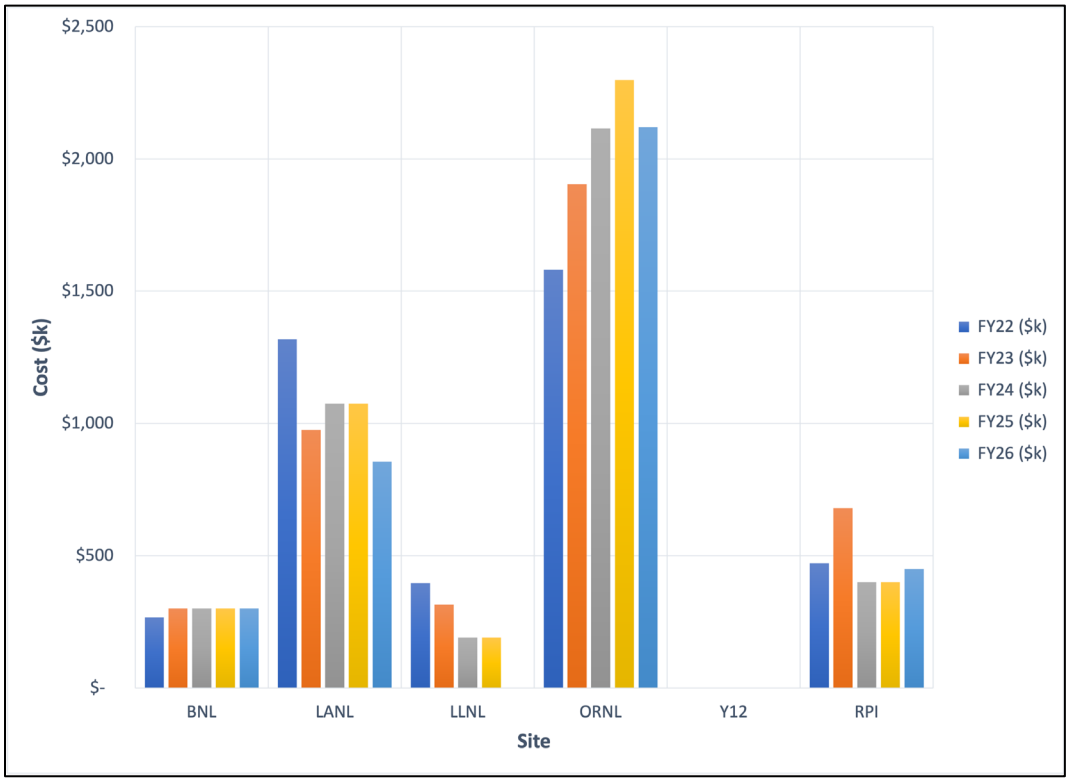
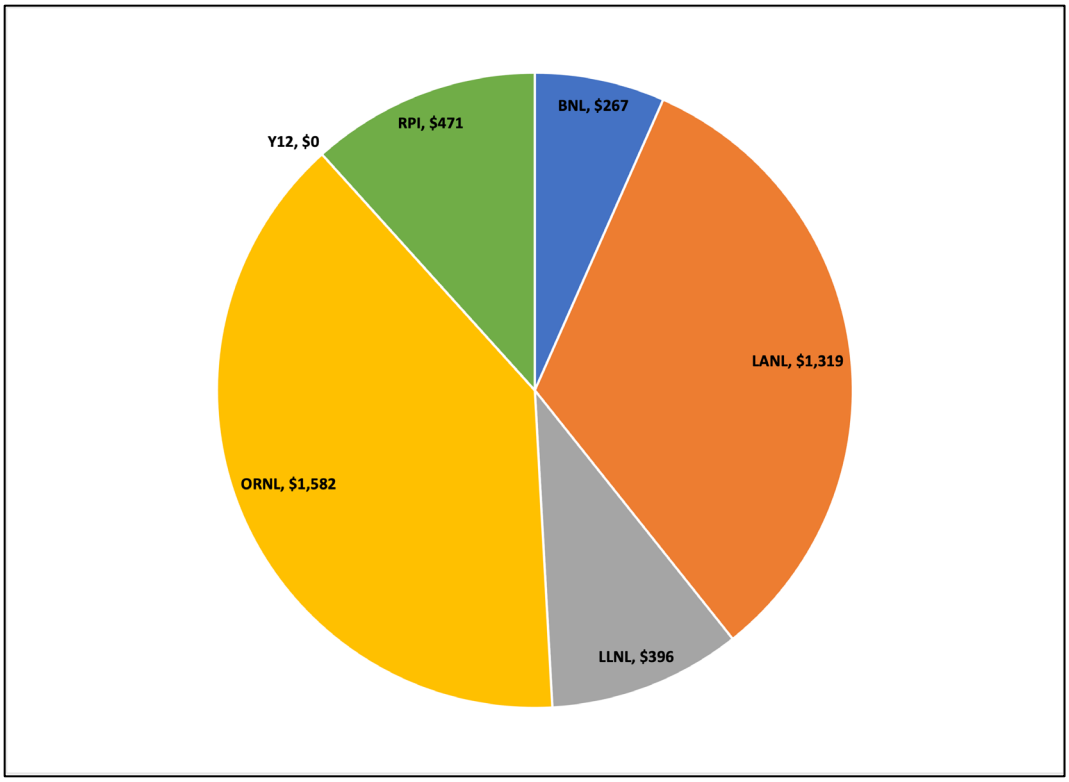


Figure 2.5-2 ND Budget (FY2022)

NCSP Site	FY22 ($k)
BNL	$267
LANL	$1,319
LLNL	$396
ORNL	$1,582
RPI	$471
Grand Total	**$4,035**

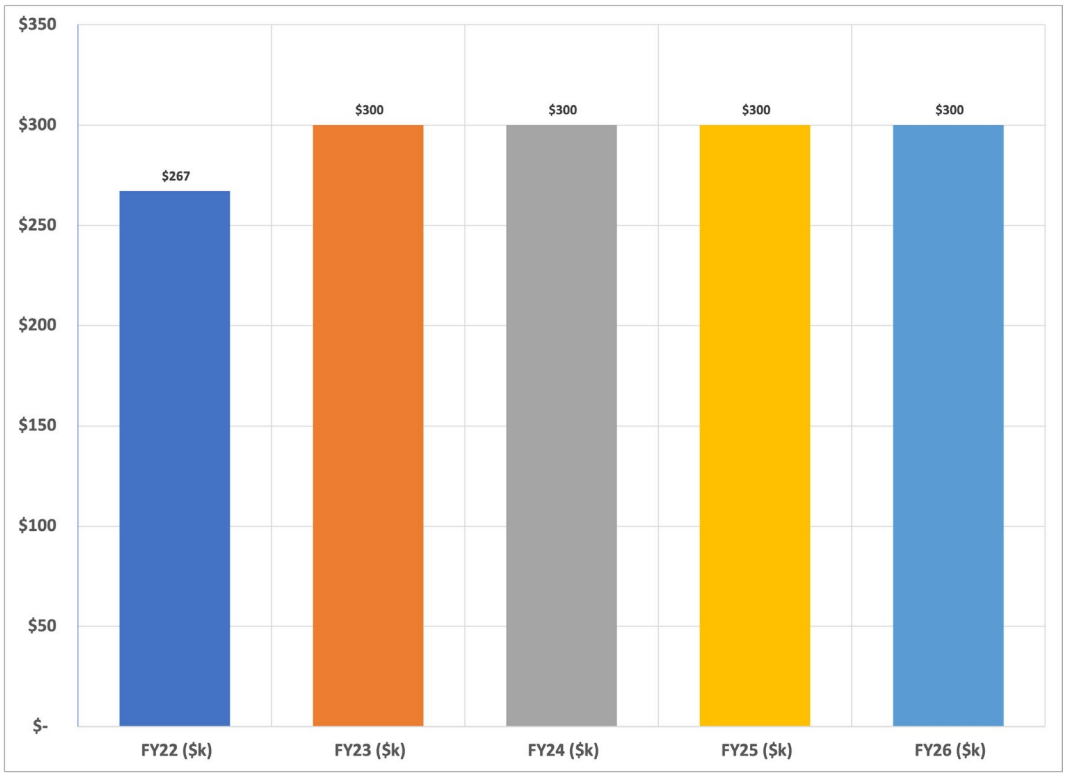

BNL, $267
LANL, $1,319
LLNL, $396
ORNL, $1,582
Y12, $0
RPI, $471

2.5.2 Approved Tasks

2.5.2.1 Brookhaven National Laboratory (BNL)

Task Name	BNL ND1
Collaborators	None
Task Title	National Nuclear Data Center (NNDC) Support to the NCSP
Proposal Submitted	Ongoing
Task Budget (FY22)	$267K
Task Description	This is an ongoing approved task to provide technical support to the NCSP to ensure that NCSP cross-section evaluations are checked, processed, visualized, reviewed, archived, and made available through the National Nuclear Data Center (NNDC) Gitlab system as candidate evaluations for the future versions of the ENDF/B library. Maintain Atlas of Neutron Resonances as a unique resource of thermal and resonance data and their uncertainties.
FY22 Milestones	All 4 Quarters o Maintain and upgrade ADVANCE code system by performing data verification of new NCSP evaluations and performing quality assurance on the data as required. Provide status reports on all ND1 activities in the NCSP Quarterly Progress Reports. o If mandated by CSEWG, release new ENDF library. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Figure 2.5-3 BNL ND Budget Trend (FY2022-FY2026)



EOC – for out-year peaks and dips in budget plots:
The BNL ND budgets are stable from FY22-FY26. The increase in funding for NNDC support to the NCSP is due to modest increase planned by the NCSP manager a few years ago.

2.5.2.2 Los Alamos National Laboratory (LANL)

Task Name	LANL ND1
Collaborators	IRSN (IRSN-ND2)
Task Title	Nuclear Data Evaluation and Testing
Proposal Submitted	Ongoing
Task Budget (FY22)	$744K
Task Description	This is an ongoing approved task to provide differential data evaluation and covariance development in the energy region above the resonance range for heavy elements (often in partnership with resonance-range work from ORNL), and over the entire ENDF energy range for light elements. Particular focus will be on neutron fission. Perform data testing analysis with new evaluated sets. Contribute to NDAG, CSEWG, INDEN, WPEC, and IAEA CRP. The LANL nuclear data measurements and evaluations are performed in accordance with the milestone schedule in Appendix B.
FY22 Milestones	All 4 Quarters o Provide status reports on LANL participation in US and International Nuclear Data collaborations in the NCSP Quarterly Progress Reports Quarter 1 o Conduct CSEWG Evaluation and Covariance sessions. o Report data testing results with ENDF/B-VIII.0 and additional beta release cross sections at CSEWG. Quarter 2 – None Quarter 3 – None Quarter 4 o Deliver nuclear data evaluations as indicated in Appendix B of this document.

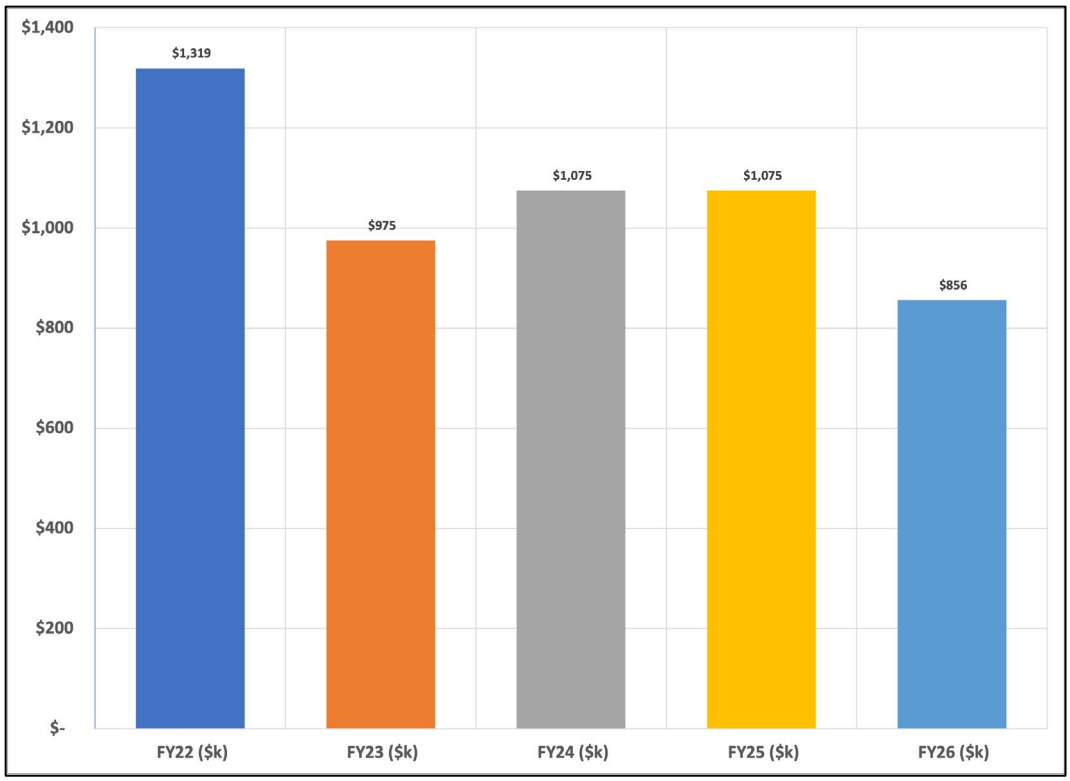
Task Name	LANL ND2
Collaborators	IRSN (IRSN-ND2); LLNL (LLNL-ND11)
Task Title	Prompt Fission Neutron Spectra (PFNS) Measurement of Plutonium-240
Proposal Submitted	FY20
Task Budget (FY22)	$325K
Task Description	Building upon recent improvements in measurements techniques for uranium-235, plutonium239 and uranium-238 (ongoing), this work is to measure the prompt fission neutron spectra (PFNS) for plutonium-240. This work has low technical risk, building upon previously established measurement and evaluation techniques. This work will be done using the Chi-Nu detectors at WNR, part of the LANSCE/LANL facility, with analysis carried out by a postdoc (to be hired) supervised by senior staff. Please note the Chi-Nu detectors include a liquid scintillator array for the high-energy (HE) tail and a lithium glass array for the low-energy (LE) tail with measurements performed separately. The Pu240 fission detector will be fabricated and tested by LLNL, starting with procurement in Q4 FY2020.
FY22 Milestones	All 4 Quarters o Provide status report on ND2 activities in the NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None

	Quarter 4 o Obtain final experimental results for Pu-240 PFNS at LANSCE, finalize data analysis, and deliver data to evaluators

Task Name	LANL ND3
Collaborators	None
Task Title	Unresolved and Fast Measurements of Uraunium-233 (n,gamma)
Proposal Submitted	FY20
Task Budget (FY22)	$250K
Task Description	Building upon recent improvements in measurements techniques for capture cross section (and alpha, the capture to fission ratio) that have been successfully applied for U-235 and Pu-239, this work is to measure the U-233 capture cross section. This is a low-risk measurement based upon now well-established techniques that have yielded 2% uncertainties on alpha in the keV region to 10% uncertainties around 1 MeV. These measurements will complement and extend previous uranium-233 total and capture measurements at lower energies. This work will be done using the DANCE detector at the Lujan center, part of the LANSCE/LANL facility, with analysis carried out by a postdoc supervised by senior staff.
FY22 Milestones	All 4 Quarters o Provide status report on ND3 activities in the NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 o Finalize acquisition of U-233 thick target capture data, finalize data analysis, and deliver data to evaluators

Task Name	LANL ND4
Collaborators	IRSN
Task Title	^{95}Mo neutron capture and transmission measurements in the resolved and unresolved resonance regions, resonance spin/parity measurements, and resonance evaluation
Proposal Submitted	FY21
Task Budget (FY22)	$0K (use FY21 carryover)
Task Description	At LANL, we propose to finish analysis of ^{95}Mo neutron capture, transmission, and resonance spin/parity data taken at ORELA, publish these data, and make them available to the general community. IRSN will then use these data in a new ^{95}Mo evaluation.
FY22 Milestones	All 4 Quarters o Provide status report on ND4 activities in the NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 o Finalize the analysis, submit the results for publication, and make the data available to IRSN and EXFOR.

Figure 2.5-4 LANL ND Budget Trend (FY2022-FY2026)



EOC – for out-year peaks and dips in budget plots:
Budget fluctuations for LANL ND work is due to LANL-ND2 Pu-240 PFNS measurement completion in FY22. LANL-ND3 is also due to be completed in FY22 (U-233 measurements). The budgets are stable beginning in FY23.

2.5.2.3 Lawrence Livermore National Laboratory (LLNL)

Task Name	LLNL ND2
Collaborators	North Carolina State University and Naval Nuclear Laboratory
Task Title	Generation and Benchmarking of Thermal Neutron Scattering Cross Sections in Support of Advanced Nuclear Reactor Concepts
Proposal Submitted	Ongoing
Task Budget (FY22)	$29K
Task Description	This is an ongoing approved task in collaboration with NCSU and NNL to refine and complete basic atomistic models for executing molecular dynamics simulations for the moderator materials specified in Appendix B. A potential function describing the atomistic interactions will be chosen and parameterized to reproduce its observed characteristics. Subsequently, the excitation spectrum (i.e., vibrations, rotations, etc.) will be calculated. This information will be used to develop modules in FLASHH and NJOY (if possible) to calculate the scattering law, S(α,β), and the thermal neutron scattering cross sections at temperatures of interest. The libraries produced will account for both inelastic and coherent elastic scattering, when applicable. With LLNL assistance, these S(α,β) libraries in both ENDF File 7 and ACE ("A Compact ENDF" file) formats will be tested in NCSP analytic methods using relevant criticality safety benchmarks selected from the ICSBEP Handbook. Finally, the S(α,β) libraries in ENDF File 7 will be provided to the National Nuclear Data Center at Brookhaven National Laboratory. The NR Program (NNL) will provide $75K in matching funding.
FY22 Milestones	All 4 Quarters o Provide status on LLNL/NCSU nuclear data activities in the NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 o Deliver thermal neutron scattering data evaluations as indicated in Appendix B of the 5-Year Plan.

Task Name	LLNL ND5
Collaborators	North Carolina State University and Naval Nuclear Laboratory
Task Title	Development and Implementation of a Modern Doppler Broadening Approach Including Atomic Binding Effects
Proposal Submitted	FY18
Task Budget (FY22)	$39K
Task Description	This is a 5-year task in collaboration with NCSU and NNL to formulate, develop and implement a modern Doppler broadening of nuclear cross sections that abandons the free gas approximation and accounts for atomic binding effects. The NR Program (NNL) will provide $50K in matching funding.
FY22 Milestones	All 4 Quarters o Provide status on LLNL/NCSU nuclear data activities in the NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None

	Quarter 3 – None Quarter 4 – None

Task Name	LLNL ND7
Collaborators	None
Task Title	'Alpha-N' Benchmark Measurements
Proposal Submitted	FY19
Task Budget (FY21)	$104K
Task Description	The proposal is to utilize LLNL's hybrid neutron time-of-flight spectrometer to measure the neutron emission rate and spectrum for materials of interest. Note that this spectrometer has already been successfully used to measure the high-energy portion of the Godiva spectrum as part of IER-147. LLNL also has a number of MSA 'HEX' cans containing significant quantities of pure $^{239}PuO_2$. In FY-2019, the proposal is to modernize the data acquisition system and calibrate the spectrometer using reference mono-energetic neutron fields. In FY-2020, LLNL will deploy this instrument to measure the $^{239}PuO_2$ (α,n) and spontaneous fission neutron emission spectrum and compare the results to COG and MC21 calculated results. NNL has agreed to provide independent analysis of the proposed experiment free of charge to NCSP. If successful, a separate proposal will be developed in consultation with NNL and other laboratories to measure other materials of interest (e.g., UF_6, UF_4, PuF_4, Am-Be, Am-B, Am-Li). These are also candidates for future NA-22/NP nuclear data proposals (FY-2020+) as there was considerable discussion at the recent NDREW meeting regarding the national need for such (α,n) nuclear data (measurements, evaluations), and validation benchmarks). NNL has also expressed interest in LLNL measuring a production Am-Be neutron test source as used in the fleet. This proposal furthers the ongoing collaboration between LLNL and NNL and provides fundamental nuclear reaction data needed for applications ranging from nuclear fuel burnup monitoring (NR) to probability of initiation (DP) and "alpha ratio" (NCSP, NCT).
FY22 Milestones	All 4 Quarters o Provide status on LLNL/NCSU nuclear data activities to NCSP Manager Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

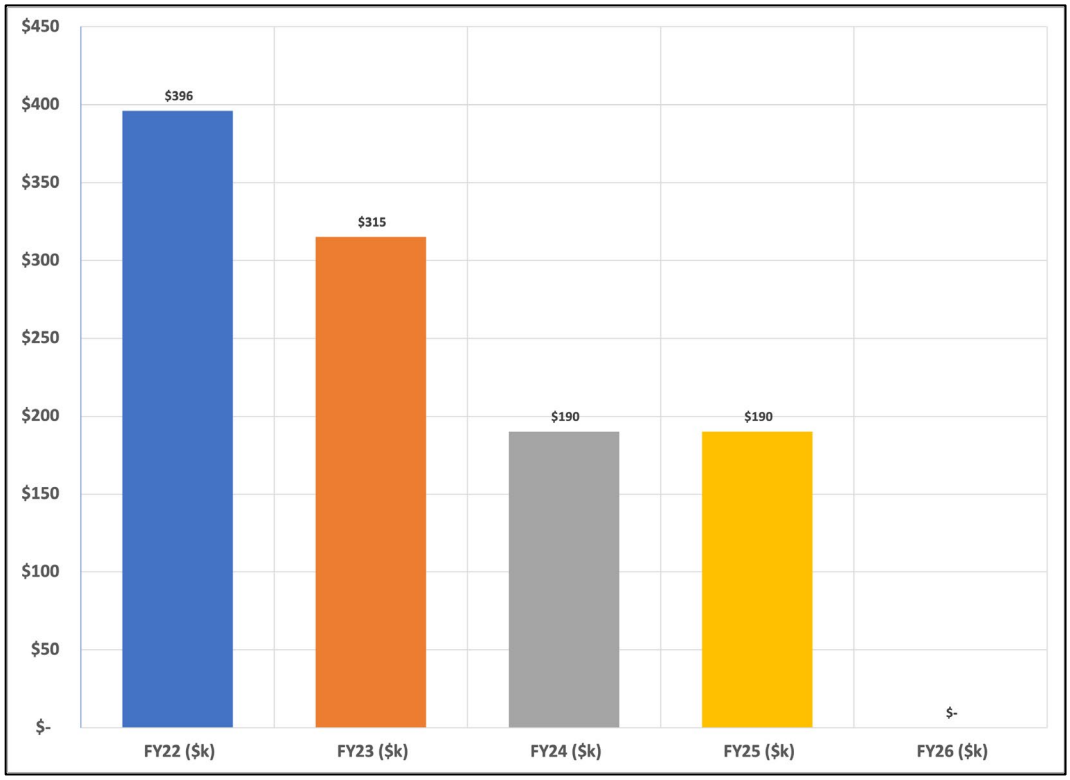
Task Name	LLNL ND8
Collaborators	IRSN (IRSN-ND3)
Task Title	Study: Fission TPC Measurement of the U-233/U-235 (n,f) Cross Section Ratio
Proposal Submitted	FY19
Task Budget (FY21)	$125K
Task Description	Design an experiment to measure the U-233(n,f)/U-235 (n,f) cross section ratio over an energy range and to a precision relevant to NA-50 program requirements.
FY22 Milestones	All 4 Quarters o Provide status on ND8 to NCSP Manager Quarter 1 – None Quarter 2 – None Quarter 3 – None

	Quarter 4 – None

Task Name	LLNL ND10
Collaborators	NNL, NCSU
Task Title	Development and Implementation of Machine Learning Methods for Thermal Scattering Law Evaluations
Proposal Submitted	FY21
Task Budget (FY22)	$49K
Task Description	This NCSU/LLNL task will involve a new paradigm for the evaluation and representation of TSL data that utilizes a machine/deep learning (ML/DL) approach for the generation of the required data. Specifically, the multi-dimensional discrete TSL phase space will be reconstructed continuously using artificial neural networks (ANN) and cast into a form that can be used on-the-fly by multi-physics neutronic simulation systems.
FY22 Milestones	All 4 Quarters o Provide status on ND10 activities in the NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – Provide an update on the development and testing of NeTS modules for selected materials such as light water, graphite, etc.

Task Name	LLNL ND11
Collaborators	LANL (LANL-ND2)
Task Title	Fabricate the Pu240 PPAC targets and fission detector components
Proposal Submitted	FY21
Task Budget (FY22)	$50K
Task Description	The funding allows LLNL participation in the experimental measurement at LANL and subsequent analysis of the experimental results with LANL researchers.
FY22 Milestones	All 4 Quarters o Provide status report on PPAC target fabrication activities in the NCSP Quarterly Status Reports. . Quarter 1 o Fabricate the Pu240 PPAC targets and fission detector components Quarter 2 o Assemble and test the Pu240 fission detector Quarter 3 – None Quarter 4– None

Figure 2.5-5 LLNL ND Budget Trend (FY2022-FY2026)



EOC – for out-year peaks and dips in budget plots:
There are decreases in the LLNL ND budget due to projects that are completed in FY22 (LLNL-ND5, LLNL-ND7, LLNL-ND8, and LLNL-ND11). The LLNL ND task list is zero in FY26 due to the completion of all active projects currently on the task list; however, some of the LLNL-ND10 thermal scattering law evaluation work will likely continue into the outyears.

2.5.2.4 Oak Ridge National Laboratory (ORNL)

Task Name	ORNL ND1
Collaborators	IRSN (IRSN-ND1), JRC-Geel, RPI (RPI-ND1)
Task Title	Nuclear Data Measurement and Evaluation
Proposal Submitted	Ongoing
Task Budget (FY22)	$1140K
Task Description	Ongoing task to 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. The ORNL nuclear data measurements and evaluations are performed in accordance with the milestone schedule in Appendix B.
FY22 Milestones	All 4 Quarters o Provide status reports on all ND1 activities in the NCSP Quarterly Progress Reports o Provide status reports on ORNL participation in US and International Nuclear Data collaborations, and for foreign travel, provide a brief trip summary report to NCSP Manager on items of NCSP interest o Complete cross-section measurement and evaluation deliverables per the nuclear data schedule in Appendix B Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	ORNL ND3
Collaborators	JRC-Geel, Rensselaer Polytechnic Institute
Task Title	Isotopic Sample Leases to Support ND1 ND Measurements
Proposal Submitted	Ongoing
Task Budget (FY22)	$50K
Task Description	This "task" is to separate out funding for natural and stable, isotopically enriched samples, for nuclear data measurements aligned with the priorities and schedule provided in Appendix B. The task also supports activation analysis to demonstrate the likely lease options to negotiate with DOE Office of Science- Nuclear Physics (DOE/SC-NP)
FY22 Milestones	All 4 Quarters o Provide status reports on all ND3 activities in the NCSP Quarterly Progress Reports o Provide status reports on ORNL participation in US and International Nuclear Data collaborations, and for foreign travel, provide a brief trip summary report to NCSP Manager on items of NCSP interest o Complete cross-section measurement and evaluation deliverables per the nuclear data schedule in Appendix B Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	ORNL ND4
Collaborators	(NNL-ND2), Rensselaer Polytechnic Institute
Task Title	Thermal Neutron Total Cross Section Measurements for Improvement of Criticality Calculations and Propagation of Scattering Kernel Uncertainties
Proposal Submitted	Ongoing
Task Budget (FY22)	$0K (use FY21 carryover)
Task Description	This is an ongoing approved task in collaboration with ORNL to support the thermal Neutron Scattering Measurement for Improvement of Criticality Calculations and Propagation of Scattering Kernel Uncertainties. This task also supports the work to broaden and maintain the U.S. capabilities to support NCSP experimental nuclear data needs by providing priority NCSP thermal scattering law data. Aligns with NNL-ND2. **(ORNL ND4 was added using carryover funding in FY22 5-year plan, Rev. 1)**
FY22 Milestones	All 4 Quarters o Provide status reports on all ND4 activities in NCSP Quarterly Progress Reports Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	ORNL ND6
Collaborators	JRC-Geel, Rensselaer Polytechnic Institute
Task Title	SAMMY Nuclear Data Evaluation Code Modernization
Proposal Submitted	Ongoing
Task Budget (FY22)	$392K
Task Description	This a continuing task to modernize the SAMMY software that is an essential tool needed by nuclear data evaluators to analyze measured cross-section data and produce nuclear data evaluations with covariance data for the NCSP. SAMMY is primarily used to analyze differential data from the RPI Gaertner linear accelerator, IRMM Geel Electron Linear Accelerator (GELINA), and Los Alamos Neutron Science Center (LANSCE) to produce nuclear data evaluations. An initial step toward modernization will be the merger of SAMMY under the SCALE continuous integration (CI) development framework. Once complete, SAMMY will be developed under the SCALE software quality assurance plan (SQAP) thereby providing increased confidence in the quality of the data evaluations developed and deployed by SAMMY. Once SAMMY is completely under SQA and integrated with the SCALE/AMPX CI development framework, the work will be performed to modernize SAMMY by utilizing modern computing frameworks and libraries that harness the emerging computing power of parallel architectures, and that enable a rapid development of new data analysis capabilities. The overall modernization work effort will ensure the SAMMY software is up-to-date and positioned for long-term sustainability in order to support NCSP nuclear data evaluation needs.
FY22 Milestones	All 4 Quarters o Provide status reports on all ND6 activities in the NCSP Quarterly Progress Reports Quarter 1 – None

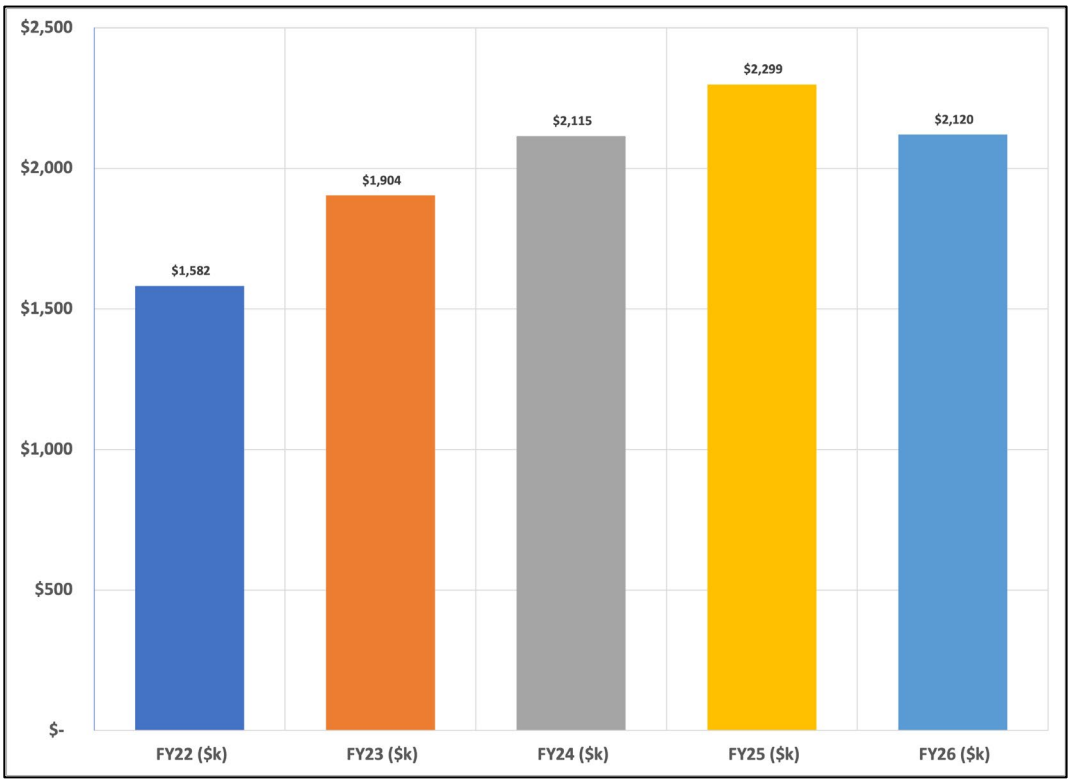
	Quarter 2 – None Quarter 3 – None Quarter 4 o Document SAMMY modernization progress and report status annually to the NCSP Manager

Task Name	ORNL ND10
Collaborators	None
Task Title	Monte Carlo Evaluation of Differential and Integral Data
Proposal Submitted	FY19
Task Budget (FY22)	$0K (use FY21 carryover)
Task Description	This is new work to build on ORNL's recent applications of Monte Carlo method to some of the VALID library IBEs (350), and to the Monte Carlo evaluation of thermal neutron scattering data on light water, while applying most recent advances in Bayesian Monte Carlo methods. The Monte Carlo evaluation of R-matrix resonance parameters would be leveraged by the ORNL's nuclear data evaluation code SAMMY that is being modernized in the NCSP ORNL-ND6 task. The proposed framework would complement the S/U tools in SCALE by computing response sensitivities, it would quantify the magnitude of presently neglected non-linear effects, and when used for simultaneous evaluation of differential and integral data it would obviate the need for conventional data adjustment. After this methodology is developed, it will be demonstrated on a small scale and results provided to the NCSP manager. Ultimately, if the results are successful, this task will be scaled up to the level of the proposal (FY19, proposal 35) and be used to prioritize nuclear data measurements. **(ORNL ND10 was added using carryover funding in FY22 5-year plan, Rev. 1)**
FY22 Milestones	All 4 Quarters o Provide status reports on all ND10 activities in NCSP Quarterly Progress Reports Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	ORNL ND11
Collaborators	None
Task Title	Thermal neutron scattering measurements and evaluations for DHS applications at temperature
Proposal Submitted	None – Approved by NCSP Manager
Task Budget (FY22)	$0K (use FY21 carryover)
Task Description	Generate measurement data from the ORNL Spallation Neutron Source and develop ENDF-format thermal neutron scattering files of the following materials at temperatures of interest for DHS application (spanning -40°C to +40°C): o Portland Cement o Silicone Elastomer

	o Polyethylene o Light Water **(ORNL ND11 was added using carryover funding in FY22 5-year plan, Rev. 1)**
FY22 Milestones	Quarters 3 – 4: o Provide status reports on all ND11 activities in NCSP Quarterly Progress Reports Quarter 3 – None Quarter 4 – None

Figure 2.5-6 ORNL ND Budget Trend (FY2022-FY2026)



EOC – for out-year peaks and dips in budget plots:
The ORNL ND budgets increase in the outyears to adjust for inflation and alignment to workload in Appendix B. ORNL-ND9 begins in FY23, which represents a significant fraction of the budget increase starting in FY23.

2.5.2.5 Rensselaer Polytechnic Institute (RPI)

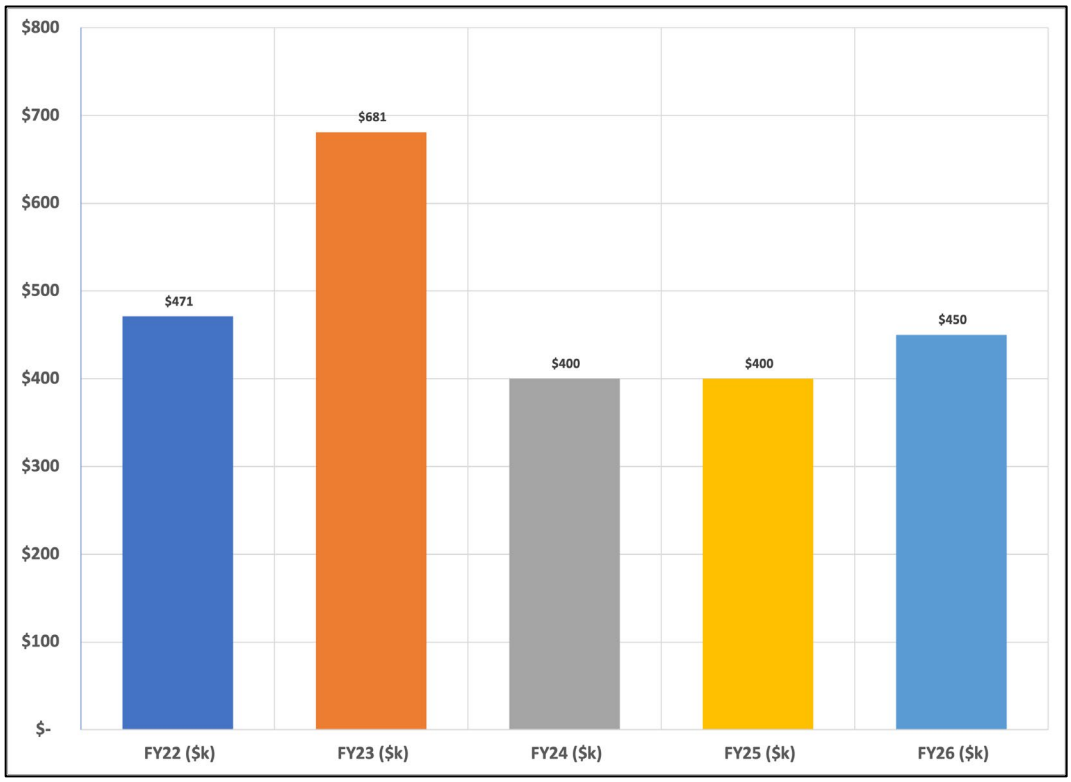
Per agreement between Naval Reactors (NA-30) and the Nuclear Criticality Safety Program, the NNL acts as the Maintenance and Operations Contractor (MOC) for work conducted at the RPI linear accelerator facility. NNL voluntarily administers NCSP contracts supporting these RPI tasks in conjunction with the Naval Reactors nuclear data measurements and evaluations program.

Task Name	RPI ND1
Collaborators	IRSN (IRSN-ND1), ORNL (ORNL-ND1), Naval Nuclear Laboratory
Task Title	Resonance Region Nuclear Data Measurement Capability
Proposal Submitted	Ongoing
Task Budget (FY22)	$471K
Task Description	This is an ongoing approved task in collaboration with IRSN and ORNL to support the resonance region Nuclear Data Measurement Capability at RPI and to perform cross-section measurements and qualification of the new capabilities. Aligns with LANL-ND1 and ORNL-ND1 (evaluation) and IRSN-ND1 (evaluation).
FY22 Milestones	All 4 Quarters o Provide status reports on all ND1 activities in NCSP Quarterly Progress Reports o Provide status reports on RPI participation in US and International Nuclear Data collaborations, and for foreign travel, provide a brief trip summary report to NCSP Manager on items of NCSP interest Quarter 1 o Complete analysis of measurement from previous year Quarter 2 – None Quarter 3 o Complete nuclear data measurements (transmission/capture or scattering) per the nuclear data schedule in Appendix B Quarter 4 o Complete measurements data analysis and provide the data to ORNL as needed to support the evaluation effort per the nuclear data schedule in Appendix B

Task Name	RPI ND3
Collaborators	Naval Nuclear Laboratory, ORNL
Task Title	RPI/ORNL: LINAC 2020 Nuclear Data Capabilities Maintenance Plan
Proposal Submitted	Ongoing
Task Budget (FY22)	$0K (use FY21 carryover)
Task Description	This is an ongoing approved task to support the Linear Accelerator (LINAC) 2020 Nuclear Data Capabilities Maintenance Plan in collaboration with Naval Reactors (NA-30) who is co funding 2/3 of the total refurbishment costs. In order to be able to continue to deliver a reliable neutron beam with the proper conditions required for these experiments, a long-term maintenance and update plan is being implemented.
FY22 Milestones	All 4 Quarters o Provide status report on all LINAC refurbishment activities in the NCSP Quarterly Progress Reports Quarter 1 o Complete of SOL 1 Accelerator Section RF Conditioning. Quarter 2

	○ Complete TPV Accelerator Section RF Conditioning. Quarter 3 ○ Start fabrication of 2nd batch of speed of light structures 2, 3 and 4. Quarter 4 ○ Complete delivery of solenoids and quadrupoles components

Figure 2.5-7 RPI ND Budget Trend (FY2022-FY2026)

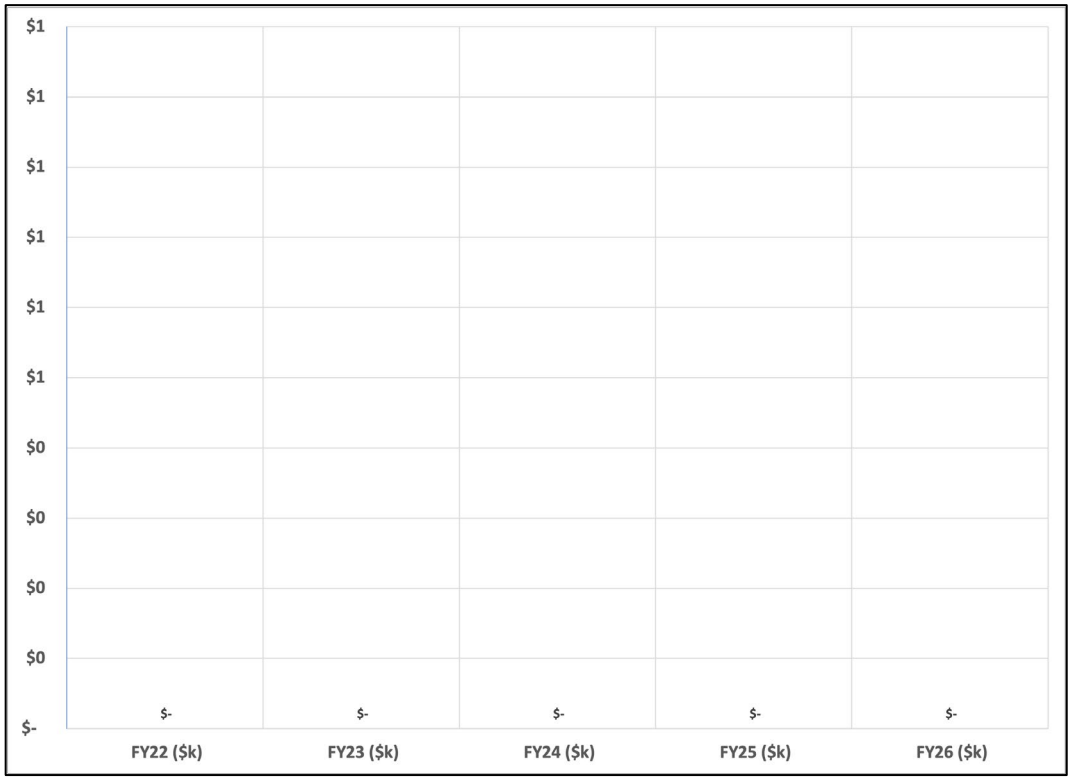


EOC – for out-year peaks and dips in budget plots:
The RPI ND budget is stable in the $400k level except for FY23. The $200k increase in funding for FY23 is due to LINAC refurbishment costs.

2.5.2.6 Y-12 National Security Complex

Task Name	Y12 ND1
Collaborators	IRMM
Task Title	Y-12 Fabrication of New Uranium Target for IRMM/GELINA for Cross-section Measurements
Proposal Submitted	FY19
Task Budget (FY22)	$0K (Use carryover funding)
Task Description	This FY2019 task involves the fabrication of a new depleted uranium/molybdenum target for IRMM/GELINA for cross section measurements. As part of the IRMM collaboration, this task will ensure continued availability of the accelerator for NCSP nuclear data measurements.
FY22 Milestones	All 4 Quarters o Provide a status report of the fabrication of a depleted uranium/molybdenum target per IRMM/GELINA specifications to the NCSP Manager. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Figure 2.5-8 Y-12 ND Budget Trend (FY2022-FY2026)



EOC – for out-year peaks and dips in budget plots:
The Y-12 ND budget is zero throughout the 5-year period. The neutron target for GELINA will be assembled and transported to Belgium using FY21 carryover funding.

2.6 Training and Education (TE)

2.6.1 Program Element Description

The TE program element continues to offer hands-on training courses as needed by DOE and identify training needs and develop training resources in areas where no suitable materials exist. The primary purpose of the TE 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. A significant portion of the TE work effort is to provide both the 2-week hands-on criticality safety courses for criticality safety engineers and 1-week hands-on criticality safety courses for Criticality Safety Officers, process supervisors, and managers.

Each year, at the annual Budget Execution Meeting, the NCSP Manager will review and determine the location of the classroom portion of the Hands-on Training course. Out-year budget profiles will be revised at that time, and funding profiles will not be increased until the location of the course is determined.

Figure 2.6-1 TE Budget (FY2022-FY2026)

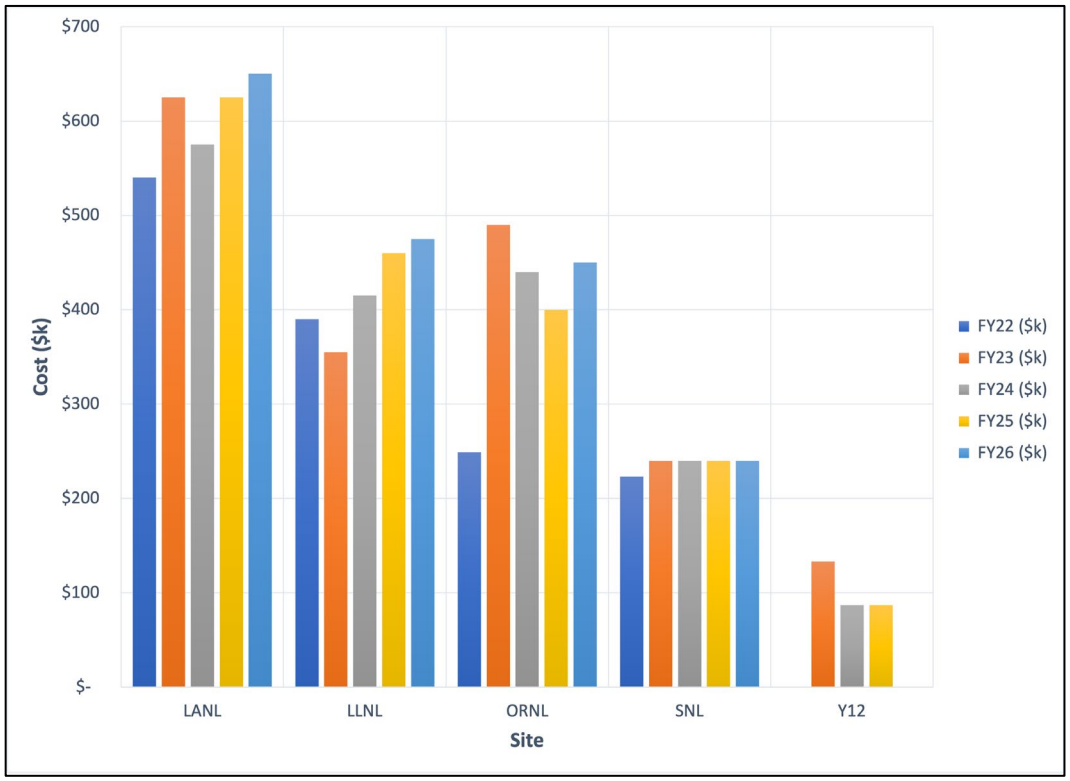
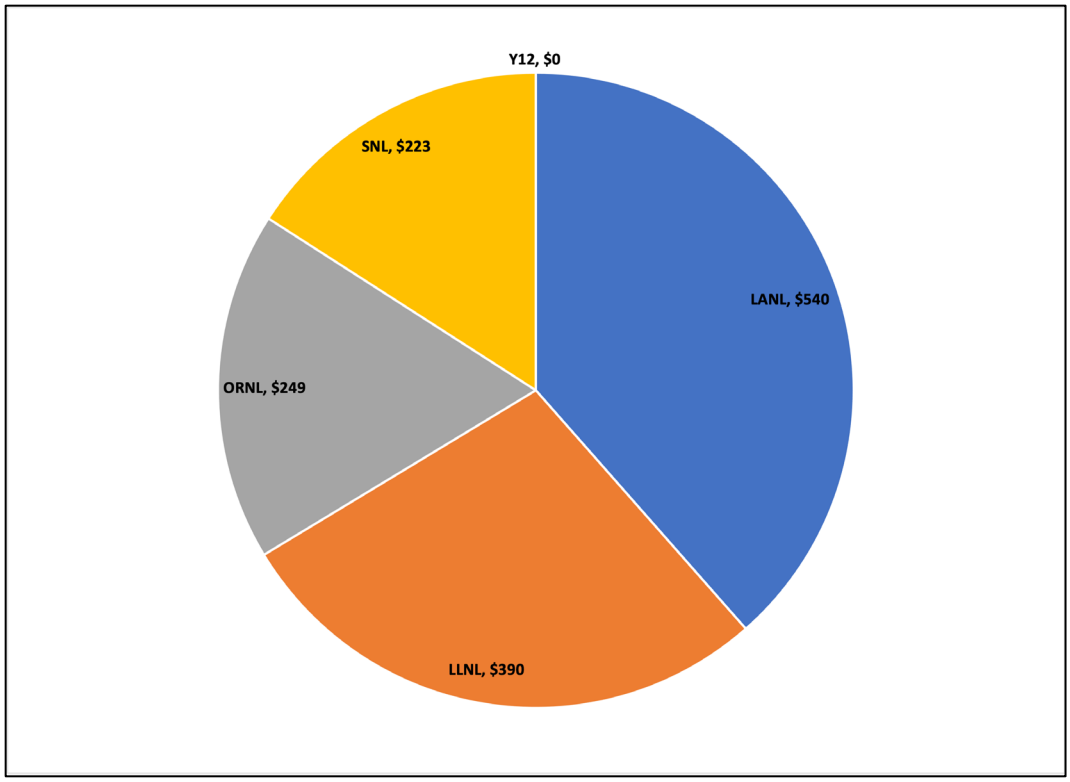


Figure 2.6-2 TE Budget (FY2022)

NCSP Site	FY22 ($k)
LANL	$540
LLNL	$390
ORNL	$249
SNL	$223
Y12	$0
Grand Total	**$1,402**


Y12, $0
SNL, $223
LANL, $540
ORNL, $249
LLNL, $390

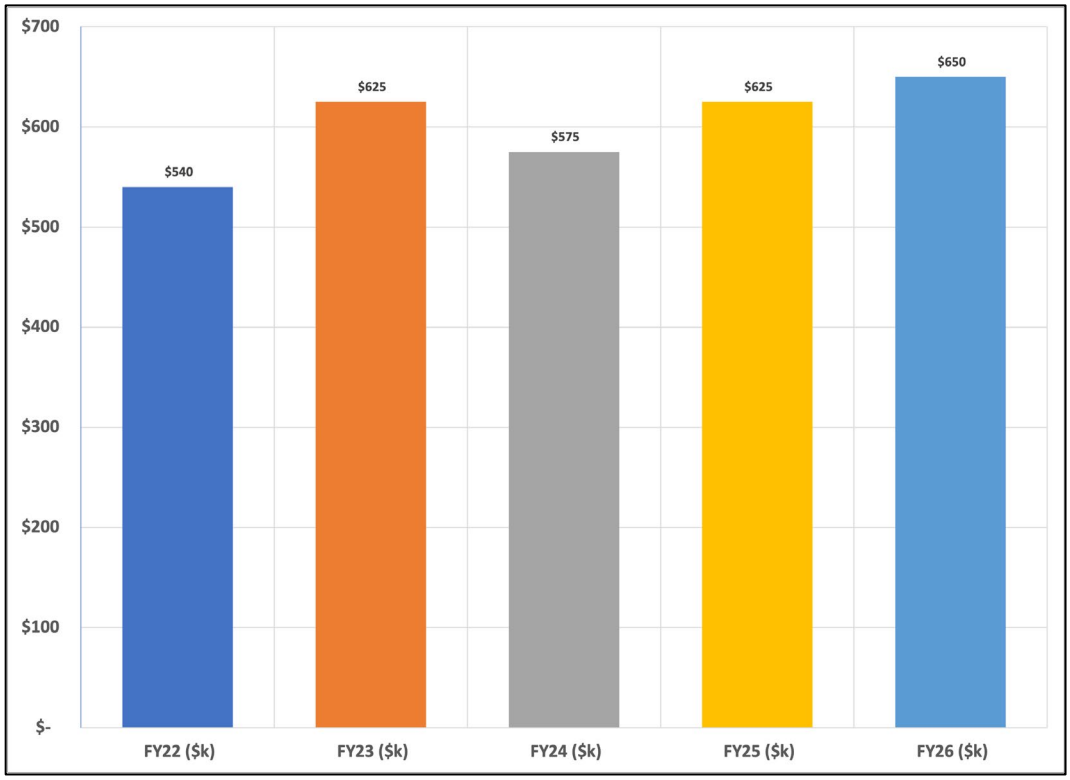
2.6.2 Approved Tasks

2.6.2.1 Los Alamos National Laboratory (LANL)

Task Name	LANL TE3
Collaborators	None
Task Title	Conduct Hands-On Criticality Safety Training Course at NCERC
Proposal Submitted	Ongoing
Task Budget (FY22)	$490K
Task Description	This is an ongoing approved task to conduct criticality safety hands-on training at NCERC according to an integrated schedule developed by ORNL and approved by the NCSP manager.
FY22 Milestones	All 4 Quarters o Provide status reports on all TE3 activities in the NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	LANL TE6
Collaborators	None
Task Title	Development of University Pipeline for Criticality Safety Professionals
Proposal Submitted	FY18
Task Budget (FY22)	$50K
Task Description	Development of a University Pipeline for Criticality Safety Professionals.
FY22 Milestones	All 4 Quarters o Provide status reports on all TE6 activities in the NCSP Quarterly Progress Reports Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Figure 2.6-3 LANL TE Budget Trend (FY2022-FY2026)



EOC – for out-year peaks and dips in budget plots:
There is a slight increase in LANL TE funding from FY22-FY26 due to projected increases in costs at NCERC to support NCS training. Further, several new tasks (LANL-TE4, LANL-TE5, and LANL-TE8) are due to start in FY23 that contribute to the increased budget at LANL for TE work.

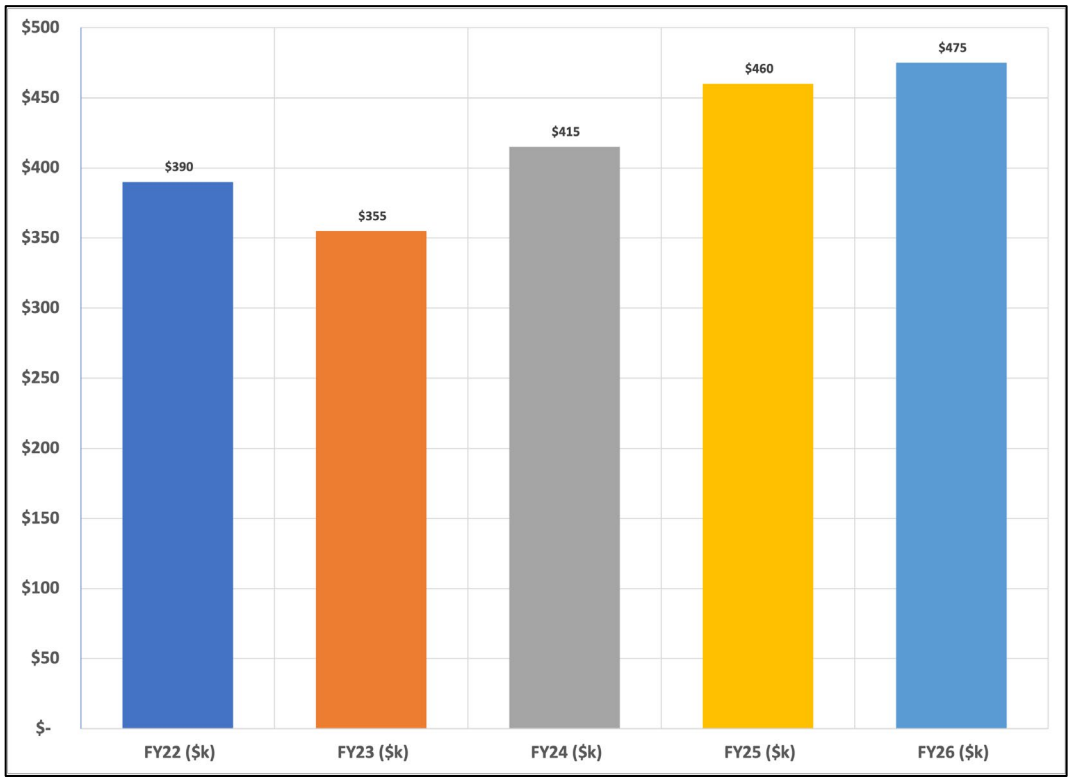
2.6.2.2 Lawrence Livermore National Laboratory (LLNL)

Task Name	LLNL TE1
Collaborators	None
Task Title	Conduct Hands-on Training at the DAF (TACS)
Proposal Submitted	Ongoing
Task Budget (FY22)	$265K
Task Description	This is an ongoing approved task to provide unique "hands-on" training at the Device Assembly Facility (DAF) using the Training Assembly for Criticality Safety (TACS). This task also supports continued LLNL coordination of the course registration process for all courses at NSF, NATM, NCERC and SNL.
FY22 Milestones	All 4 Quarters o Provide a status report on TE1 activities in the NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	LLNL TE3
Collaborators	None
Task Title	Classroom Criticality Safety Training
Proposal Submitted	Ongoing
Task Budget (FY22)	$75K
Task Description	This is an ongoing approved task to provide LLNL support classroom instruction at the Nevada Site Facility and participation in TE development activities.
FY22 Milestones	All 4 Quarters o Provide a status report on TE3 activities in the NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	LLNL TE8
Collaborators	None
Task Title	Development of University Pipeline for Criticality Safety Professionals
Proposal Submitted	FY21 – Direct request to the NCSP Manager
Task Budget (FY21)	$50K
Task Description	Development of a University Pipeline for Criticality Safety Professionals.
FY22 Milestones	All 4 Quarters o Provide status reports on all training activities to the NCSP Manager, to include photos and content for the quarterly newsletter Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Figure 2.6-4 LLNL TE Budget Trend (FY2022-FY2026)



EOC – for out-year peaks and dips in budget plots:
The LLNL TE budget increases over the budget period due mostly to increases in costs for performing TACS subcritical training to support the NCSP training and education program. The LLNL-TE8 task is current not funded beyond FY22 and contributes to the funding decrease in FY23.

2.6.2.3 Oak Ridge National Laboratory (ORNL)

Task Name	ORNL TE1
Collaborators	IRSN (IRSN TE1), AWE (AWE TE1)
Task Title	Manage and Provide Instruction for the DOE Nuclear Criticality Safety Training & Education Program
Proposal Submitted	Ongoing
Task Budget (FY22)	$99K
Task Description	Ongoing ORNL task to manage the collaborative multi-laboratory development, designing, and scheduling of the multi-faceted and phased NCSP training program and manage the execution of the program. The task also includes support for an ORNL nondestructive assay (NDA) expert, an NCS expert, and an NCS expert with federal experience to support the 2-week hands-on and manager courses.
FY22 Milestones	All 4 Quarters o Provide a status report on implementation of the NCS training program in the NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	ORNL TE3
Collaborators	None
Task Title	Hand-calculation Primer Expansion, LA-14244-M
Proposal Submitted	FY14
Task Budget (FY22)	$0K (use FY21 carryover)
Task Description	This task is to expand the current Hand Calculation Primer, LA-14244-M, to include new methods, examples, and to fix errors. This document will be generated as an ORNL document.
FY22 Milestones	All 4 Quarters o Provide a status report of progress on TE3 activities in the NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

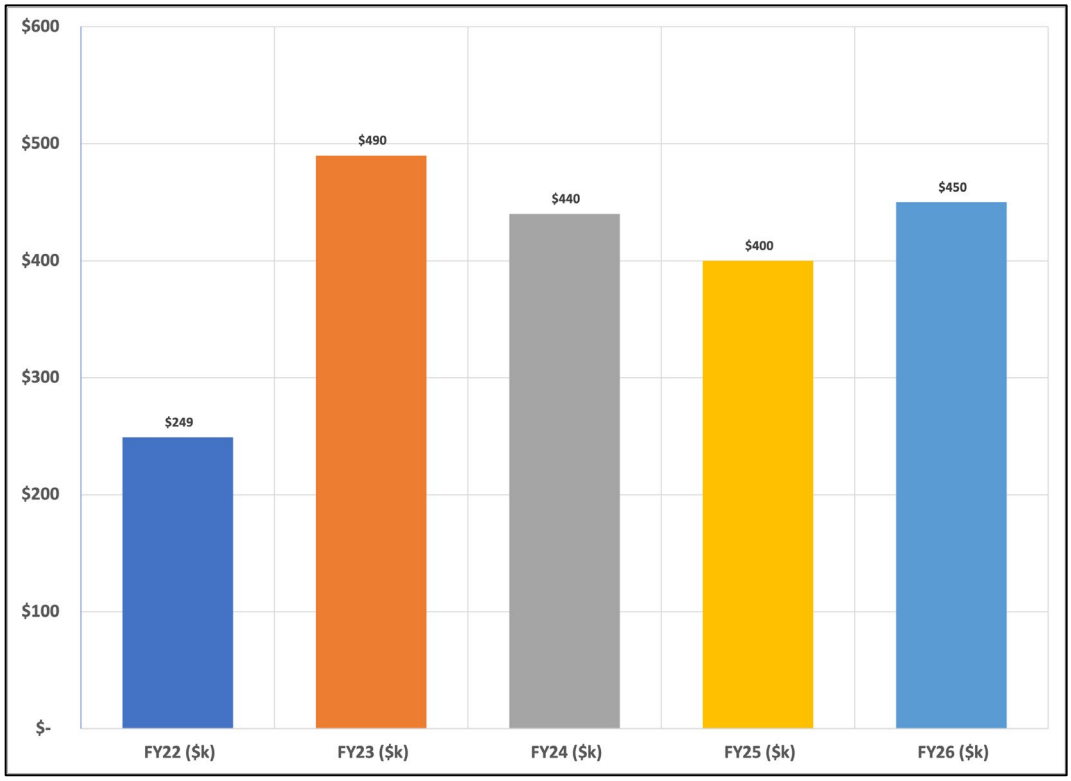
Task Name	ORNL TE11
Collaborators	None
Task Title	Revision of the LA-12808 Nuclear Criticality Safety Guide
Proposal Submitted	FY21
Task Budget (FY22)	$50K
Task Description	ORNL to revise this document to make clarifications and enhancements because of almost 25 years of NCS lessons learned since the last revision.
FY22 Milestones	All 4 Quarters

	o Provide a status report of progress on TE11 in the NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	ORNL TE12
Collaborators	None
Task Title	Design of a Subcritical/Critical Assembly at ORNL for Use with the CSO/FMH Courses
Proposal Submitted	FY21
Task Budget (FY22)	$0K (use FY21 carryover)
Task Description	This is a continuing task based on the results of a feasibility study or preliminary design performed in FY2019. The inclusion of a subcritical assembly located at Oak Ridge National Laboratory allows the CSO/FMH course to be taught near many sites in the eastern United States with CSOs and FHMs. Many sites will not invest travel and labor costs sending CSOs and FMHs to NCS courses and this can be a way to attract as many CSOs and FMHs to the training course. Further, this assembly can be used to offset facility issues at either NCERC or Sandia and can be used to train university students in the southeast United States.
FY22 Milestones	All 4 Quarters o Provide a status report of progress on TE12in the NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	ORNL TE14
Collaborators	Georgia Institute of Technology, Texas A&M University
Task Title	Nuclear Criticality Safety Training and Pipeline Development
Proposal Submitted	FY22
Task Budget (FY22)	$100K
Task Description	Develop a new university-based nuclear criticality training certificate program with the intent to develop a pipeline of nuclear criticality specialists into Department of Energy Laboratory complex. This program will attract students across the United States but will have a regional focus on the Southeastern United States.
FY22 Milestones	All 4 Quarters o Provide a status report of progress in the NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Figure 2.6-5 ORNL TE Budget Trend (FY2022-FY2026)

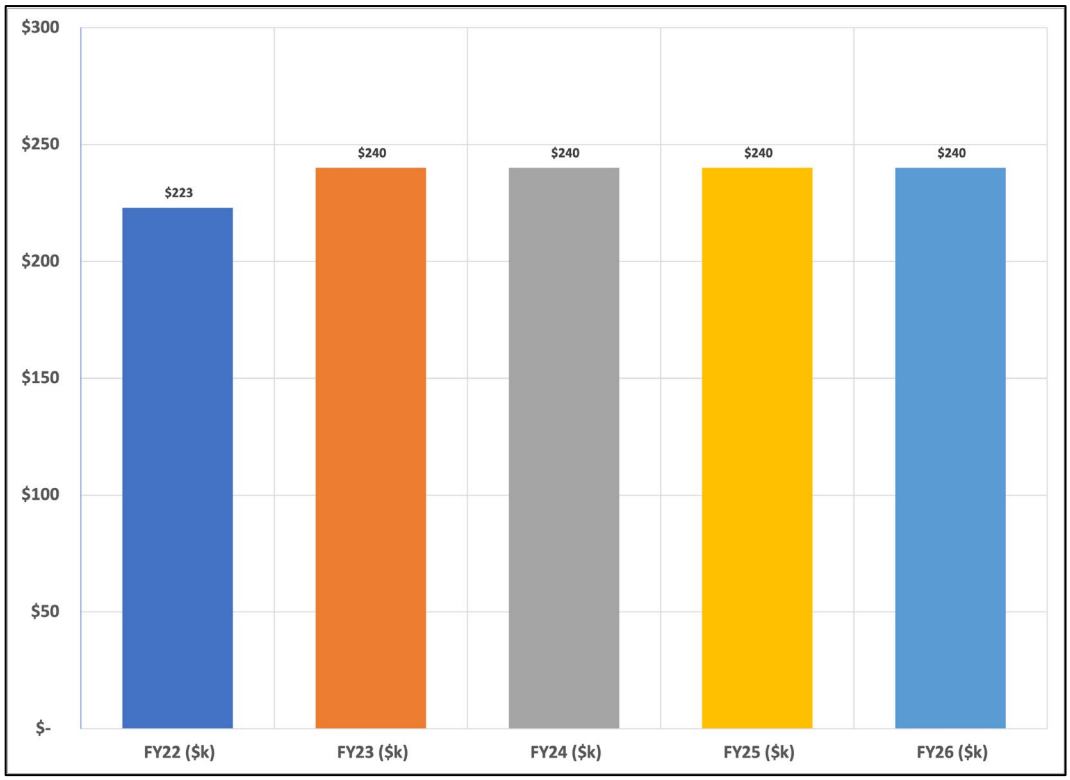


EOC – for out-year peaks and dips in budget plots:
The ORNL TE budget was significantly decreased due to carryover in FY21. The ORNL TE budget increases significantly in FY23 due to restoring typical TE funding to manage the NCSP training and education program and the new NCS training and pipeline development collaboration with GA Tech and Texas A&M. Several tasks are also due to begin starting in FY23 to add to the NCSET NCS library (ORNL-TE6, ORNL-TE7, ORNL-TE8, ORNL-TE13).

2.6.2.4 Sandia National Laboratories (SNL)

Task Name	SNL TE1
Collaborators	IRSN (IRSN-TE1), AWE (AWE-TE1)
Task Title	Prepare for and Conduct Hands-on Criticality Safety Training at SNL
Proposal Submitted	Ongoing
Task Budget (FY22)	$223K
Task Description	This is an ongoing approved task to conduct hands-on criticality safety training classes at SNL according to an integrated schedule developed by ORNL and approved by the NCSP Manager. Provide Human Factors and Equipment Reliability module support to the training class.
FY22 Milestones	All 4 Quarters o Conduct hands-on training classes at Sandia and provide Human Factors and Equipment Reliability module support to the LANL training classes in accordance with the approved schedule. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Figure 2.6-6 SNL TE Budget Trend (FY2022-FY2026)

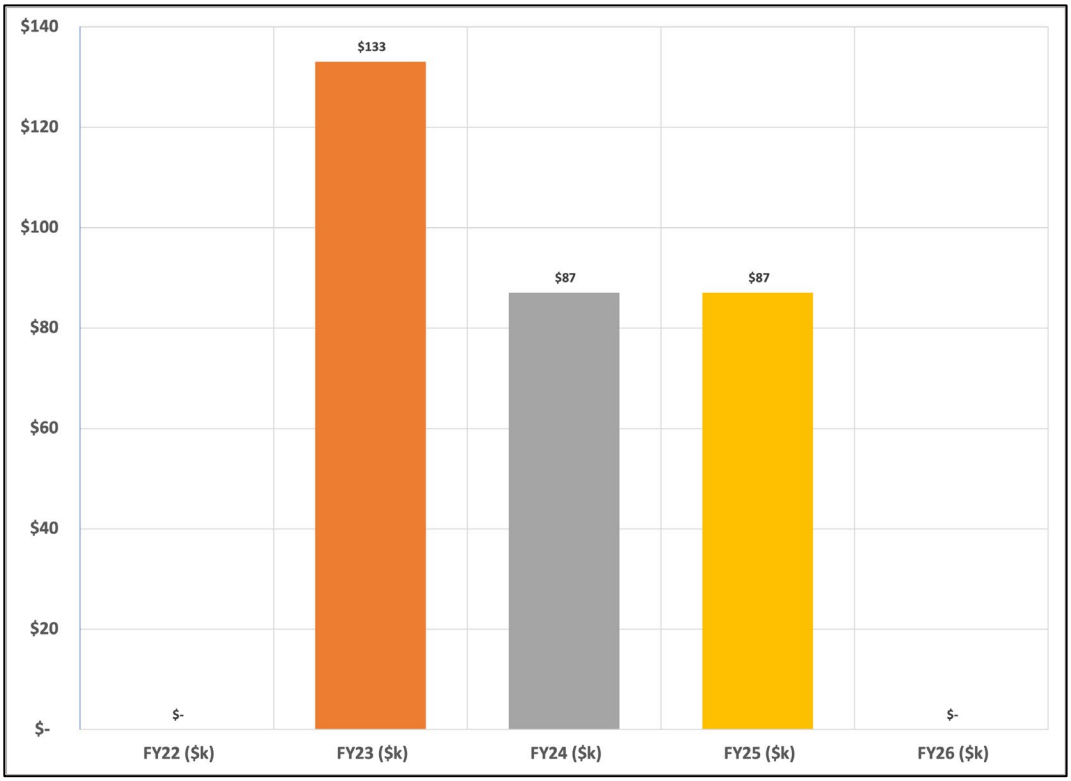


EOC – for out-year peaks and dips in budget plots:
SNL TE budgets are relatively unchanged over the budget period other than a slight increase from FY22 to FY23.

2.6.2.5 Y-12 National Security Complex

Task Name	Y12 TE1
Collaborators	ORNL (ORNL TE9), LLNL (LLNL TE9), LANL (LANL TE7)
Task Title	Conduct Hands-On Criticality Safety Training Course (Lecture support week 1 of 2-week hands-on course and course material development)
Proposal Submitted	Ongoing
Task Budget (FY22)	$0K (use FY21 carryover)
Task Description	This is an ongoing integrated, approved task for Y12 to assist in conducting the current criticality safety training classes at NFO and NCERC (as necessary). This task will also involve assisting with generating new training materials at the NFO classroom portion of the course as necessary.
FY22 Milestones	All 4 Quarters o Provide a status report of Y-12 activities to support the hands-on training courses. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Figure 2.6-7 Y12 TE Budget Trend (FY2022-FY2026)



EOC – for out-year peaks and dips in budget plots:
The Y-12 TE budget for FY22 was eliminated due to excess carryover in FY21. The Y-12 TE budget is restored in FY23 along with the initiation of a new task Y12-TE2. The Y-12 FY26 budget will likely have ongoing training support but it is not currently planned in the current five year task list.

3.0 NCSP Technical Support

NCSP Technical Support to assist the NCSP Management Team in the program management and execution of the NCSP and funding for the succession planning of key program elements as defined in the 10-year Mission and Vision.

Figure 3.1 NCSP Technical Support (FY2022-FY2026) - by Laboratory

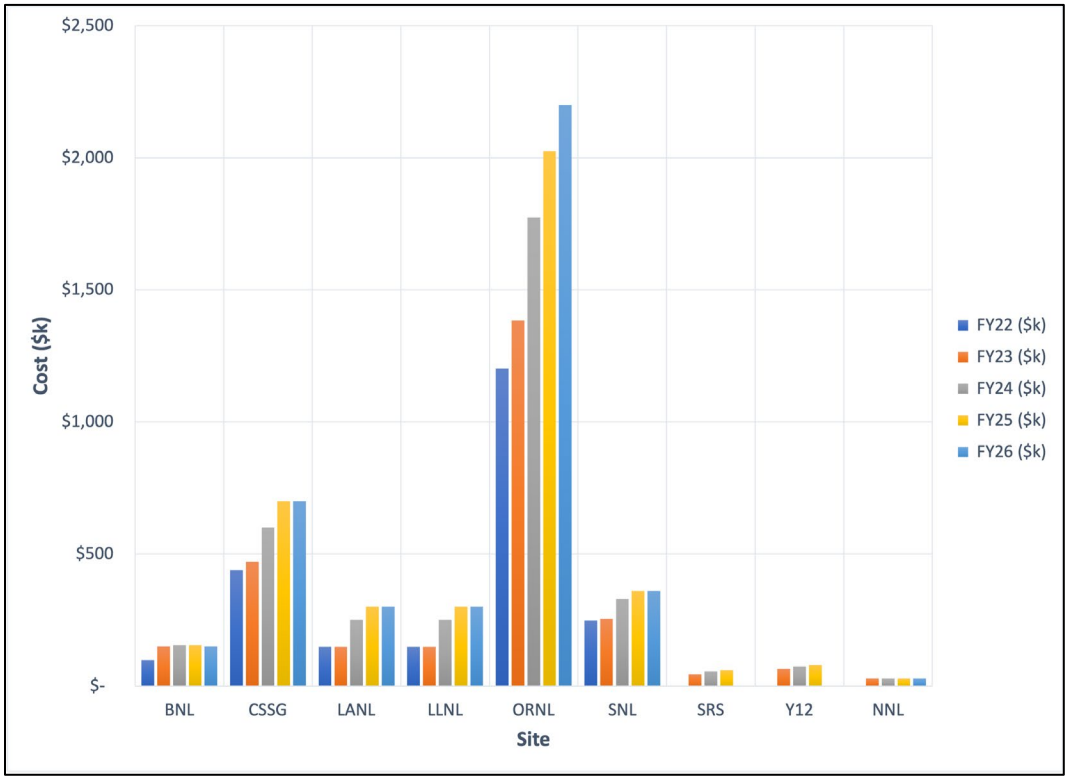
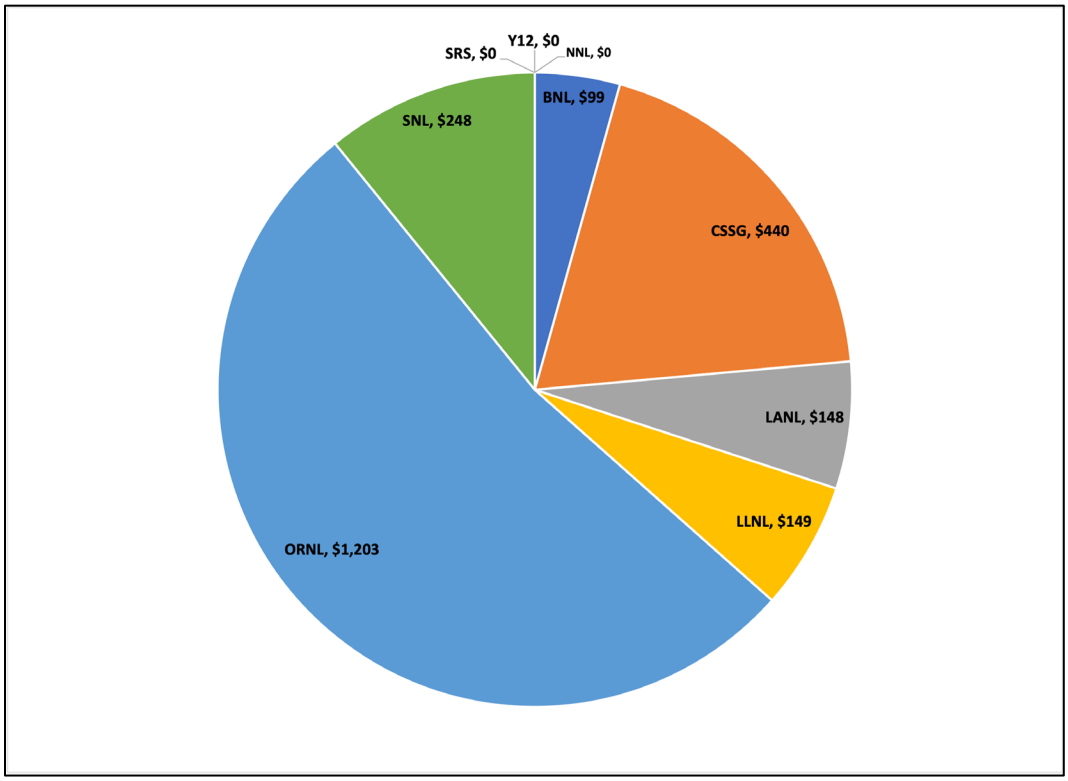


Figure 3.2 NCSP Technical Support (FY2022) - by Laboratory

NCSP Site	FY22 ($k)
BNL	$99
CSSG	$440
LANL	$148
LLNL	$149
ORNL	$1,203
SNL	$248
SRS	$0
Y12	$0
NNL	$0
Grand Total	**$2,287**



Task Name	NCSP TS1													
Collaborators	None													
Task Title	CSSG – Support for the Criticality Safety Support Group													
Proposal Submitted	Ongoing													
Task Budget & Member Costs by Site (FY21)	$440K													
	NCSP MGR	ANL	DOE EM	LANL		LLNL	ORNL						SRS	Y-12
	$0K	$0K	$0K	$60K	$65K	$50K	$35K	$35K	$50K	$5K	$10K	$50K	$50K	$30K
Task Description	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. There are normally 10 CSSG members (periodically there could be additional members to support new member transition and overlap). Only contractor members of the CSSG are modestly funded. One CSSG member is funded by DOE-EM. This is an ongoing approved task to provide Technical Support as tasked by NCSP Manager through approved CSSG Taskings as documented and provided on the NCSP Website.													
FY22 Milestones	All 4 Quarters o Provide a status report of TS1 activities in the NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None													

Task Name	ORNL TS2
Collaborators	None
Task Title	ORNL – Support for Lead Lab to Execute the NCSP
Proposal Submitted	Ongoing
Task Budget (FY22)	$654K
Task Description	Ongoing ORNL task to support the NCSP Management Team in the program management and execution of the NCSP.
FY22 Milestones	All 4 Quarters o Maintain up-to-date spreadsheet of proposed tasks for NCSP Manager after the NCSP proposal review meeting and through the final task prioritization effort by the NCSP Management Team. o Manage 5-year plan development and maintenance and oversee the CEDT process and manage main 5-year plan and Integral Experiment Request Milestones Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 o Organize and lead the Budget Execution Meeting and assist NCSP Manager in finalization of approved tasks for next FY o Publish final Five-Year Plan.

Task Name	SNL TS3
Collaborators	None
Task Title	SNL – Support for Experimentalist Succession Planning
Proposal Submitted	Ongoing
Task Budget (FY22)	$75K
Task Description	In accordance with the ten-year Mission and Vision, the NCSP has identified the need to develop and implement succession plans for key staff expert capabilities to support continued execution of the NCSP Mission. At SNL, there is a need to maintain the integral experiment expertise using the SNL critical experiment capabilities. The work associated with this task is to develop and execute IE Succession Planning for new experimentalists at SNL.
FY22 Milestones	All 4 Quarters o Provide NCSP Manager annual report of succession planning efforts. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	LANL TS4
Collaborators	None
Task Title	LANL – AM, IE, ND Succession Planning
Proposal Submitted	Ongoing
Task Budget (FY22)	$148K
Task Description	In accordance with the ten-year Mission and Vision, the NCSP has identified the need to develop and implement succession plans for key staff expert capabilities to

	support continued execution of the NCSP Mission. There is a need to maintain expertise in the analytical methods, integral experiments and nuclear data capabilities that currently exist at LANL. The work associated with this task is to develop and execute AM, IE, and ND Succession Planning at LANL as defined in the NCSP Mission and Vision document for cross-section processing developers, radiation transport methods developers, experimentalists, and nuclear data evaluators.
FY22 Milestones	All 4 Quarters o Provide NCSP Manager annual report of succession planning efforts. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	LLNL TS5
Collaborators	None
Task Title	LLNL – AM, IE, ND Succession Planning
Proposal Submitted	Ongoing
Task Budget (FY22)	$149K
Task Description	In accordance with the ten-year Mission and Vision, the NCSP has identified the need to develop and implement succession plans for key staff expert capabilities to support continued execution of the NCSP Mission. There is a need to maintain expertise in the analytical methods and integral experiment capabilities that currently exist at LLNL. The work associated with this task is to develop and execute AM and IE Succession Planning at LLNL as defined in the NCSP Mission and Vision document for integral experiment equipment Support, facility support, and radiation transport methods developers.
FY22 Milestones	All 4 Quarters o Provide NCSP Manager annual report of succession planning efforts. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	BNL TS6
Collaborators	None
Task Title	BNL – ND Succession Planning
Proposal Submitted	Ongoing
Task Budget (FY22)	$99K
Task Description	In accordance with the ten-year Mission and Vision, the NCSP has identified the need to develop and implement succession plans for key staff expert capabilities to support continued execution of the NCSP Mission. There is a need to maintain expertise in the nuclear data analysis capabilities that currently exist at BNL. The work associated with this task is to develop and execute ND Succession Planning at BNL as defined in the NCSP Mission and Vision document for nuclear data analysis capabilities needed to support operations at the National Nuclear Data Center.
FY22 Milestones	All 4 Quarters o Provide NCSP Manager annual report of succession planning efforts. Quarter 1 – None Quarter 2 – None

	Quarter 3 – None Quarter 4 – None

Task Name	ORNL TS7
Collaborators	None
Task Title	ORNL – AM, ND Succession Planning
Proposal Submitted	Ongoing
Task Budget (FY22)	$148K
Task Description	Task to address key nuclear data and analytical methods succession planning needs for the NCSP. As part of this task, junior ORNL staff (e.g., post-doctoral staff member or entry-level staff member) will work with key ORNL ND and AM specialists to complete NCSP ND and AM work tasks thereby training the next generation of experts to perform key NCSP nuclear data and analytical methods tasks.
FY22 Milestones	All 4 Quarters o Provide NCSP Manager annual report of succession planning efforts. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	ORNL TS8
Collaborators	None
Task Title	ORNL – NCSP Program Management Tools Development
Proposal Submitted	Ongoing
Task Budget (FY22)	$198K
Task Description	This task continues work initiated in FY2017 to develop a program management tool that will improve the overall efficiency of managing the NCSP. A new IER database has been created and implemented. This funding will be used to maintain the IER database in the G2 system, fix programming errors, and to modestly enhance the system as needed to support IE 5-year plan objectives.
FY22 Milestones	All 4 Quarters o Provide NCSP Manager a status report of progress on the new IER system in G2 in the NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	NNL TS9
Collaborators	None
Task Title	NNL – Support for NDAG Chair activities
Proposal Submitted	Ongoing
Task Budget (FY22)	$0K (Use FY21 Carryover)
Task Description	Provide support for NDAG Chair activities, participate in relevant Working Groups and domestic and international nuclear data meetings as the nuclear data lead for the NCSP, and coordinate NCSP ND element work program with current and future

	DOE needs. Support the development of the 5-year plan by coordinating and planning nuclear data prioritization meetings and working with the NCSP management team for tracking progress nuclear data tasks over the course of the year.
FY22 Milestones	All 4 Quarters o Provide status report on all NDAG chair activities in NCSP Quarterly Progress Reports, Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	SNL TS12
Collaborators	None
Task Title	SNL – NCSP C_EdT Manager Support
Proposal Submitted	Ongoing
Task Budget (FY22)	$173K
Task Description	Activities for this task include integral experiment request (IER) tracking, experimental facility metrics, C_EdT duties, Work for Others tracking/approval, keeping the NCSP management team informed about DAF NCSP activities, 5YP IE plan support, working with task MGRs to submit BCR forms, conduct integral experiment (IE) telecons to track IE NCSP work, availability of NCERC and Sandia critical assemblies for NCSP work, and other tasks at the discretion of NCSP manager or execution manager.
FY22 Milestones	All 4 Quarters o Provide the NCSP manager with a summary of NCSP C_EdT support in the NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	ORNL TS13
Collaborators	None
Task Title	ORNL – NDA Technical Support Group and NDA Technical Infrastructure Project
Proposal Submitted	Ongoing
Task Budget (FY22)	$203K
Task Description	This task involves the creation of an NDA program Mission and Vision document and 5-year plan to initiate a new federal program to resolve criticality safety issues related to fissionable material holdup and other issues related to NDA technology for NCS purposes. A DOE standard, development of ANSI/ANS-8.28 standard for NDA NCS administrative practices, and support for the NDA Technical Support Group (TSG). Sites involved currently are ORNL, SRS, and Y-12. LLNL is currently helping with NDA website development. ORNL will work with NA-50 staff to help lead this task.
FY22 Milestones	All 4 Quarters o Provide the NCSP manager an update of NDA Technical Support Group and NDA Technical Infrastructure Project activities in the NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None

	Quarter 3 – None Quarter 4 – None

Task Name	Y12 TS14
Collaborators	None
Task Title	Y-12 - NDA Technical Support Group and NDA Technical Infrastructure Project
Proposal Submitted	Ongoing
Task Budget (FY22)	$0K (Use FY21 carryover funding)
Task Description	This task involves the creation of an NDA program Mission and Vision document and 5-year plan to initiate a new federal program to resolve criticality safety issues related to fissionable material holdup and other issues related to NDA technology for NCS purposes. A DOE standard, development of ANSI/ANS-8.28 standard for NDA NCS administrative practices, and support for the NDA Technical Support Group (TSG). Sites involved currently are ORNL, SRS, and Y-12.
FY22 Milestones	All 4 Quarters o Provide the NCSP manager an update of NDA Technical Support Group and NDA Technical Infrastructure Project activities in the NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

Task Name	SRS TS15
Collaborators	None
Task Title	SRS - NDA Technical Support Group and NDA Technical Infrastructure Project
Proposal Submitted	Ongoing
Task Budget (FY22)	$0K (Use FY21 carryover funding)
Task Description	This task involves the creation of an NDA program Mission and Vision document and 5-year plan to initiate a new federal program to resolve criticality safety issues related to fissionable material holdup and other issues related to NDA technology for NCS purposes. A DOE standard, development of ANSI/ANS-8.28 standard for NDA NCS administrative practices, and support for the NDA Technical Support Group (TSG). Sites involved currently are ORNL, SRS (TSG Chair), and Y-12.
FY22 Milestones	All 4 Quarters o Provide the NCSP manager an update of NDA Technical Support Group and NDA Technical Infrastructure Project activities in the NCSP Quarterly Progress Reports. Quarter 1 – None Quarter 2 – None Quarter 3 – None Quarter 4 – None

APPENDIX A: Work Authorization Statements for Nuclear Criticality Safety Program Funding for Execution Year FY2021

Provided to the NA-50 Budget Office in August 2021

Brookhaven National Laboratory (BNL): $414K
Task: Nuclear Data

Reflects funds to continue supporting nuclear data activities, including shepherding new data evaluations through the Cross-Section Evaluation Working Group (CSEWG) process, subsequent publication of these data in the United States Evaluated Nuclear Data File (ENDF), and nuclear data succession planning, as delineated in the Nuclear Criticality Safety Program (NCSP) FY22 Five-Year Plan, or as directed by the NCSP Manager.

BNL POC: David Brown (631-344-2814), dbrown@bnl.gov
DOE POC: Angela Chambers, NNSA (806-573-6407), Angela.Chambers@nnsa.doe.gov

Los Alamos National Laboratory (LANL): $12,958K (Rev. 1 update: $13,058K, Rev.3 update: $12,608K)
Tasks: Analytical Methods, Integral Experiments, Nuclear Data, Training and Education, and the Criticality Safety Support Group

Reflects funds to continue analytical methods; integral experiments; nuclear data; and training and education support, as delineated in the Nuclear Criticality Safety Program (NCSP) FY22 Five-Year Plan, or as directed by the NCSP Manager; succession planning for cross-section processing developers, radiation transport developers, experimentalists, and/or nuclear data developers/evaluators; and for participation in the Criticality Safety Support Group (CSSG), as it provides technical support to the NCSP Manager regarding planning and execution of the NCSP.

LANL POC: Joetta Goda (505-667-2812), jgoda@lanl.gov
DOE POC: Angela Chambers, NNSA (806-573-6407), Angela.Chambers@nnsa.doe.gov

Lawrence Livermore National Laboratory (LLNL): $3,916K (Rev. 1 update: $3,766K)
Tasks: Analytical Methods, Information Preservation and Dissemination, Integral Experiments, Nuclear Data, Training and Education, and the Criticality Safety Support Group

Reflects funds to continue support for analytical methods; information preservation and dissemination; integral experiments; nuclear data; training and education, as delineated in the Nuclear Criticality Safety Program (NCSP) FY22 Five-Year Plan, or as directed by the NCSP Manager; succession planning for equipment support, facility support, and/or radiation transport developers; and for participation in the Criticality Safety Support Group (CSSG), as it provides technical support to the NCSP Manager regarding planning and execution of the NCSP.

LLNL POC: Catherine Percher (925-423-9345), percher1@llnl.gov
DOE POC: Angela Chambers, NNSA (806-573-6407), Angela.Chambers@nnsa.doe.gov

Nevada National Security Site (NNSS): $3,491K (Rev. 3 update: $4,177K)
Task: Integral Experiments, Analytical Methods, and Nuclear Data Support

Reflects funds for MSTS (NNSS) continue support for integral experiments and training and education tasks as delineated in the Nuclear Criticality Safety Program (NCSP) FY22 Five-Year Plan.

NNSS POC: Sylvia Wright-Reader (702-2950597), WrightSD@nv.doe.gov
DOE POC: Angela Chambers, NNSA (806-573-6407), Angela.Chambers@nnsa.doe.gov

Naval Nuclear Laboratory (NNL): ($0K)
Task: NDAG Chair Support

Reflects funds NNL to provide NDAG chair support. Funds will be sent to the NNL M&O partner, Fluor Marine Propulsion (FMP).

NDAG Chair funds for Mike Zerkle at NNL - $29K.

NNL POC: Tim Trumbull (518-395-5203), timothy.trumbull@unnpp.gov
DOE POC: Angela Chambers, NNSA (806-573-6407), Angela.Chambers@nnsa.doe.gov

Oak Ridge National Laboratory (ORNL): $6,364K (Rev. 3 update: 6,128K)
Tasks: NCSP Technical Support, Analytical Methods, Information Preservation and Dissemination, Integral Experiments, Nuclear Data, and Training and Education

Reflects funds to continue support for analytical methods; information preservation and dissemination; integral experiments; nuclear data; and training and education, as delineated in the Nuclear Criticality Safety Program (NCSP) FY22 Five-Year Plan, or as directed by the NCSP Manager; Technical Support for NCSP management; and for succession planning for cross-section processing developers, radiation transport developers, and/or nuclear data evaluators/experimentalists/developers, and for support to the Criticality Safety Support Group (CSSG).

ORNL POC: Douglas G. Bowen (865-576-0315), bowendg@ornl.gov
DOE POC: Angela Chambers, NNSA (806-573-6407), Angela.Chambers@nnsa.doe.gov

Pacific National Northwest Laboratory (PNNL): $170K
Tasks: NCSP Analytical Methods, Integral Experiments

Reflects funds to continue support for analytical methods and integral experiments as discussed in the Nuclear Criticality Safety Program (NCSP) FY22 Five-Year Plan, or as directed by the NCSP Manager.

PNNL POC: Travis Zipperer (206-528-3474), travis.zipperer@pnnl.gov
DOE POC: Angela Chambers, NNSA (806-573-6407), Angela.Chambers@nnsa.doe.gov

Rensselaer Polytechnic Institute (RPI): ($471K)
Task: Nuclear Data Support at RPI

Reflects funds to conduct differential measurements as delineated in the Nuclear Criticality Safety Execution (NCSP) FY22 Five-Year Plan and continue work, as defined in the RPI LINAC 2022 Nuclear Data Capabilities Maintenance Plan, or as directed by the NCSP Manager. Funds will be sent to the NNL M&O partner, Fluor Marine Propulsion (FMP).

RPI POC: Yaron Danon (518-276-4008), danony@rpi.edu
NNL POC: Tim Trumbull (518-395-5203), timothy.trumbull@unnpp.gov
DOE POC: Angela Chambers, NNSA (806-573-6407), Angela.Chambers@nnsa.doe.gov

Sandia National Laboratories (SNL): $1,488K (Rev. 3 update: $1738K)
Tasks: Integral Experiments and Training and Education

Reflects funds to continue support for integral experiments; training and education; C_EdT Manager Support, and succession planning for experimentalists as, delineated in the Nuclear Criticality Safety Program (NCSP) FY22 Five-Year Plan or as directed by the NCSP Manager.

SNL POC: Gary Harms (505-845-3244), gaharms@sandia.gov
DOE POC: Angela Chambers, NNSA (806-573-6407), Angela.Chambers@nnsa.doe.gov

Savannah River Site (SRS): $60K
Tasks: Information Preservation and Dissemination and the Criticality Safety Support Group

Reflects funds to update and maintain ARH-600 as delineated in the Nuclear Criticality Safety Program (NCSP) FY22 Five-Year Plan, or as directed by the NCSP Manager, to support the NDA Technical Support Group and NDA Technical Infrastructure Project, and for participation in the CSSG, as it provides technical support to the NCSP Manager regarding planning and execution of the NCSP.

SRS POC: David Erickson (803-557-9445), david.erickson@srs.gov
DOE POC: Angela Chambers, NNSA (806-573-6407), Angela.Chambers@nnsa.doe.gov

Y-12 National Security Complex (Y-12): $105K
Tasks: Training and Education, Nuclear Data, and the Criticality Safety Support Group

Reflects funds to support the training and education program, the fabrication of a uranium target needed for nuclear data measurements, the design of integral experiments involving systems with enriched uranium, chlorine, and lithium-6, and the study of a solution reactor design in collaboration with IRSN, as delineated in the Nuclear Criticality Safety Program (NCSP) FY22 Five-Year Plan, or as directed by the NCSP Manager. Further, an additional task is funded for general NCSP and CSSG support, as required.

Y-12 POC: Kevin Reynolds (865-241-9067), keven.reynolds@cns.doe.gov
DOE POC: Angela Chambers, NNSA (806-573-6407), Angela.Chambers@nnsa.doe.gov

NCSP Manager: CSSG Hold Back – $0K
Reflects DOE HQ Hold Back for the CSSG that will be held as HQ reserve funds.

DOE POC: Angela Chambers, NNSA (806-573-6407), Angela.Chambers@nnsa.doe.gov

APPENDIX B: Nuclear Data Priorities, Basis Statements, and Milestones

Nuclear Data Measurements							
Materials	**Pre-FY2022**	**FY2022**	**FY2023**	**FY2024**	**FY2025**	**FY2026**	**Post-FY2026**
Cesium (^{133}Cs)			LANL	LANL	LANL		
Basis	^{133}Cs is an important fission product for burnup credit. Cross sections have been identified as inadequate (ORNL/TM-2005/65). The DICER and DANCE instruments will be used at LANSCE to provide necessary data to support a new evaluation. (Contingent on Funding)						
Chlorine (^{35}Cl)			ORNL	ORNL			
			LANL	LANL			
Basis	Measurement of the ^{35}Cl (n,p) cross section from thermal to 100 keV using LENZ at LANL. Chlorine is present in fuel cycle facilities in Pu solutions, electrorefining processes, chloride salts, and as brine/drift in some repository environments. Improved ^{35}Cl (n,p) cross sections needed for poison credit in these in these environments. A need for improved ^{35}Cl cross sections has been specifically identified at LANL and Y-12. (Contingent on Funding)						
Chromium (^{53}Cr)	RPI						
Chromium (^{50,53}Cr)				ORNL			
Basis	Measurement of the ^{53}Cr neutron capture cross section in the 2-10 keV energy range is needed to resolve discrepancies observed in historical fast assembly benchmarks containing stainless steel. The RPI measurement will address data request by CSEWG and IAEA. ORNL will measure ^{50,53}Cr neutron capture below 10 keV at GELINA using diluted samples to reduce or minimize multiple scattering and neutron sensitivity effects impacting prior measurements. Cr50 data over the RR range are needed.						
Fluorine (^{19}F)				ORNL	ORNL		
				IRSN	IRSN		
Basis	Measurement of the ^{19}F inelastic scattering reaction channels at GELINA that appear to be underestimated in the current evaluation. Analysis and evaluation of the angular distributions in the RRR. Errors in fluorine may be contributing to bias in ^{233}U benchmarks. Fluorine is used in the uranium enrichment process and molten salt reactor coolants.						
Iodine						RPI	
Basis	Measurement of neutron capture cross section of Iodine at RPI needed to resolve large discrepancies in simulations of large NaI detectors used for neutron capture cross section measurements. Will also support improved modeling of NaI gamma detectors in neutron fields for other DOE and DOD applications.						
Iron (^{54}Fe)	RPI	RPI					
	IRSN	IRSN					
Basis	Measurement of the neutron capture cross section for ^{54}Fe in the keV energy range at RPI is needed to support development of consistent Fe cross section evaluations. Recent measurement and evaluation work on ^{56}Fe has highlighted the need for new measurements and evaluation for ^{54}Fe. Iron is a ubiquitous element used in reactor, fuel cycle facility, spent fuel storage, and radiation shielding applications. IRSN is interested in this measurement as well.						
Molybdenum (^{95}Mo)					RPI	RPI	RPI
					NNL	NNL	NNL
	LANL						
	IRSN						
Basis	Measurement of neutron capture in ^{95}Mo in resonance range, URR at RPI. Neutron transmission measurements previously completed at RPI. ^{95}Mo is a stable fission product and the primary absorbing nuclide in natural Molybdenum. Molybdenum isotopes are currently encountered in irradiated fuel as fission products or in molybdenum alloys in research reactors and space reactors. The current primary interest in NCS is for fission product credit for transport casks, irradiated fuel storage, and reprocessing plants (UPu-MoZr deposits in French reprocessing plant equipment for example). Needs identified by NR and IRSN for fission product credit and Y-12 for U-Mo applications (lower priority). Isotopically enriched sample required. LANL completed analysis of existing high-quality ORELA capture and transmission data in the resolved and unresolved resonance regions. RPI/NNL to reassess the						

Nuclear Data Measurements							
Materials	**Pre-FY2022**	**FY2022**	**FY2023**	**FY2024**	**FY2025**	**FY2026**	**Post-FY2026**
	needs for addition measurements once the RPI LINAC returns to operation following the upgrade.						
Neptunium (^{237}Np)					ORNL	ORNL	ORNL
					LANL	LANL	LANL
Basis	Measurement of ^{237}Np nuclear data at LANL. ^{237}Np is an actinide of interest in nuclear criticality safety for applications at ORNL and other sites. Applications include ^{238}Pu production w/ HFIR at ORNL (low NCSP priority) and fast burst reactor for LANL. Nuclear data improvements will improve critical mass estimates. On the HPRL there is a request for fission cross section in the energy range from 200 keV to 20 MeV. The application list was fast systems, and the required accuracy is 1.5-4%. This requirement comes from the desire to improve the current low accuracy in the covariance matrix (6-8%). (Note that LANL Measurement is Contingent on Funding)						
Plutonium (^{239}Pu)			LANL	LANL	LANL		
			IRSN	IRSN	IRSN		
Basis	There has been a recent IRSN request for a new measurement of the ^{239}Pu neutron total cross section at low neutron energies to better enable a new resonance evaluation of the plutonium isotopes. This evaluation work is concentrated on the evaluation of ^{239}Pu to improve benchmark calculations for thermal plutonium solutions, which remain problematic despite much work over the years. While transmission (total cross section) data are available in the low-energy region, the majority of these data are not of the quality needed to inform the resonance evaluation. Capabilities afforded by the new DICER (Device for Indirect Capture Experiments on Radionuclides) instrument at LANSCE (Los Alamos) promise higher-quality data to support the evaluation work.						
Plutonium (^{240}Pu)	LANL	LANL					
	LLNL	LLNL					
Basis	Measure ^{240}Pu prompt fission neutron energy spectra (PFNS) with Chi-Nu detector at LANL (LANCSE/WNR). The need for more accurate PFNS has been recognized. Supports applications with WG Pu and reactor grade Pu. This is a joint LANL/LLNL measurement.						
Samarium (^{151}Sm)							LANL
Basis	^{151}Sm is an important fission product for burnup credit. Cross sections have been identified as inadequate (ORNL/TM-2005/65). The DICER and DANCE instruments will be used at LANSCE to provide necessary data. (Contingent on Funding)						
Strontium (^{86,87}Sr)						ORNL	ORNL
Basis	Enriched ^{86,87}Sr transmission and capture measurements at GELINA are needed to supplement existing ^{88}Sr ORNL measurements to support complete RR evaluation for natural strontium isotopes for ENDF/B. ^{86,87}Sr are minor isotopes representing about 18% of natural strontium.						
Uranium (^{233}U)	LANL	LANL		LANL	LANL	LANL	
Basis	^{233}U neutron capture measurements in resonance range and the unresolved fast energy range at the Lujan center at LANCE/LANL using the DANCE detector. ORNL report on ^{233}U data assessment concluded that a new evaluation with revised (renormalized) fission cross section is needed. After re-evaluation of the ^{233}U, new capture cross section measurements (resonance region) may be needed to support this evaluation. NCS applications at LANL (CMR), ORNL, DAF/NCERC, spare unirradiated LWBR modules at INL. LANL will measure capture cross section using the DANCE detector multiplicity features in FY20-FY22. Prompt fission neutron spectra will be measured at LANSCE / Chi-Nu in FY24-FY26 (subject to available funding).						
Uranium (^{236}U)						ORNL	ORNL
Basis	^{236}U high-resolution transmission measurements in the RRR at GELINA or LANL to complement recent LANL fast energy evaluation. ^{236}U is a minor activation product present in HEU. Improved ^{236}U cross section evaluation supports all DOE programs using HEU.						
Vanadium (^{51}V)				ORNL	ORNL		
Basis	Recent vanadium measurements showed large multiple scattering corrections needed to be accounted for neutron energies below 10 keV. Additional measurements are needed at GELINA possible using diluted samples on order to reduce or minimize the neutron sensitivity to experimental setup. Vanadium is used in some fissile material containers.						

Nuclear Data Measurements							
Materials	**Pre-FY2022**	**FY2022**	**FY2023**	**FY2024**	**FY2025**	**FY2026**	**Post-FY2026**
Zirconium ($^{90,91,92,94,96}Zr$)	ORNL	ORNL	ORNL	ORNL			
Basis	Neutron capture and possibly transmission measurements in resonance range at GELINA. Old ORELA transmission data on enriched isotopes are available for analysis. Isotopically enriched samples are required. Zirconium is a key structural element that is primarily used in cladding for fuel rods and is currently in consideration for use with advanced nuclear fuel matrices in the form of zirconium hydride. The main application is reactor fuel cladding. ^{nat}Zr transmission and capture measurements were recently completed by ORNL. NR continues to be unsatisfied with Zr evaluations in ENDF.						
Polystyrene (C_8H_8)	ORNL	ORNL					
	RPI						
Basis	Polystyrene is a moderator material found in several thermal systems (PCT001, PCT02, MCT012, MCT013, MCT014, MCT016). Currently, polyethylene is used as a surrogate to represent thermal scattering in polystyrene in neutron transport simulations. This SNS measurement and evaluation will determine the validity of this approximation, as well as inform future substitutions for other hydrocarbons found in benchmarks. RPI will perform subthermal transmission measurements to support this TSL evaluation.						
Polyethylene (C_2H_4)	RPI						
Basis	Polyethylene is a ubiquitous moderator material used in critical assemblies, shipping containers and fuel cycle facilities. RPI will perform subthermal transmission measurements to support TSL evaluation validation.						
Yttrium Hydride (YH_x)	RPI	RPI					
Basis	Yttrium hydride is an advanced high temperature moderator used in advanced reactor designs. RPI performed subthermal transmission measurements to support TSL evaluation validation as part of the subthermal transmission target development.						

List Legend	ORNL	RPI	LANL	LLNL/NCSU	IRSN	NNL	BNL

Nuclear Data Evaluations							
Materials	**Pre-FY2022**	**FY2022**	**FY2023**	**FY2024**	**FY2025**	**FY2026**	**Post-FY2026**
Beryllium (^{9}Be)		LANL	LANL	LANL	LANL	LANL	
Basis	Be-9 evaluations continue to be challenged by benchmark critical experiments. See pg. 167 of the ENDF/B-VIII.0 report. The accompanying text indicates "there is considerable spread in these Be assembly results." The ENDF/B-VIII.0 evaluation of Be-9 carried over cross sections from ENDF/B-VII.1 but adopted JENDL-4.0 evaluations of elastic scattering angular distribution and (n,2n) angular and energy distributions. This leaves a less-than-satisfactory inconsistency between the elastic angular distributions and integrated cross sections that should be resolved. The proposed approach is to employ a new representation of the four-body (2n,2 alpha) breakup channel in the R-matrix analysis.						
Cerium (Ce)	ORNL						
Basis	Neutron transmission and capture of ^{142}Ce in the resonance range. Cerium is an element that is predominately ^{140}Ce (88.450 a/o) and ^{142}Ce (11.114 a/o) and can be found in chemical processing streams because it is commercially used as a catalyst or additive for chemical applications (e.g., glass polishing powder). As a result, cerium appears as an admixed material in process streams. ^{142}Ce is also a stable fission product. Ce has been identified by DOE-EM as a parasitic absorber in Hanford waste processing. DOE-EM requested improved cerium cross sections to support poison credit in NCS analyses.						
Chlorine (^{35}Cl)			ORNL	ORNL	ORNL		
Basis	Revise ^{35}Cl resonance evaluation based on ^{35}Cl(n,p) measurements. Chlorine is present in fuel cycle facilities in Pu solutions, electrorefining processes, chloride salts, and as brine/drift in some repository environments. Improving ^{35}Cl(n,p) cross sections needed for poison credit in these environments. A need for improved ^{35}Cl cross sections has been specifically identified at LANL and Y-12. When measured (n,p) data from nTOF will be available, a new fit to include those can data can be performed together with any new available measurements from LANL						
Chromium (^{50,53}Cr)				ORNL	ORNL	ORNL	
Basis	Measurement and evaluation of ^{50,53}Cr neutron capture cross section below 10 keV energy range is needed to resolve discrepancies observed in historical fast assembly benchmarks containing stainless steel. ORNL will measure ^{50,53}Cr neutron capture below 10 keV at GELINA using diluted samples to reduce or minimize multiple scattering and neutron sensitivity effects impacting prior measurements. Cr50 data over the RR range is needed. The cluster of s-wave resonances (mainly for ^{53}Cr) in the neutron energy region between 1-10 keV is the major update to be performed in the ENDF/B-VIII.0 library. As in the current release the magnitude of the capture cross sections is inconsistent with benchmark calculations.						
Copper (^{63,65}Cu)	ORNL	ORNL					
		LANL	LANL	LANL			
Basis	A revised evaluation of copper isotopes is needed to improve the benchmark performance above 100 keV up to 300 keV. This will include a statistical analysis of the resonance parameters above 100 keV to quantify the impact of the missing resonances in the measured data as well as a guidance in the level spin assignment. Due to the importance of the copper being used in critical assembly applications as reflector, additional work on the angular distributions is needed. Moreover, since benchmark sensitivity extends above 300 keV, a careful analysis of the high energy cross sections is needed. With the adopted corrections described above, further analyses will be devoted to quantifying the impact of the angular distributions in the RRR on benchmarks calculations and neutron scattering measurements.						
Fluorine (^{19}F)				ORNL	ORNL	ORNL	
				IRSN	IRSN	IRSN	
Basis	The evaluation of the ^{19}F inelastic scattering reaction channel is needed since it appears to be underestimated in the current ENDF/B-VIII.0 evaluation. Further analyses and related evaluation of the angular distributions in the RRR are needed. Since fluorine is used in the uranium enrichment process and molten salt reactor coolants, errors in the ^{19}F evaluated data may be contributing to bias in ^{233}U benchmarks.						

Nuclear Data Evaluations							
Materials	**Pre-FY2022**	**FY2022**	**FY2023**	**FY2024**	**FY2025**	**FY2026**	**Post-FY2026**
Hafnium (^{176,177,178,179,180}Hf)	ORNL	ORNL	ORNL	ORNL			
	IRSN	IRSN	IRSN	IRSN			
	NNL	NNL	NNL	NNL			
Basis	Hafnium is a neutron poison used in reactor and fuel cycle applications. IRSN, ORNL and NNL will review the existing Hf RRR and URR evaluations and develop new evaluations if needed to improve agreement with the TEX HEU/Hf experiment. New isotopic measurements needed to make desired improvement.						
Iron (^{54,56,57}Fe)	ORNL	ORNL	ORNL				
	IRSN	IRSN	IRSN				
	BNL	BNL	BNL				
Basis	Although the effort on the Fe isotopes was planned as joint effort between ORNL and IRSN, IRSN mainly led the evaluation effort and it is unclear the status of this set of evaluations. The ORNL contribution to ^{56}Fe was the generation of a preliminary ENDF file solving the problem with the benchmark performance. However, a rigorous evaluation work is still needed for the three major isotopes mainly for the assessment of the inelastic scattering reaction channel. ORNL will revise the ^{54}Fe, ^{56}Fe, and ^{57}Fe resonance evaluations. BNL also participating under DOE-SC funding.						
Iron (^{56}Fe)	ORNL	ORNL	ORNL				
	IRSN	IRSN	IRSN				
	BNL	BNL	BNL				
Basis	Revise high energy resonance region evaluation. Iron is a key element of structural materials in the DOE Complex (e.g., steel) and is used in many configurations (e.g., tanks, piping, admixed material that can serve as neutron absorber, etc.). ^{56}Fe has numerous resonances above the evaluated resonance range, extending far above the threshold for the first inelastic state. Currently, the latest ^{56}Fe evaluation in the ENDF/B data files does not have detailed resonance parameters here; rather, the evaluation provides a pointwise representation. The ^{56}Fe resonance evaluation will significantly improve radiation transport calculations for systems involving iron (i.e., critical benchmark analyses and criticality safety analyses of processes in the DOE Complex). Evaluation work was performed at IRSN in the past but was not apparently included in ENDF (this will be reviewed and considered for inclusion in ENDF). BNL also participating under DOE-SC funding.						
Lanthanum (La)	ORNL	ORNL					
Basis	^{139}La resonance range evaluation based on ^{nat}La measurements. Lanthanum is an element that is predominantly ^{139}La (99.910 a/o) and a stable fission product. The primary NCS interest is for fission product credit. In the latest version of ENDF nuclear data library, the resonance analysis is based on parameters obtained with an experimental set up which is known to have certain problems. Currently, ENDF/B-VIII evaluations for La do not have adequate covariance data based on experimental data. Improved covariance data are needed to support sensitivity/uncertainty analyses for fission product credit applications.						
Lead (^{204,206,207,208}Pb)	ORNL	ORNL	ORNL				
	RPI	RPI	RPI				
	BNL	BNL	BNL				
	NNL	NNL	NNL				
	IRSN	IRSN	IRSN				
Basis	Lead is a ubiquitous material in the nuclear industry. Lead possesses not only high photon attenuation properties, which make it almost a universal choice as a gamma-ray shielding material, but also desirable neutronic qualities. Our ability to match experimental data with Pb (reflectors and as a scattering target) is less that we desire. Pb-208 is the majority isotope of natural lead. The current ENDF evaluation is known to suffer from deficiencies in neutron angular distributions. The emphasis of the re-evaluation work is on these angular distributions. We will judge success of this work based on recent semi-integral measurements performed at RPI. ORNL proposed to revisit RRR to address angular distribution concerns. RPI/BNL/NNL/IRSN also have a NE funded collaboration to evaluate Pb at energies relevant to fast reactors.						

Nuclear Data Evaluations							
Materials	**Pre-FY2022**	**FY2022**	**FY2023**	**FY2024**	**FY2025**	**FY2026**	**Post-FY2026**
Lithium (^{6}Li)	LANL	LANL	LANL	LANL			
Basis	The Li-6 evaluation in ENDF/B-VIII.0 was based on a combination of EDA R-Matrix fits to all reactions open in the Li-7 system up to ~ 4 MeV, influenced by the standards GMA 2017 result for the (n,t) reaction, and ENDF/B-VII.1 values above ~4 MeV. Li-6 is important for a number of reasons, including as a detector (and reference) in experiments, for example, for Chi-Nu measurement of prompt fission neutron spectra. It is important to extend the R-Matrix analysis to the full 20 MeV range for better precision and more complete (covariance information) at the important lower energy scale of a few MeV. Supports need at Y-12 for the new electrorefining process.						
Molybdenum (^{95}Mo)			IRSN	IRSN	IRSN		
Basis	Resonance region evaluation. ^{95}Mo is a stable fission product and the primary absorbing nuclide in natural molybdenum. Molybdenum isotopes are currently encountered in irradiated fuel as fission products or in molybdenum alloys in research reactors and space reactors. Current primary interest for NCS is for fission product credit for transport casks, irradiated fuel storage, and reprocessing plants (UPu-MoZr deposits in reprocessing plant equipment for example). Needs identified by NR and IRSN for fission product credit and Y-12 for U-Mo applications (lower priority).						
Neptunium (^{237}Np)				ORNL	ORNL		
				LANL	LANL		
Basis	Fast and RRR/URR evaluation. ^{237}Np is an actinide of interest in nuclear criticality safety for applications at ORNL and other sites. Applications include ^{238}Pu production w/ HFIR (low NCSP priority) and fast burst reactor for LANL. Nuclear data improvements will improve critical mass estimates. On the HPRL there is a request for fission cross section in the energy range from 200 keV to 20 MeV. The application list was fast systems, and the required accuracy is 1.5-4%. This requirement comes from the desire to improve the current low accuracy in the covariance matrix (6-8%). ORNL to provide RRR/URR evaluation and LANL the fast energy range evaluation.						
Nitrogen (^{14}N)		ORNL	ORNL	ORNL			
	Nitrogen cross section are important in the reprocessing process and related analyses. Nitrogen was recently included as action item in the series of INDEN meetings for light nuclei evaluations. In the ENDF/B-VIII.0 library there are no resonance parameters for nitrogen.						
Oxygen (^{16}O)		LANL	LANL	LANL	LANL	LANL	
Basis	^{16}O is a pervasive isotope in criticality safety applications, including as a component of water or a component of fissile material. Challenges related to fidelity of ^{16}O evaluations have persisted for decades in validation studies. Extending high-fidelity R-Matrix analysis to higher incident neutron energies should help address these issues.						
Plutonium (^{238}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu)		LANL	LANL		LANL	LANL	
Basis	Minor isotopes of plutonium are always a part of the overall material. It is therefore important that appropriate attention be given to their nuclear data, especially fission data. Los Alamos has committed to consistent evaluations across isotopes. Develop consistent nu-bar evaluation supported by a model code to provide better evaluated nu-bar for minor Pu-isotopes in FY22-FY23. Develop consistent PFNS evaluation supported by a model code to provide better evaluated PFNS for minor Pu-isotopes in FY25-FY26.						

Nuclear Data Evaluations							
Materials	**Pre-FY2022**	**FY2022**	**FY2023**	**FY2024**	**FY2025**	**FY2026**	**Post-FY2026**
Plutonium (^{239}Pu)	LANL	LANL					
	ORNL	ORNL	ORNL	ORNL			
		IRSN	IRSN	IRSN			
Basis	^{239}Pu is one of the three major fissile isotopes of interest in Nuclear Criticality Safety. ^{239}Pu is used at LANL, LLNL, Hanford, SRS, and other locations in sufficient quantities to be an NCS concern. ^{239}Pu is a major factor in countless ICSBEP benchmarks. NCSP driver includes inadequate agreement of computations with PU-SOL-THERM benchmarks (biased high). Major experimental campaigns at LANSCE for ^{239}Pu fission cross section and PFNS are nearing conclusion and the resulting data need to be incorporated into an updated evaluation. ORNL to assist with evaluation work. ORNL and IRSN will collaborate on a review of existing RRR and URR evaluation data and prepare new RRR/URR evaluations that will improve agreement with TEX Pu experimental results.						
Plutonium (^{240}Pu)				ORNL	ORNL		
		LANL	LANL	LANL			
Basis	^{240}Pu is a meaningful component of almost all Pu benchmark experiments, and a significant component in some. This isotope is the next major constituent of plutonium and can reach 20% or more enrichment in reactor fuel. Some changes were made in ENDF/B-VIII.0, but there have been no accurate prompt fission spectra measurements previously. Such experiments, and subsequent re-evaluation will benefit criticality safety analysis for MOX fuel reprocessing, fabrication and disposal. LANL will evaluate the ^{240}Pu PFNS based on recent Chi-Nu measurements. ORNL will evaluate RR.						
Rhodium (^{103}Rh)	ORNL	ORNL	ORNL				
	NNL	NNL	NNL				
	IRSN	IRSN	IRSN				
Basis	Update resonance evaluation based on RPI transmission and capture measurements in the RRR/URR. ^{103}Rh is a stable fission product, NCS interest is for fission product credit. Integral experiments are in process that will determine need for new evaluations. Evaluation priority - elevated per IRSN request.						
Strontium (^{88}Sr)	ORNL	ORNL	ORNL				
Basis	Existing R-matrix analysis of ^{88}Sr in the RRR was performed from the fit of ORELA transmission and capture measurements but the evaluation work was never included in the ENDF/B-VIII.0 library. Strontium is a fission product typically found in spent fuel and in high level waste tanks at Hanford and Savanah River.						
Strontium (^{86,87}Sr)						ORNL	ORNL
Basis	^{86,87}Sr RR evaluation based on transmission and capture measurements performed at GELINA to supplement existing ^{88}Sr ORNL measurements to support complete RR evaluation for natural strontium isotopes for ENDF/B. ^{86,87}Sr are minor isotopes representing about 18% of natural strontium.						
Tantalum (Ta)	ORNL	ORNL					
	NNL	NNL					
	LANL	LANL					
Basis	Resonance evaluation based on GELINA and RPI measurements. Tantalum is used at Y-12 for recovering uranium from machine turnings and at LANL for Pu casting operations in PF-4 where it may provide modest moderation and reflection of fissile material. Tantalum is chosen due to its material properties, as it is one of the few materials that can contain molten plutonium metal. Due to this characteristic, tantalum is often used as crucible, distributer, launder, or molds for plutonium casting operations. The wall thickness of these materials varies from a few mm all the way up to a few cm. ^{181}Ta is one of the oldest evaluations in ENDF and long overdue for update. Integral experiments in progress to validate Ta cross sections. Fast region evaluation at LANL in support of PF-4 operations.						

Nuclear Data Evaluations							
Materials	**Pre-FY2022**	**FY2022**	**FY2023**	**FY2024**	**FY2025**	**FY2026**	**Post-FY2026**
Uranium-233	ORNL	ORNL	ORNL	ORNL			
	IRSN	IRSN	IRSN	IRSN			
		LANL	LANL	LANL		LANL	LANL
Basis	^{233}U is a fissile nuclide of interest to criticality safety. The availability of ^{233}U is important to NCS applications mainly at Y-12, ORNL, and at NCERC. 1. The evaluation will include the newly evaluated thermal values from the standard evaluation including the updated fission prompt neutron spectrum. Reevaluate differential data to check the renormalization of ORNL fission data. A new fit for the fission cross sections to account for the Guber and n_TOF fission data, that agree within 2% from 10 eV to 100 keV and higher than the current ENDF/B-VIII.0 evaluated data. Above 100 eV, there are serious discrepancies between ENDF and the new experimental fission data (from Guber and n_TOF) of up to 10% in the 1–10 keV range (Guber). Update with the new standards. RPI has ^{233}U capture data, which is likely the Weston data (Danon). 2. New evaluation fast. Fission spectrum is important for intermediate benchmarks. Renormalize to new standards. Evaluation in the RRR is planned at ORNL/IRSN and in the fast region at LANL. In the RRR the main goal of the new evaluation is to improve the negative bias in the benchmark calculations.						
Uranium-234	LANL						
			ORNL	ORNL			
Basis	While ^{234}U makes up a small fraction of natural uranium, previous studies have shown that ignoring ^{234}U for HEU metal benchmarks can lead to a non-conservative result by as much as 0.4%. Recent advances in the capabilities of the DANCE detector at LANSCE, combined with improved theoretical modeling of the capture reaction (for example, including the M1 scissors-mode contribution to the gamma strength function) have enabled more accurate evaluations of (n,g) cross sections. This work to update the ^{234}U capture cross section will utilize both the experimental and theoretical advances. ORNL work will focus on checking the RRR to determine if it needs to be revised.						
Uranium-235	LANL	LANL	LANL				
			ORNL				
			IRSN				
Basis	^{235}U is one of the three major fissile isotopes of interest in Nuclear Criticality Safety. ^{235}U is used at LANL, LLNL, Hanford, SRS, and GDPs, Y-12, and other locations in sufficient quantities to be an NCS concern. ^{235}U is a major factor in countless ICSBEP benchmarks. Major LANSCE experiments of ^{235}U fission cross section and PFNS are concluding in the next few years, and the resulting data needs to be incorporated into an updated evaluation. Inelastic scattering cross section measurements are also planned, which will allow evaluators to better address these high-uncertainty interactions. Improvement of ^{235}U URR because based on old average resonance parameters. Includes ORNL revisiting ^{235}U URR evaluation.						
Uranium-236	LANL						
							ORNL
							NNL
Basis	^{236}U needs to be considered in modeling of spent fuel. Recent advances in the capabilities of the DANCE detector at LANSCE, combined with improved theoretical modeling of the capture reaction (for example, including the M1 scissors-mode contribution to the gamma strength function) have enabled more accurate evaluations of (n,g) cross sections. This work to update the ^{236}U capture cross section will utilize both the experimental and theoretical advances. ORNL/NNL will evaluate ^{236}U high-resolution transmission measurements in the RRR to complement recent LANL fast energy evaluation. ^{236}U is a minor activation product present in HEU. Improved ^{236}U cross section evaluation supports all DOE programs using HEU.						

Nuclear Data Evaluations							
Materials	**Pre-FY2022**	**FY2022**	**FY2023**	**FY2024**	**FY2025**	**FY2026**	**Post-FY2026**
Uranium-238	LANL	LANL	LANL				
	BNL	BNL	BNL				
Basis	^{238}U is a ubiquitous isotope in HEU, LEU, natural uranium, and depleted uranium. It's presence in HEU and LEU fuels makes it a significant contributor to their reactivity and performance. NU and DU are often used as reflectors or shielding materials, and ^{238}U is obviously the dominant isotope in these materials. ^{238}U is a major factor in countless ICSBEP benchmarks. Major LANSCE experiments on the ^{238}U fission cross section and PFNS are concluding in the next few years, and the resulting data needs to be incorporated into an updated evaluation. LANL will evaluate PFNS and multiplicity data for ^{238}U. As part of a joint DOE-SC NDIAWG funded project, LANL and LBNL are remeasuring ^{238}U(n,n') cross section data. This will be evaluated into the existing ENDF evaluation by BNL also as part of this project. This evaluation is expected to also have an impact on neutron leakage in fast systems.						
Vanadium (^{51}V)	ORNL	ORNL	ORNL	ORNL			
Basis	Vanadium is a key structural element and is predominately ^{51}V (99.75 atom %). Primary NCS application is fire resistant cans. Recent data testing by LANL for ICSBEP critical benchmarks involving vanadium (i.e., HMF25, HMF40, and HMM16) results in an over-predication of the experiment eigenvalue. In addition, the HMF25 series of experiments exhibit an increasing calculated eigenvalue trend with increasing reflector thickness. The integral data testing indicates that there may be deficiencies in either the elastic scattering angular distributions or secondary energy distributions. In addition, the latest ENDF/B-VII.1 resonance evaluation is based on the JENDL-4.0 evaluation and does not have covariance data. Also, the ENDF/B-VII.1 and JENDL 4.0 resonance evaluations are based on the parameters provided in the Atlas of Neutron Resonances up to 42.5 keV, and the entire resolved resonance evaluation (up to 100 keV) is represented by the multi-level Breit Wigner (MLBW) formalism. As a result, the MLBW resonance evaluation does not account for the resonance-resonance interference effects. Therefore, the evaluated resonance parameters are not based on a detailed R-matrix analysis. Differential measurements are needed in the resonance region to accurately predict the neutron resonances, and a corresponding resonance evaluation is needed to provide detailed resonance parameters and covariance data. In addition, the SAMMY evaluation software has the capability to generate angular scattering distributions from the resonance parameters thereby providing detailed resonance scattering structure that will improve the elastic scattering modeling in the evaluation. The request is for ORNL to complete new ^{51}V cross-section measurements and a resonance evaluation to address computational biases with the existing ^{51}V evaluation. New measurement/evaluation of fast scattering angular distribution recommended.						
Zirconium (^{90,91,92,94,96}Zr)				ORNL	ORNL	ORNL	
				NNL	NNL	NNL	
		BNL	BNL				
Basis	Resonance evaluations. Zirconium is a key structural element that is primarily used in cladding for fuel rods and is currently in consideration for use with advanced nuclear fuel matrices in the form of zirconium hydride. The latest ENDF/B-VII.1 resonance evaluation relies on JENDL-4 data and resonance parameters from the Atlas of Neutron Resonances. As a result, the evaluated resonance parameters are not based on detailed R-matrix analyses. In addition, newer RPI total cross-section measurements on natural zirconium indicate that the older ENDF/B-VI.8 data match the recent RPI measurements better than the newer isotopic evaluations. Furthermore, improved differential measurements of the zirconium isotopes have been identified on the OECD/NEA nuclear data High Priority Request List (HPRL). Differential measurements are needed in the resonance region to accurately predict the neutron resonances for the zirconium isotopes, and corresponding resonance evaluations are needed to provide detailed resonance parameters and covariance data. In addition, the SAMMY evaluation software has the capability to generate angular scattering distributions from the resonance parameters thereby providing detailed resonance scattering structure that will improve the elastic scattering modeling for the zirconium isotope evaluations. NR continues to be unsatisfied with Zr evaluations in ENDF. BNL will re-evaluate the fast and URR regions of all stable Zr isotopes to ensure that the elastic scattering angular distribution is consistent with the rest of the fast region, to						

Nuclear Data Evaluations							
Materials	**Pre-FY2022**	**FY2022**	**FY2023**	**FY2024**	**FY2025**	**FY2026**	**Post-FY2026**
	improve the inelastic scattering cross sections and to correct issues with the URR evaluation implemented in ENDF/B-VIII.0 (under DOE-SC funding).						
Water (H_2O)	LLNL/NCSU	LLNL/NCSU					
Basis	TSL evaluation. Water is this most important moderator and moderating reflector material for criticality safety and light water reactor physics. Problems with evaluations submitted by CAB at elevated temperatures (that were noticed during the ENDF/B-VIII.0 evaluation process) warrant re-evaluating this essential material using the latest methods developed under LLNL ND2, ND3.						
Hydrofluoric Acid (HF)	LLNL/NCSU						
Basis	TSL evaluation. HEU-SOL-THERM-039, "Mixture of Uranium (93%) Hexafluoride and Hydrofluoric Acid (Low H/U Ratio) in a Hot-Water-Reflected Spherical Tank," critical experiments overpredict k-eff from 2-6% regardless of cross-section library or code utilized. An appropriate thermal scattering law for the liquid Hydrofluoric acid (HF) moderator will likely resolve this calculational discrepancy.						
Calcium Hydride (CaH_2)	LLNL/NCSU	LLNL/NCSU					
Basis	TSL evaluation. Calcium hydride is a solid moderator material used in proposed advanced and micro reactor designs. Emergent need requested by micro reactor community.						
Reactor Grade Graphite (20% Porosity)	LLNL/NCSU	LLNL/NCSU					
Basis	TSL evaluation. Graphite is a moderator/reflector material used in advanced reactor designs and in fuel cycle facilities. The prior DOE-NE funded work to produce reactor grade graphite with 10% and 30% porosity will be extended to include 20% porosity per CSEWG request.						
Uranium Metal (U)	LLNL/NCSU	LLNL/NCSU					
Basis	TSL evaluation. Requested by the RPI for use in U-235 resonance parameter analysis.						
Uranium Carbide (UC)	LLNL/NCSU	LLNL/NCSU	LLNL/NCSU				
Basis	TSL evaluation. A common fissile compound under consideration for high-temperature advanced nuclear reactor fuel. A thermal scattering law for UC will improve Doppler broadening using advanced methods currently under development as LLNL ND5.						
Paraffin (C_nH_{2n+2})		LLNL/NCSU	LLNL/NCSU	LLNL/NCSU			
Basis	TSL evaluation. A common moderator and moderating reflector material for which there are numerous critical benchmarks in the ICSBEP Handbook. A thermal scattering law for paraffin will improve simulations through higher fidelity and reduce uncertainties.						
Triuranium Octoxide (U_3O_8)			LLNL/NCSU	LLNL/NCSU	LLNL/NCSU		
Basis	TSL evaluation. A common fissile compound for which there are numerous critical experiments in the ICSBEP Handbook. A thermal scattering law for U_3O_8 will improve Doppler broadening using advanced methods currently under development as LLNL ND5.						
Uranyl Fluoride (UO_2F_2)				LLNL/NCSU	LLNL/NCSU	LLNL/NCSU	
Basis	TSL evaluation. A common fissile compound for which there are numerous critical experiments in the ICSBEP Handbook. A thermal scattering law for UO_2F_2 will improve Doppler broadening using advanced methods currently under development as LLNL ND5.						
Uranium Silicide (U_3Si_2)					LLNL/NCSU	LLNL/NCSU	LLNL/NCSU
Basis	TSL evaluation. A common fissile compound in use in advanced nuclear reactor fuel. A thermal scattering law for U_3Si_2 will improve Doppler broadening using advanced methods currently under development as LLNL ND5.						
Plutonium Oxide (PuO_2)						LLNL/NCSU	LLNL/NCSU
Basis	TSL evaluation. A common fissile compound for which there are critical experiments in the ICSBEP Handbook. A thermal scattering law for PuO_2 will improve Doppler broadening using advanced methods currently under development as LLNL ND5.						
Lithium-7 Hydride (^7LiH)	NNL						
Basis	TSL evaluation. Super-moderator for use in critical mass studies. Evaluation funded by NR.						

Nuclear Data Evaluations							
Materials	**Pre-FY2022**	**FY2022**	**FY2023**	**FY2024**	**FY2025**	**FY2026**	**Post-FY2026**
Lithium-7 Deuteride (^{7}LID)	NNL						
Basis	TSL evaluation. Super-moderator for use in critical mass studies. Evaluation funded by NR.						
Beryllium Carbide (Be_2C)	NNL						
Basis	TSL evaluation. Super-moderator for use in critical mass studies. Evaluation funded by NR.						
Zirconium Hydride (ZrH_x, ZrH_2)	NNL						
Basis	TSL evaluations for delta-phase (ZrH_x) and epsilon-phase (ZrH_2) of zirconium hydride. Moderator and reflector used in TRIGA research reactors, SNAP 10A and several advanced reactors. Evaluation funded by NR.						
Beryllium Hydride (BeH_2)	NNL	NNL					
Basis	TSL evaluation. Super-moderator for use in critical mass studies. Evaluation funded by NR.						
Plutonium Hydride (PuH_{2+x})					NNL	NNL	
Basis	TSL evaluation. A common fissile compound in use in fissile material operations using hydride/de-hydride processes. A thermal scattering law for PuH_{2+X} will improve Doppler broadening using advanced methods currently under development as LLNL ND5. Evaluation funded by NR.						
Polystyrene $(C_8H_8)_n$	ORNL	ORNL					
Basis	Polystyrene is a moderator material found in several thermal systems (PCT001, PCT02, MCT012, MCT013, MCT014, MCT016). Currently, polyethylene is used as a surrogate to represent thermal scattering in polystyrene in neutron transport simulations. This measurement and evaluation will determine the validity of this approximation, as well as inform future substitutions for other hydrocarbons found in benchmarks. RPI could perform sub-thermal transmission measurements to support this TSL evaluation.						

List Legend	ORNL	RPI	LANL	LLNL/NCSU	IRSN	NNL	BNL

B-1 Differential Measurements and Evaluations
(The following list provides the specific milestones to refer to for each element work schedule in Table B-1)

- Beryllium (Be-9)
- Cerium (Ce)
- Cesium (Cs-133)
- Chlorine (Cl-35)
- Chromium (Cr-50,53)
- Copper (Cu-63,65)
- Fluorine (F-19)
- Hafnium (Hf-176,177,178,179,180)
- Iron (Fe-54,56,57)
- Lanthanum (La)
- Lead (Pb-204,206,207,208)
- Lithium (Li-6)
- Molybdenum (Mo-95)
- Neptunium (Np-237)
- Plutonium (Pu-238, 240, 241, 242)
- Plutonium (Pu-239) (LANL/IRSN plus ORNL/IRSN Collaboration)
- Plutonium (Pu-240)
- Samarium (Sm-151)
- Strontium (Sr-88)
- Tantalum (Ta-181)
- Uranium-233 (U-233)
- Uranium-234 (U-234)
- Uranium-235 (U-235)
- Uranium-238 (U-238)
- Vanadium (V-51)
- Zirconium (Zr-90, 91, 92, 94, 96)

<u>Completed Work</u>

- Calcium (Ca)
- Cobalt (Co-59)
- Copper (Cu-63, 65)
- Copper (^{nat}Cu) - scattering angular distributions
- Dysprosium (Dy-161, 162, 163, 164)
- Gadolinium (Gd-155, 156, 157, 158, 160)
- Lead (Pb-208)
- Nickel (Ni-58, 60)
- Oxygen (O-16)
- Tungsten (W-182, 183, 184, 186)
- Uranium-236 (U-236)

Completed Differential Measurements and Evaluations – Elements
(Evaluations have been submitted to NNDC and are candidates for the next ENDF release. Testing will be performed as part of ENDF release effort, and additional revisions may be requested by NNDC before evaluations are formally released. The GANTT charts are retained in the Five-Year Plan pending release of the new evaluations by NNDC.)

Table B-1. Differential Measurements and Evaluations

Isotope(s)	Start Date	End Date	Responsible Laboratory	Comments
Beryllium (Be-9)	11/1/11	9/30/26		
Deliver an improved and more consistent evaluation to NNDC	11/15/19	9/30/20	LANL	
Finalize Evaluation and Deliver to NNDC	10/1/19	9/30/20	LANL	
Phase I Testing, Post to ENDF/A and Broadcast	10/1/20	2/1/21	BNL	
CSEWG Validation Testing	12/1/20	5/1/21	NDAG	
CSEWG Approval of Complete Evaluation	5/1/21	8/1/21	BNL	
Extend the upper end of the R-Matrix evaluation from 5 MeV to 10 MeV (including inelastic angular distributions), provide R-Matrix parameters, and deliver evaluation to NNDC	10/1/21	9/30/22	LANL	
Phase I Testing, Post to ENDF/A and Broadcast	10/1/22	2/1/23	BNL	
CSEWG Validation Testing	12/1/22	5/1/23	NDAG	
CSEWG Approval of Complete Evaluation	5/1/23	8/1/23	BNL	
Extend the upper end of the R-Matrix evaluation from 10 MeV to 15 MeV (including 4-body breakup reaction) and deliver evaluation to NNDC	10/1/22	9/30/26	LANL	
Phase I Testing, Post to ENDF/A and Broadcast	10/1/26	2/1/27	BNL:	
CSEWG Validation Testing	12/1/26	5/1/27	NDAG	
CSEWG Approval of Complete Evaluation	5/1/27	8/1/27	BNL	
Cerium (Ce-142)	11/01/11	10/30/20		
Transmission and Capture Measurements	11/15/19	12/30/20	ORNL (JRC-Geel)	Transmission and capture measurements were performed in FY19, however, additional transmission measurements for 142-Ce were needed to have better statistics.
Experimentalist Data Reduction and Testing	01/01/20	4/01/20	ORNL	
Resolved Resonance Region Evaluation	11/15/19	3/31/21	ORNL	
Assess Data for URR Evaluation and Complete URR Evaluation	6/01/19	3/31/21	ORNL	URR will be performed on the basis of available measured data if any
Finalize Resonance Evaluation and Deliver to NNDC	4/1/21	5/30/21	ORNL	
Phase I testing, Post to ENDF/A and Broadcast	6/1/21	6/15/21	BNL	
CSEWG Validation Testing	6/16/21	6/30/21	NDAG	
CSEWG Approval of Complete Evaluation	7/1/21	9/31/21	BNL	
Cesium (Cs-133)	10/1/22	9/30/25		
Perform transmission and capture measurements using	10/1/22	9/30/25	LANL	Currently Unfunded

Isotope(s)	Start Date	End Date	Responsible Laboratory	Comments
DICER and DANCE at LANSCE, analyze results, publish data, and deliver evaluation to NNDC				
Chlorine (Cl-35)	10/1/20	9/30/23		
Perform (n,p) Measurements	10/1/20	9/30/21	ORNL	Funding source: ORNL ND1
Complete Lujan measurements of Cl-35 (n,p), finalize report on LENZ analysis, and deliver final experimental cross-sections to evaluators	10/1/22	9/30/24	LANL	Currently Unfunded
Resolve Resonance Region Evaluation	10/01/21	9/30/24	ORNL	
Finalize isotopic Evaluation Resonance Region Evaluation and Deliver to NNDC	9/30/23	10/15/24	ORNL	
Phase I testing, Post to ENDF/A and Broadcast	10/16/23	10/30/24	BNL	
CSEWG Validation Testing	11/01/23	11/15/24	NDAG	
CSEWG Approval of Complete Evaluation	11/16/23	12/30/24	BNL	
Chromium (Cr-50, 53)				The two links below describe the problem and motivation for the proposed work. In addition to ORNL plans to 1) to develop procedure to treat experimental effects such as neutron sensitivity and multiple scattering corrections with geometry different from cylindric. https://www.oecd-nea.org/dbdata/hprl/hprlview.pl?ID=518 and https://www.oecd-nea.org/dbdata/hprl/hprlview.pl?ID=519 . Measurements for both isotopes below 10 keV with diluted sample are needed to reduce or minimize the neutron sensitivity of the experimental set up and MS in the sample. Cr50 data over the whole energy ranges is needed.
Perform Capture Measurements	1/1/24	9/30/25	ORNL	
Perform SAMMY Analysis	1/1/24	9/30/26	ORNL	
Resolved Resonance Region Evaluation for Cr-50, 53				
Finalize isotopic Evaluation Resonance Region Evaluation and Deliver to NNDC				
Phase I testing, Post to ENDF/A and Broadcast	10/16/26	10/30/26	BNL	
CSEWG Validation Testing	11/1/26	11/15/26	NDAG	
CSEWG Approval of Complete Evaluation	11/16/26	12/30/26	BNL	
Cu (Cu-63,65)				A revised evaluation on copper isotopes is needed to improve the benchmark performance above 100 keV up to 300 keV. This will include a statistical analysis of the resonance
Perform Capture Measurements	N/A	N/A	–	
Perform SAMMY Analysis	10/1/19	9/30/22	ORNL	

Isotope(s)	Start Date	End Date	Responsible Laboratory	Comments
Resolved Resonance Region Evaluation for Cu-63,65				parameters above 100 keV to quantify the impact of the missing resonances in the measured data as well as a guidance in the level spin assignment. Due to the importance of the copper being used in reactor applications as reflector, additional work on the angular distributions is needed. Moreover, since benchmark sensitivity extends above 300 keV, a careful analysis of the high energy cross sections might be needed.
Finalize isotopic Evaluation Resonance Region Evaluation and Deliver to NNDC				
Phase I testing, Post to ENDF/A and Broadcast	10/1/22	1/15/23	BNL	
CSEWG Validation Testing	1/16/23	1/31/23	NDAG	
CSEWG Approval of Complete Evaluation	2/1/23	3/30/23	BNL	
Work with the IER 537 design team to help optimize the nuclear-data return from the experiment and incorporate improvements into the evaluations. Deliver updated evaluations to NNDC.	1/1/21	9/30/24	LANL	
Phase I testing, Post to ENDF/A and Broadcast	10/1/24	1/15/25	BNL	
CSEWG Validation Testing	1/16/25	1/31/25	NDAG	
CSEWG Approval of Complete Evaluation	2/1/25	3/30/25	BNL	
Fluorine (F-19)	1/1/24	9/30/26		F-19 might be the main cause bias in ^{233}U solution benchmarks. There are no resonance parameters in the ENDF/B-VIII.0 library because the RRR evaluation was converted to point wise cross sections. There are no high-resolution measured data for F-19 inelastic scattering reaction channel, e.g. (n,n'), (n,n0), (n,n1), that in the current evaluation seems to be underestimated. Analysis and evaluation on the angular distributions in RRR is required.
Perform Inelastic Measurements (IRMM)	1/1/24	12/30/24	ORNL	
Perform SAMMY Analysis	12/30/24	9/30/26	ORNL	
Resolve Resonance Region Evaluation for F-19				
Finalize isotopic Evaluation Resonance Region Evaluation and Deliver to NNDC				
Phase I testing, Post to ENDF/A and Broadcast	10/1/26	10/15/26	BNL	
CSEWG Validation Testing	10/15/26	11/1/26	NDAG	
CSEWG Approval of Complete Evaluation	11/1/26	12/31/26	BNL	
Hafnium (Hf-176,177,178,179,180)	10/1/19			Resolved and unresolved resonance evaluations for Hf isotopes have been carried out mainly to address issues on benchmark results in the thermal energy region. IRSN and LLNL will be working on the development of the TEX-Hf experiments focusing in the epithermal energy region. Indeed, MORET calculations of the benchmark sensitive to Hf in the epithermal energy region have demonstrated discrepancies calculated and experimental multiplication factors result. The intent of the proposal is to review and re-evaluate the Hf cross sections in the resolved and unresolved resonance regions with additional covariance and uncertainty information. (ORNL is waiting for IRSN feedback)
Perform assessment of the available Hf evaluation in the resolved and unresolved resonance regions in the JEFF, ENDF and JENDL libraries; Perform detail study of the sensitivity of Hf cross sections in the calculations using the TEX-Hf benchmarks; Examine the results from different cross section libraries; Initiate resonance parameter evaluation in the resolved and unresolved resonance regions.	10/1/19	9/30/20	ORNL/IRSN	

Isotope(s)	Start Date	End Date	Responsible Laboratory	Comments
Continue tasks initiated in previous year; Incorporate experimental differential data in the evaluation process as they become available; Continue evaluation using computer evaluation tool.	10/1/20	9/30/21	ORNL/IRSN	
Complete the resolved resonance and resonance parameter covariance evaluation; Use the evaluation for testing in benchmark calculation; Work with ORNL on the benchmark validation; Submit the evaluation to JEFF and ENDF for further testing;	10/1/21	9/30/22	ORNL/IRSN	
Initiate the unresolved resonance region evaluation; Incorporate experimental differential data in the evaluation process as they become available; Continue evaluation using computer evaluation tool;	10/1/22	9/30/23	ORNL/IRSN	
Complete the unresolved resonance and cross section covariance evaluation; Use the evaluation for testing in benchmark calculation; Work with ORNL on the benchmark validation; Submit the evaluation to JEFF and ENDF for further testing.	10/1/23	9/30/24	ORNL/IRSN	
CSEWG Approval of Complete Evaluations				
Fe (Fe-54, 56, 57)	1/1/13	12/31/23		Although the effort on the Fe isotopes was planned as joint effort between ORNL and IRSN, IRSN mainly led the evaluation effort and it is unclear the status of this set of evaluations. The ORNL contribution to 56-Fe was the generation of a preliminary ENDF file solving the problem with the benchmark performance. However, a rigorous evaluation work is still needed for the three major isotopes mainly for the assessment of the inelastic scattering reaction channel.
Perform Capture Measurements for Fe-54	10/1/21	9/30/23	RPI	
Perform SAMMY Analysis Finalize isotopic Evaluation Resonance Region Evaluation and Deliver to NNDC	1/1/21	9/30/23	ORNL	
Phase I testing, Post to ENDF/A and Broadcast	10/1/23	10/15/23	BNL	
CSEWG Validation Testing	10/16/23	11/1/23	NDAG	
CSEWG Approval of Complete Evaluation	11/1/23	12/31/23	BNL	
Lanthanum (La)				Updated from FY2019
Transmission and Capture Measurements	10/1/17	6/1/18	ORNL	
Experimentalist Data Reduction and Testing	6/1/18	9/30/19	ORNL	
Resolved Resonance Region Evaluation	10/1/21	6/30/22	ORNL	
Finalize Resonance Evaluation and Deliver to NNDC	7/1/22	9/30/22	ORNL	
Phase I Testing, Post to ENDF/A and Broadcast	10/1/22	10/15/22	BNL	
CSEWG Validation Testing	10/15/22	11/1/22	NDAG	

Isotope(s)	Start Date	End Date	Responsible Laboratory	Comments
CSEWG Approval of Complete Evaluation	11/1/22	12/31/22	BNL	
Lead (Pb-204,206,207,208)	10/1/21	12/31/23		Lead is a ubiquitous material in the nuclear industry. Lead possesses not only high photon attenuation properties, which make it almost a universal choice as a gamma-ray shielding material, but also desirable neutronic qualities. Our ability to match experimental data with Pb (reflectors and as a scattering target) is less that we desire. Pb-208 is the majority isotope of natural lead. The current ENDF evaluation is known to suffer from deficiencies in neutron angular distributions. The emphasis of the re-evaluation work is on these angular distributions. We will judge success of this work based on recent semi-integral measurements performed at RPI. ORNL proposed to revisit RRR to address angular distribution concerns
Resolved Resonance Region Evaluation	4/1/21	9/30/23	ORNL	
Phase I Testing, Post to ENDF/A and Broadcast	10/1/23	10/14/23	BNL	
CSEWG Validation Testing	10/15/23	10/31/23	NDAG	
CSEWG Approval of Complete Evaluation	11/1/23	12/31/23	BNL	
Lithium (Li-6)	10/1/21	8/1/25		
Perform data compilation and add EDA code capabilities to support new R-Matrix evaluation up to 20 MeV	10/1/20	9/30/22	LANL	
Deliver new evaluation using R-Matrix analysis to 20 MeV	10/1/22	9/30/24	LANL	
Phase I Testing, Post to ENDF/A and Broadcast	10/1/24	2/1/25	BNL	
CSEWG Validation Testing	12/1/24	5/1/25	NDAG	
CSEWG Approval of Complete Evaluation	5/1/25	8/1/25	BNL	
Molybdenum (Mo-95)	10/1/20	>FY24		
Reduce prior ORELA transmission and capture measurement data and submit to EXFOR	10/1/20	9/30/21	LANL	
Transmission and Capture Measurements	10/1/22	>FY24	RPI	
Experimentalist Data Reduction and Testing	TBD	TBD	RPI	
Resolved Resonance Region Evaluation	TBD	TBD	RPI/NNL	IRSN will collaborate on evaluation.
Finalize Resonance Evaluation and Deliver to NNDC	TBD	TBD	RPI/NNL	
Phase I Testing, Post to ENDF/A and Broadcast	TBD	TBD	BNL	
CSEWG Validation Testing	TBD	TBD	NDAG	
CSEWG Approval of Complete Evaluation	TBD	>FY24	BNL	
Neptunium (Np-237)	10/1/20	>FY26		

Isotope(s)	Start Date	End Date	Responsible Laboratory	Comments
Assess needs for new Np-237 differential experiments at LANSCE	10/1/20	9/30/21	LANL	
Finalize Np-237 fission measurement at LANSCE	TBD	TBD	LANL	
Complete capture measurements at DANCE, finalize the analysis of the results, and publish the data	10/1/24	9/30/27	ORNL/LANL	Currently unfunded
Finalize Fast Region Evaluation and Deliver to NNDC	10/1/23	9/30/25	LANL	
Resonance Region Evaluation	10/1/23	9/30/25	ORNL	
Finalize Resonance Evaluation and Deliver to NNDC	10/1/23	9/30/25	ORNL	
Phase I Testing, Post to ENDF/A and Broadcast	TBD	TBD	BNL	
CSEWG Validation Testing	TBD	TBD	NDAG	
CSEWG Approval of Complete Evaluation	TBD	>FY25	BNL	
Nitrogen (N-14)	12/30/20	9/30/23		Nitrogen cross section are important in the reprocessing process and related analyses. Nitrogen was recently included as action item in the series of INDEN meetings for light nuclei evaluations. In the ENDF/B-VIII.0 library there are no resonance parameters for nitrogen.
Transmission and Capture Measurements	–	–		
Experimentalist Data Reduction and Testing	–	–		
Resolved Resonance Region Evaluation	12/30/22	9/30/24	ORNL	
Assess Data for URR Evaluation and Complete URR Evaluation				
Phase I Testing, Post to ENDF/A and Broadcast	10/1/24	10/15/24	BNL	
CSEWG Validation Testing	10/15/24	11/1/24	NDAG	
CSEWG Approval of Complete Evaluation	11/1/24	12/30/24	BNL	
Oxygen (O-16)	10/1/13	12/31/26		To be discussed by NDAG in FY2021. Not in App. B tables.
Update evaluation as part of Cielo Project	<FY19	6/30/21	ORNL	This milestones is based on the availability of the (n,a) measured at LANL. After several years, this data should be ready for release and put some light on the magnitude of the (n,a) reaction channel. Moreover, the quality of this evaluation is also linked to the updates in the SAMMY code regarding the multiple incident channel option.
Finalize Evaluation and Deliver to NNDC	7/1/21	9/30/21	ORNL	
Phase I testing, Post to ENDF/A and Broadcast	10/1/21	10/15/21	BNL	Define post evaluation process
CSEWG Validation Testing	10/15/21	11/1/21	NDAG	
CSEWG Approval of Complete Evaluation(s)	11/1/21	12/31/21	BNL	
Extend the upper end of the R-Matrix evaluation from 7 MeV to 10 MeV (including new data), provide R-Matrix parameters, and deliver evaluation to NNDC.	10/1/21	9/30/22	LANL	
Phase I testing, Post to ENDF/A and Broadcast	10/1/22	10/15/22	BNL	

Isotope(s)	Start Date	End Date	Responsible Laboratory	Comments
CSEWG Validation Testing	10/15/22	11/1/22	NDAG	
CSEWG Approval of Complete Evaluation(s)	11/1/22	12/31/22	BNL	
Extend the upper end of the R-Matrix evaluation from 10 MeV to 15 MeV (including additional data) and deliver evaluation to NNDC.	10/1/22	9/30/26	LANL	
Phase I testing, Post to ENDF/A and Broadcast	10/1/26	10/15/26	BNL	
CSEWG Validation Testing	10/15/26	11/1/26	NDAG	
CSEWG Approval of Complete Evaluation(s)	11/1/26	12/31/26	BNL	
Rhodium (Rh-103)	6/30/21	1/1/23		Reprioritized to FY21-FY23.
Assess data for Resolved Resonance Region Evaluation	6/30/21	9/30/23	ORNL	NNL & IRSN will collaborate
Finalize Resonance Evaluation and Deliver to NNDC			ORNL	
Phase I Testing, Post to ENDF/A and Broadcast	10/1/23	10/15/23	BNL	Define post process evaluation
CSEWG Validation Testing	10/15/23	11/1/23	NDAG	
CSEWG Approval of Complete Evaluation(s)	11/1/23	12/31/23	BNL	
Minor Plutonium Isotopes (Pu-238, Pu-240, Pu-241, Pu-242)	10/1/21	12/31/26		
Attempt a consistent nu-bar evaluation supported by a model code to provide better evaluated nu-bar for minor Pu-isotopes	10/1/21	9/30/23	LANL	
Attempt a consistent PFNS evaluation supported by a model code to provide better evaluated PFNS for minor Pu-isotopes	10/1/24	9/30/26	LANL	
Finalize Evaluation and Deliver to NNDC	7/1/26	9/30/26	LANL	
Phase I testing, Post to ENDF/A and Broadcast	10/1/26	10/15/26	BNL	
CSEWG Validation Testing	10/15/26	11/1/26	NDAG	
CSEWG Approval of Complete Evaluation(s)	11/1/26	12/31/26	BNL	
Plutonium (Pu-239)	10/1/10	9/30/24		IRSN to collaborate with ORNL evaluation work.
Deliver p(nu) Data in ENDF/B format	10/1/12	9/30/13	LANL	
Update Prompt Fission Neutron Spectra Based on LANSCE Low-Energy Emission Data	10/1/18	3/31/20	LANL	
Deliver Multiplicity-Dependent Fission Spectra	10/1/13	9/30/14	LANL	
Deliver Prompt Fission Gamma Spectra	10/1/14	3/31/16	LANL	
Update Prompt Fission Neutron Spectra Based on LANSCE High-Energy Emission Data	10/1/18	3/31/20	LANL	

Isotope(s)	Start Date	End Date	Responsible Laboratory	Comments
WPEC SG34 Improved Resonance Evaluation	<FY19	TBD	ORNL	
URR Evaluation using Hwang-Leal Methodology	TBD	TBD	ORNL	
Finalize Resonance Region Evaluation and Deliver to NNDC	TBD	9/30/24	ORNL	
Phase I testing, Post to ENDF/A and Broadcast	TBD	TBD	BNL	
CSEWG Validation Testing	TBD	TBD	NDAG	
CSEWG Approval of Complete Evaluation	TBD	TBD	BNL	
Finalize a report assessing our methodology to evaluate PFNS and multiplicity consistently, including angular information about prompt neutrons	4/1/19	9/30/20	LANL	
Evaluate PFNS and multiplicity consistently, including angular information about prompt neutrons	10/1/19	9/30/22	LANL	
Update Fission Cross-Section Based on TPC Results (based on Pu239/U235 ratio data)	10/1/19	9/30/22	LANL	
Update Evaluation Based on LANL Updates and CSEWG & WPEC Testing	10/1/20	>FY24	ORNL	
Procure samples for LANSCE DICER experiment	10/1/23	9/30/23	LANL	
Perform transmission measurements at LANSCE DICER	10/1/23	9/30/24	LANL	
Analyze and publish the results of the LANSCE DICER measurement and transmit to IRSN	10/1/24	9/30/25	LANL	
Plutonium-240 (Pu-240)	10/1/19	8/1/25		
Procure a Pu-240 target for PFNS measurements	10/1/19	9/30/20	LANL	
Fabricate, assemble, and test the Pu-240 PPAC target and fission detector components	6/1/20	8/31/21	LLNL	
Obtain final experimental results for Pu-240 PFNS at LANSCE, finalize data analysis, and deliver data to evaluators	9/1/21	9/30/22	LANL	
Update evaluation to include new LANSCE / Chi-Nu prompt fission neutron spectra	3/30/22	3/30/24	LANL	
Resolved Resonance Region Evaluation	10/1/22	9/30/24	ORNL	
Phase I Testing, Post to ENDF/A and Broadcast	10/1/24	2/1/25	BNL	
CSEWG Validation Testing	12/1/24	5/1/25	NDAG	
CSEWG Approval of Complete Evaluation(s)	5/1/25	8/1/25	BNL	

Isotope(s)	Start Date	End Date	Responsible Laboratory	Comments
Samarium (Sm-151)	10/1/26	9/30/28		
Perform transmission and capture measurements using DICER and DANCE at LANSCE, analyze results, publish data, and submit to EXFOR.	10/1/26	9/30/28	LANL	Currently Unfunded
Strontium (Sr-88)	10/1/21	12/31/23		
Resolved Resonance Region Evaluation	10/1/21	9/30/23	ORNL	
Assess Data for URR Evaluation and Complete URR Evaluation	10/1/23	9/30/23	ORNL	
Finalize Resonance Evaluation and Deliver to NNDC	10/1/23	10/15/23	ORNL	
Phase I Testing, Post to ENDF/A and Broadcast	10/16/23	10/30/23	BNL	
CSEWG Validation Testing	11/1/23	11/15/23	NDAG	
CSEWG Approval of Complete Evaluation	11/16/23	12/30/23	BNL	
Strontium (Sr-86,87)	10/1/25	12/30/28		
Transmission and Capture Measurements (Geel)	10/1/25	9/30/27	ORNL	
Experimentalist Data Reduction and Testing	10/1/27	3/30/28	ORNL	
Resolved Resonance Region Evaluation	4/1/26	9/30/28	ORNL	
Finalize Resonance Evaluation and Deliver to NNDC	10/1/28	10/15/28	ORNL	
Phase I Testing, Post to ENDF/A and Broadcast	10/16/28	10/30/28	BNL	
CSEWG Validation Testing	11/1/28	11/15/28	NDAG	
CSEWG Approval of Complete Evaluation	11/16/28	12/30/28	BNL	
Tantalum (Ta)	10/1/15	1/1/23		ORNL is/was not part of the measurement campaign. However, ORNL is working with NNL to generate an evaluation in the RRR.
Transmission and Capture Measurements	10/1/15	9/30/21	RPI	
Experimentalist Data Reduction and Testing	10/1/21	9/30/22	RPI	
Resolved Resonance Region Evaluation	10/1/18	9/30/22	NNL/ORNL	
Assess Data for URR Evaluation and Complete URR Evaluation			NNL/ORNL	
Finalize Resonance Evaluation and Deliver to NNDC			NNL/ORNL	
Finalize updates to high-energy portion of the ENDF evaluation and coordinate with resonance work at ORNL and NNL to deliver a final product validated with critical experiments	10/1/20	9/30/22	LANL	
Phase I Testing, Post to ENDF/A and Broadcast	10/1/22	10/15/22	BNL	
CSEWG Validation Testing	10/15/22	11/1/22	NDAG	

Isotope(s)	Start Date	End Date	Responsible Laboratory	Comments
CSEWG Approval of Complete Evaluation	11/1/22	1/1/23	BNL	
Uranium (U-233)	10/1/2019	1/1/28		
Complete review of previous "thin" target U233 measurements and finalize specifications for new "thick" U233 target	10/1/2019	6/30/20	LANL	The measurements will be performed on the basis of the cross section evaluation and the performance with the benchmarks
Complete fabrication of new "thick" U-233 target	7/1/20	6/30/21	LANL	
Finalize acquisition of U-233 thick target capture data, finalize data analysis, and deliver data to evaluators	7/1/21	9/30/22	LANL	
Resolved Resonance Region Evaluation	4/1/20	9/30/23	ORNL	IRSN will collaborate
Assess data for Unresolved Resonance Region Evaluation	10/1/23	9/30/24	ORNL	
Finalize Fast Region Evaluation, including new DANCE capture data, and Deliver to NNDC	10/1/22	9/30/24	LANL	
Phase I testing, Post to ENDF/A and Broadcast	10/1/24	2/1/25	BNL	
CSEWG Validation Testing	12/1/24	5/1/25	NDAG	
CSEWG Approval of Complete Evaluations	5/1/25	12/30/248/1/25	BNL	
Complete PFNS measurements at Chi-Nu, finalize the analysis of the results, and publish the data	10/1/23	9/30/26	LANL	Currently Unfunded
Incorporate new PFNS data into evaluation and deliver to NNDC	4/1/25	9/30/27	LANL	
Phase I testing, Post to ENDF/A and Broadcast	10/1/27	10/15/27	BNL	
CSEWG Validation Testing	10/15/27	11/1/27	NDAG	
CSEWG Approval of Complete Evaluations	11/1/27	1/1/28	BNL	
Uranium (U-234)	10/1/11	9/30/24		
Finalize Resonance Evaluation and Deliver to NNDC	10/1/11	9/30/14	ORNL	
Phase I testing, Post to ENDF/A and Broadcast	10/1/14	9/30/17	BNL	
CSEWG Validation Testing	10/1/17	12/31/17	NDAG	
CSEWG Approval of Complete Evaluations	10/1/15	12/31/16	BNL	
Revisit capture cross section and covariance based on new DANCE data	4/1/18	3/31/20	LANL	
Update U-234 evaluation based on new capture cross section and deliver to NNDC	10/1/19	9/30/20	LANL	
Phase I testing, Post to ENDF/A and Broadcast	10/1/20	2/1/21	BNL	

Isotope(s)	Start Date	End Date	Responsible Laboratory	Comments
CSEWG Validation Testing	12/1/20	5/1/21	NDAG	
CSEWG Approval of Complete Evaluations	5/1/21	8/1/21	BNL	
Check the status the RRR evaluation	10/1/23	9/30/24	ORNL	
Uranium (U-235)	10/1/11	8/1/24		
Deliver p(nu) Data in ENDF/B Format	10/2/12	9/30/13	LANL	
Deliver Multiplicity-Dependent Fission Spectra	10/2/13	9/30/14	LANL	
Deliver Prompt Fission Gamma Spectra	10/1/14	3/31/16	LANL	
Review the evaluation of U-235 capture and fission cross sections based on new measurements at LANSCE	4/1/16	9/30/17	LANL	
Resolved Resonance Capture Evaluation Per WPEC SG29 Recommendations	10/1/11	9/30/14	ORNL	
CSEWG Validation Testing	10/1/14	9/30/17	NDAG	
CSEWG Approval of Complete Evaluation(s)	10/1/17	12/31/17	BNL	
Update Prompt Fission Neutron Spectra Based on LANSCE Low-Energy Emission Data	10/1/15	9/30/18	LANL	
Finalize prompt fission neutron spectra based on LANSCE high-energy emission data from Chi-Nu	10/1/20	3/31/22	LANL	
Finalize a report assessing our methodology to evaluate PFNS and multiplicity consistently, including angular information about prompt neutrons	4/1/19	9/30/20	LANL	
Evaluate PFNS and multiplicity consistently, including angular information about prompt neutrons	10/1/19	9/30/22	LANL	
Update fission cross section and covariance evaluation based on new TPC results (from U235/U238 ratio data)	10/1/18	9/30/19	LANL	
Update fission cross section based on TPC Results (from Pu-239/U-235 ratio data)	10/1/20	9/30/21	LANL	
Develop consistent evaluation of fission yields, neutron multiplicity, and spectra from thermal to 20 MeV	10/1/19	9/30/22	LANL	
Revisit elastic and inelastic cross sections based on planned LANSCE experiments using Chi-Nu	10/1/21	9/30/23	LANL	

Isotope(s)	Start Date	End Date	Responsible Laboratory	Comments
Finalize evaluation and deliver to NNDC	7/1/23	9/30/23	LANL	
Phase I testing, Post to ENDF/A and Broadcast	10/1/23	2/1/24	BNL	
CSEWG Validation Testing	12/1/23	5/1/24	NDAG	
CSEWG Approval of Complete Evaluations	5/1/23	8/1/24	BNL	
Uranium (U-236)	10/1/26	2/1/30		
Transmission measurements at LANL or GELINA	>2026		ORNL	
Resonance evaluation	>2027		ORNL	NNL will collaborate
Finalize RRR evaluation and deliver to NNDC	TBD	TBD	ORNL	
Phase I testing, Post to ENDF/A and Broadcast	TBD	TBD	BNL	
CSEWG Validation Testing	TBD	TBD	NDAG	
CSEWG Approval of Complete Evaluations	TBD	2/1/30	BNL	
Uranium (U-238)	10/1/12	3/31/23		
Unresolved Resonance Region Evaluation Using the Hwang-Leal Methodology	10/1/13	12/31/15	ORNL	
Finalize URR Evaluation and Deliver to NNDC	1/1/16	1/1/16	ORNL	
Deliver p(nu) Data in ENDF/B Format	10/1/12	9/30/13	LANL	
Deliver Multiplicity-Dependent Fission Spectra	10/1/13	9/30/14	LANL	
Deliver Prompt Fission Gamma Spectra	10/1/14	3/31/16	LANL	
Phase I Testing, Post to ENDF/A and Broadcast	1/1/16	1/15/16	BNL	
CSEWG Validation Testing	1/16/16	12/31/16	NDAG	
CSEWG Approval of Complete Evaluation(s)	1/1/17	2/28/17	BNL	
Revisit fission cross section and covariance evaluation based on new TPC data (based on U238/U235 ratio data)	10/1/17	9/30/19	LANL	

Isotope(s)	Start Date	End Date	Responsible Laboratory	Comments
Finalize Prompt Fission Neutron Spectra Based on LANSCE Chi-Nu Data	10/1/21	3/31/23	LANL	
Finalize a report assessing our methodology to evaluate PFNS and multiplicity consistently, including angular information about prompt neutrons	4/1/19	9/30/20	LANL	
Evaluate PFNS and multiplicity consistently, including angular information about prompt neutrons	10/1/20	9/30/22	LANL	
Vanadium (V-51)	10/1/14	12/31/24		Additional task for measurement was described above
Complete Resonance Region Capture Measurements (Geel)	12/30/21	9/30/22	ORNL	Due to enhanced neutron scattering and MS of the thin V sample, experiments with a diluted sample are needed for the energy region below 10 keV.
Perform SAMMY Analysis	12/30/21	9/30/24	ORNL	The evaluation work should be started on the basis on the additional needed measurements
Finalize Resonance Evaluation and Deliver to NNDC	9/30/24	9/30/24	ORNL	
Phase I Testing, Post to ENDF/A and Broadcast	10/1/24	10/15/24	BNL	
CSEWG Validation Testing	10/16/24	10/31/24	NDAG	
CSEWG Approval of Complete Evaluation(s)	11/1/24	12/31/24	BNL	
Zirconium (Zr-90,91,92,94,96)	9/30/14	12/30/24		Capture and transmission Experiments with different nat-Zr samples have been performed
Deliver Updated High-Energy Evaluation of Zr-90	10/1/14	9/30/15	LANL	
Phase I Testing, Post to ENDF/A and Broadcast	10/1/15	10/15/15	BNL	
CSEWG Validation Testing	10/16/15	10/31/16	NDAG	
CSEWG Approval of Complete Evaluations	11/1/16	12/31/16	BNL	
Transmission and Capture Measurements	3/30/20	3/30/25	ORNL	Delay due to COVID-19
Experimentalist Data Reduction and Testing			ORNL	
Resolved Resonance Region Evaluation	3/30/21	6/30/26	ORNL	
Assess Data for URR Evaluation and Complete URR Evaluation	TBD	TBD	ORNL	
Finalize Resonance Evaluation and Deliver to NNDC	TBD	TBD	ORNL	

B-2 Differential Measurements and Evaluations – Compounds
(The following list provides the specific GANTT chart to refer to for each element work schedule)

- Paraffin (C_nH_{2n+2})
- Plutonium Oxide **(**PuO_2)
- Polystyrene $(C_8H_8)_n$
- Calcium Hydride (CaH_2)
- Reactor Grade Graphite (20% porosity)
- Uranium Metal (U)
- Uranium Carbide (UC)
- Uranyl Fluoride (UO_2F_2)
- Triuranium Octoxide (U_3O_8)
- Uranium Silicide (U_3Si_2)
- Water (H_2O)
- Polyethylene $(C_2H_4)_n$ – subthermal transmission
- Polystyrene $(C_8H_8)_n$ – subthermal transmission
- Yttrium Hydride (YH_x) – subthermal transmission
-

<u>Completed Work</u>

- Lucite **(**$C_5O_2H_8$)
- Polyethylene $(CH_2)_n$
- Beryllium (metal)
- Beryllium Oxide (BeO)
- Crystal Graphite
- Reactor Graphite
- Silicon Carbide (SiC)
- Silicon Dioxide (SiO_2)
- Uranium Dioxide (UO_2)
- Uranium Nitride (UN)
- Hexagonal Ice (H_2O) – evaluated by NNL
- Yttrium Hydride (YH_2) – evaluated by NNL
- FLiBe liquid
- Paraffinic Oil
- Uranium Hydride (UH_3) – evaluate by NNL
- Hydrofluoric Acid (HF)

Table B-2. Thermal Scattering Measurements and Evaluations - Compounds

Isotope(s)	Start Date	End Date	Responsible Laboratory	Comments
Water (H_2O)	10/1/17	12/31/21		
Thermal Scattering Evaluation	10/1/17	9/30/21	NCSU	
Finalize and Deliver Evaluation to NNDC	TBD	9/30/21	NCSU	
Phase 1 Testing, Post to ENDF/A and Broadcast	TBD	TBD	BNL	
CSEWG Validation Testing	TBD	TBD	NDAG	
CSEWG Approval of Complete Evaluation	TBD	12/31/21	BNL	
Calcium Hydride (CaH_2)	10/1/19	9/30/22		Emergent request from micro reactor community
Thermal Scattering Evaluation	10/1/19	9/30/21	NCSU	
Finalize and Deliver Evaluation to NNDC	TBD	9/30/21	NCSU	
Phase 1 Testing, Post to ENDF/A and Broadcast	TBD	TBD	BNL	
CSEWG Validation Testing	TBD	TBD	NDAG	
CSEWG Approval of Complete Evaluation	TBD	9/30/22	BNL	
Reactor Grade Graphite (20% porosity)	10/1/19	9/30/22		
Thermal Scattering Evaluation	10/1/19	9/30/21	NCSU	
Finalize and Deliver Evaluation to NNDC	TBD	9/30/21	NCSU	
Phase 1 Testing, Post to ENDF/A and Broadcast	TBD	TBD	BNL	
CSEWG Validation Testing	TBD	TBD	NDAG	
CSEWG Approval of Complete Evaluation	TBD	9/30/22	BNL	
Uranium Metal (U)	10/1/19	12/31/21		Replaced hydraulic fluid.
Thermal Scattering Evaluation	TBD	TBD	NCSU	
Finalize and Deliver Evaluation to NNDC	TBD	TBD	NCSU	
Phase 1 Testing, Post to ENDF/A and Broadcast	TBD	TBD	BNL	
CSEWG Validation Testing	TBD	TBD	NDAG	
CSEWG Approval of Complete Evaluation	TBD	12/31/21	BNL	
Uranium Carbide (UC)	10/1/20	12/31/22		
Thermal Scattering Evaluation	TBD	TBD	NCSU	
Finalize and Deliver Evaluation to NNDC	TBD	TBD	NCSU	
Phase 1 Testing, Post to ENDF/A and Broadcast	TBD	TBD	BNL	
CSEWG Validation Testing	TBD	TBD	NDAG	
CSEWG Approval of Complete Evaluation	TBD	12/31/22	BNL	

Isotope(s)	Start Date	End Date	Responsible Laboratory	Comments
Paraffin (C_nH_{n+2})	10/1/21	12/31/23		
Thermal Transmission Measurements	TBD	TBD	RPI	
Thermal Scattering Evaluation	TBD	TBD	NCSU	
Finalize and Deliver Evaluation to NNDC	TBD	TBD	NCSU	
Phase 1 Testing, Post to ENDF/A and Broadcast	TBD	TBD	BNL	
CSEWG Validation Testing	TBD	TBD	NDAG	
CSEWG Approval of Complete Evaluation	TBD	12/31/23	BNL	
Triuranium Octoxide (U_3O_8)	10/1/22	12/31/24		
Thermal Transmission Measurements	TBD	TBD	RPI	
Thermal Scattering Evaluation	TBD	TBD	NCSU	
Finalize and Deliver Evaluation to NNDC	TBD	TBD	NCSU	
Phase 1 Testing, Post to ENDF/A and Broadcast	TBD	TBD	BNL	
CSEWG Validation Testing	TBD	TBD	NDAG	
CSEWG Approval of Complete Evaluation	TBD	12/31/24	BNL	
Uranyl Fluoride (UO_2F_2)	10/1/23	12/31/25		
Thermal Transmission Measurements	TBD	TBD	RPI	
Thermal Scattering Evaluation	TBD	TBD	NCSU	
Finalize and Deliver Evaluation to NNDC	TBD	TBD	NCSU	
Phase 1 Testing, Post to ENDF/A and Broadcast	TBD	TBD	BNL	
CSEWG Validation Testing	TBD	TBD	NDAG	
CSEWG Approval of Complete Evaluation	TBD	12/31/25	BNL	
Uranium Silicide (U_3Si_2)	10/1/24	12/31/26		
Thermal Transmission Measurements	TBD	TBD	RPI	
Thermal Scattering Evaluation	TBD	TBD	NCSU	
Finalize and Deliver Evaluation to NNDC	TBD	TBD	NCSU	
Phase 1 Testing, Post to ENDF/A and Broadcast	TBD	TBD	BNL	
CSEWG Validation Testing	TBD	TBD	NDAG	
CSEWG Approval of Complete Evaluation	TBD	12/31/26	BNL	
Plutonium Oxide (PuO_2)	10/1/25	12/31/27		.
Thermal Scattering Measurements	TBD	TBD	NCSU	
Thermal Scattering Evaluation	TBD	TBD	NCSU	
Finalize and Deliver Evaluation to NNDC	TBD	TBD	NCSU	
Phase 1 Testing, Post to ENDF/A and Broadcast	TBD	TBD	BNL	

Isotope(s)	Start Date	End Date	Responsible Laboratory	Comments
CSEWG Validation Testing	TBD	TBD	NDAG	
CSEWG Approval of Complete Evaluation	TBD	12/31/27	BNL	
Uranium Silicide (U_3Si_2)	10/1/24	12/31/26		
Thermal Transmission Measurements	TBD	TBD	RPI	
Thermal Scattering Evaluation	TBD	TBD	NCSU	
Finalize and Deliver Evaluation to NNDC	TBD	TBD	NCSU	
Phase 1 Testing, Post to ENDF/A and Broadcast	TBD	TBD	BNL	
CSEWG Validation Testing	TBD	TBD	NDAG	
CSEWG Approval of Complete Evaluation	TBD	12/31/26	BNL	
Polystyrene $(C_8H_8)_n$	10/1/19	9/30/22		
Procure Samples	10/1/19	6/30/20	ORNL	
Write Proposal for Beamtime	3/30/20	3/30/20	ORNL	
Experiment Preparations	6/30/20	6/30/20	ORNL	
Differential Thermal Scattering Measurements at SNS	7/1/20	12/31/20	ORNL	Experiments may be delayed due to COVID-19
Data Reduction & Analysis of SNS Data	7/1/20	2/28/21	ORNL	
Sub thermal Transmission Measurements at RPI	1/1/21	4/1/21	ORNL/RPI	Dependent on progress of sub thermal moderator at RPI, which is experiencing COVID-19 related delays.
Data Reduction & Analysis of RPI Data	1/1/21	5/1/21	ORNL/RPI	
Prepare Experimental Data for Submission to EXFOR	5/1/21	7/31/21	ORNL	
Submit Experimental Data to EXFOR	7/31/21	7/31/21	ORNL	
Perform Thermal Scattering Evaluation	6/1/20	7/1/22	ORNL	
Finalize and Deliver Evaluation to NNDC	7/15/22	7/31/22	ORNL	
Phase 1 Testing, Post to ENDF/A and Broadcast	8/1/22	8/14/22	BNL	
CSEWG Validation Testing	8/15/22	8/30/22	NDAG	
CSEWG Approval of Complete Evaluation	9/1/22	9/30/22	BNL	
Polyethylene $(C_2H_4)_n$	10/1/20	9/30/21		
Sub-thermal transmission measurements at RPI	10/1/20	9/30/21	RPI	
Data reduction and analysis	10/1/20	9/30/21	RPI	
Submit Experimental data to EXFOR	9/1/21	9/30/21	RPI	
Yttrium Hydride (YH_x)	10/1/20	9/30/22		
Sub-thermal transmission measurements at RPI	10/1/20	9/30/21	RPI	

Isotope(s)	Start Date	End Date	Responsible Laboratory	Comments
Data reduction and analysis	10/1/20	9/30/22	RPI	
Submit Experimental data to EXFOR	9/1/22	9/30/22	RPI	

APPENDIX C: Fiscal Year 2022 Projected Foreign Travel

Lab and Participant(s)	Destination	Date	Count	Costs ($)	Conference/Meeting Title	Task	Milestone	Justification
BNL Brown, Vorabbi	Tokyo, Japan	Sep-22	2	12,000	Fifth International Conference on Nuclear Data Covariances	AM, ND, TS	Provide brief trip summary report to NCSP Manager (Q4).	Premier workshop on covariances and S/U methods.
LANL Hutchinson, Amundson, McKenzie, McSpaden, , Favorite, Weldon, Smith	OECD/NEA Paris, France	Oct-21	7	42,000 (in person) or 0 (Virtual)	ICSBEP, IRPhE, and SINBAD Technical Review Meetings	IE, TS	Provide brief trip summary report to NCSP Manager (Q1).	Authors or reviewers for CURIE and JAEA evaluations for ICSBEP, as well as authors of future submissions who have not attended previously. Will also attend IRPhE, and SINBAD Technical Review Meetings.
LANL Leal-Cidoncha	CNR* Athens, Greece	Oct-21	1	8,000	International Workshop on Compound Nuclear Reactions	ND3	Provide brief trip summary report to NCSP Manager (Q1, pending date of conference)	Participation provides state of the art information on improving experimental methods for neutron capture studies.
LANL Conlin, Haeck	IAEA, Vienna	Fall-21	2	12,000	IAEA Consultancy Meeting	AM-1,2	Provide brief trip summary report to NCSP Manager (Q1)	Meetings are related to nuclear data processing, the codes and the processed formats. As NJOY developers (AM-2) and processors (AM-1) we play an important role.
LANL Conlin, Haeck	OECD/NEA Paris, France	Dec-21	2	12,000	Alternate WPEC Meeting	AM, ND	Provide brief trip summary report to NCSP Manager (Q2).	Contributors and co-leads of multiple sub-groups and expert groups. See below.
LANL Paris, Herman, Colin, Haeck, Thompson, Cutler	OECD/NEA Paris, France	May-22	6	36,000	WPEC Annual Meeting and associated subgroup meetings	ND, AM, IE	Provide brief trip summary report to NCSP Manager (Q3).	Contributor and co-leads of multiple sub-groups and expert groups, including SG45 "Validation of Nuclear Data Libraries (VaNDaL) Project," SG46 ""Efficient and Effective Use of Integral Experiments for Nuclear Data Validation," SG49 "Reproducibility in Nuclear Data Evaluation," and EG-GNDS "Recommended Definition of General Nuclear Database Structure." All of these groups are focused on activities that overlap with NCSP priorities.
LANL Rising, Alwin, Hayes,	OECD/NEA Paris, France	Jan-22 (virtual) Jul-22	5	30,000	WPNCS Annual Meeting and associated subgroup meetings	AM, ND, IE	Provide brief trip summary report to NCSP Manager (Q4).	Contributors and participants in multiple subgroups aimed at providing and comparing state-of-the-art information for improving MCNP®, Whisper, and

Lab and Participant(s)	Destination	Date	Count	Costs ($)	Conference/Meeting Title	Task	Milestone	Justification
Thompson, McKenzie								other computational methods that are necessary and heavily used in NCSP work. Ongoing subgroups include: benchmark quality assessments and metrics, computational bias methods and comparisons, and benchmark correlation calculational methods.
LANL Leal-Cidoncha	WONDER Aix-en-Provence, France	TBD-22	1	8,000	6th International Workshop on Nuclear Data Evaluation for Reactor Applications	ND3	Provide brief trip summary report to NCSP Manager (Q4, pending date of conference)	Participation provides state of the art information and needs for reactor application technologies, fuel cycle, and vulnerabilities.
LANL, Hutchinson, Thompson, Goda, Alwin	IRSN Paris, France	TBD 21-22	4	12,000	Coordinate International Collaboration Efforts with IRSN	IE, AM, ND, IPD	Provide brief trip summary report to NCSP Manager	Coordinate work as described the Five-Year Execution Plan, Appendix E.
LANL, Hutchinson, Cutler, Goda, Alwin	AWE	TBD 21-22	4	12,000	Coordinate International Collaboration Efforts with AWE (*if needed, combine with IRSNL trip, all but one person will travel from IRSN to AWE)	IE, AM, ND, IPD	Provide brief trip summary report to NCSP Manager	Coordinate work as described the Five-Year Execution Plan, Appendix F.
LLNL Heinrichs, Norris, Percher, Kim	OECD/NEA Paris, France	Oct-21	4	24,000	ICSBEP, IRPhE, and SINBAD Technical Review Meetings	IE, IPD, TS	Provide brief trip summary report to NCSP Manager (Q1).	ICSBEP, IRPhE, and SINBAD Technical Review Meetings.
LLNL Godfree, Mattoon	IAEA NDS Vienna, Austria	Oct-21	2	12,000	IAEA Technical Meeting on Nuclear Data Processing	AM	Provide brief trip summary report to NCSP Manager (Q1)	Technical meeting of international experts on nuclear data processing methods and codes.
LLNL Coleman, Percher	Brussels, Belgium	Nov-21	2	12,000	Nuclear Education and Training NESTet 2021 International Conference	TE	Provide brief trip summary report to NCSP Manager (Q1)	Premier conference on nuclear education and training.
LLNL Siefman, Stone	Lausanne, Switzerland	Nov-21	2	12,000	International Symposium on Reactor Dosimetry ISRD 2021	AM, IE, IPD	Provide brief trip summary report to NCSP Manager (Q1)	Premier conference on experimental techniques, databases, and standards for neutron metrology.
LLNL Ganapol, Heinrichs	Bertinoro, Italy	Dec-21	2	12,000	International Conference on Transport Theory 2021	AM	Provide brief trip summary report to NCSP Manager (Q2)	Premier conference on radiation transport theory.
LLNL Beck, Mattoon	IAEA NDS Vienna, Austria	May-22	2	12,000	IAEA Technical Workshop on Compilation of Experimental Nuclear Reaction Data (EXFOR)	ND, TS	Provide brief trip summary report to NCSP Manager (Q3)	Technical meeting of international experts on nuclear data compilation essential for nuclear data evaluation.

Lab and Participant(s)	Destination	Date	Count	Costs ($)	Conference/Meeting Title	Task	Milestone	Justification
LLNL Mattoon, Percher, Siefman	OECD/NEA Paris, France	May-22	3	18,000	WPEC Annual Meeting and associated subgroup meetings	AM, IE, ND, TS	Provide brief trip summary report to NCSP Manager (Q3).	Technical meeting of international experts on nuclear data including SG38 (GND) and SG42 (Thermal scattering law).
LLNL Coleman	Japan	Jun-22	1	6,000	World Nuclear University	TS	Provide brief trip summary report to NCSP Manager (Q3).	Unique nuclear educational and training opportunity for emerging leaders and SMEs in nuclear technology.
LLNL Percher, Coleman, Heinrichs	OECD/NEA Paris, France	Jul-22	3	18,000	WPNCS Annual Meeting and associated subgroup meetings	AM, IE, IPD, TS	Provide brief trip summary report to NCSP Manager (Q4).	Participate in activities of the Working Party on Nuclear Criticality Safety and expert group meetings on IE S/U, MC methods, criticality accidents, and experimental needs.
LLNL Norris, Siefman	Tokyo, Japan	Sep-22	2	12,000	Fifth International Workshop on Nuclear Data Covariances	AM, ND, TS	Provide brief trip summary report to NCSP Manager (Q4).	Premier workshop on covariances and S/U methods.
LLNL Coleman, Heinrichs, Percher	Aldermaston, United Kingdom	TBD-2022	3	18,000	JOWOG29/30 Meetings	AM, IE, IPD, ND, TE, TS	Provide brief trip summary report to NCSP Manager (Q4).	Coordinate joint AWE-LLNL work as described in Appendix F of the Five-Year Execution Plan.
LLNL Heinrichs, Percher, Norris	Paris, France	TBD-2022	3	18,000	Coordinate International Collaboration Efforts with IRSN	AM, IE, IPD, ND, TS5	Provide brief trip summary report to NCSP Manager (Q4).	Coordinate joint IRSN-LLNL work as described in Appendix E of the Five-Year Execution Plan.
LLNL Heinrichs, Mattoon	IAEA NDS Vienna, Austria	TBD - 2022	2	12,000	IAEA Expert Group Meeting on Nuclear Data Processing and Thermal Scattering Laws	AM, ND	Provide brief trip summary report to NCSP Manager (Q4)	Technical meeting of international experts on nuclear data processing methods and codes.
LLNL Norris, Siefman	OECD/NEA Paris, France	TBD-2022	2	12,000	OECD NEA Training Course on FISPACT-II	AM, IE, IPD, ND, TS	Provide brief trip summary report to NCSP Manager (Q4)	Unique training opportunity on UKAEA's enhanced multiphysics, inventory, and source term code system.
NNL NDAG Chair (Zerkle)	OECD/NEA Paris, France	Oct-21	1	6,000 (in person) or 0 (Virtual)	ICSBEP, SINBAD, and IRPhE Technical Review Meetings	ND	Provide brief trip summary report to NCSP Manager (Q1).	Provide oversight of NCSP IE tasks as ICSBEP, SINBAD, and IRPhEP tasks are the end product of the NCSP IE process. May be held online due to COVID-19.
NNL NDAG Chair (Zerkle)	OECD/NEA Paris, France	May-22	1	6,000	WPEC Annual Meeting and associated subgroup meetings	ND	Provide brief trip summary report to NCSP Manager (Q3).	As NDAG Chair, participate in WPEC, SG48 (Thermal Scattering Law) and EG-HPRL
NNL NDAG Chair (Zerkle)	OECD/NEA Paris, France	Jul-22	1	6,000	WPNCS Annual Meeting and associated subgroup meetings	ND	Provide brief trip summary report to NCSP Manager (Q4).	As NDAG Chair, participate in SG8 on criticality benchmark expert knowledge.
RPI Danon	OECD/NEA Paris, France	May-22	1	6,000	WPEC Annual Meeting and associated subgroup meetings.	ND	Provide brief trip summary report to NCSP Manager (Q3).	As CSEWG US Measurements Chair, participate and present in the WPEC meeting, subgroup SG-C

Lab and Participant(s)	Destination	Date	Count	Costs ($)	Conference/Meeting Title	Task	Milestone	Justification
								(high priority list), and other subgroups. Also actively participate in SG-48 (Advances in Thermal Scattering Law Analysis).
ORNL Bowen, Marshall, Clarity, Celik, Dupont	OECD/NEA Paris, France	Oct.-21	5	30,000 (in person) or 0 (Virtual)	ICSBEP, IRPhE, and SINBAD Technical Review Meetings	TS, IE, AM2	Provide brief trip summary report to NCSP Manager (Q1).	Provide oversight of NCSP IE tasks as ICSBEP tasks are the end product of the NCSP IE process, present HPRR benchmark to the TRG. The decision on in-person or virtual is expected by the end of August, 2021.
ORNL Wiarda, McDonnell, Holcomb	IAEA NDS Vienna, Austria	Oct-21	2	12,000	IAEA Technical Meeting on Nuclear Data Processing	AM	Provide brief trip summary report to NCSP Manager (Q1)	Technical meeting of international experts on nuclear data processing methods and codes.
ORNL Bowen	China	May-22	1	6,000	ISO TC85/SC5 Plenary and WG8 Nuclear Criticality Safety Meetings	TS	Provide brief trip summary report to NCSP Manager (Q3).	Continue to provide US leadership with ISO Nuclear Criticality Safety Standards (Rescheduled 2020 meeting)
ORNL Guber, Brown	IRMM Mol, Belgium	Nov-21	2	20,000	Resonance region nuclear data measurements using GELINA facility at IRMM	ND, TS	Provide brief trip summary report to NCSP Manager (Q1).	Continues cross-section measurements to support the production of new cross-section evaluations per the schedule in Appendix B of the Five-Year Plan. Jesse Brown to support half of the visits to supporting succession planning.
ORNL Guber, Brown	IRMM Mol, Belgium	Apr-22	2	20,000	Resonance region nuclear data measurements using GELINA facility at IRMM	ND, TS	Provide brief trip summary report to NCSP Manager (Q3).	Continues cross-section measurements to support the production of new cross-section evaluations per the schedule in Appendix B of the Five-Year Plan. Jesse Brown to support half of the visits to supporting succession planning.
ORNL Pigni, Wiarda, Brown, Holcomb, Chapman	OECD/NEA Paris, France	May-22	4	24,000	WPEC Annual Meeting and associated subgroup meetings	ND, TS	Provide brief trip summary report to NCSP Manager (Q3).	Technical meeting of international experts on nuclear data including SG38 (GND), EG-GNDS, SG48 (thermal scatter), SG44 (covariance), SG45 (validation), SG46 (IE for ND evaluation), SG50 (automatic readable experimental data base)
ORNL Bowen	Tokyo, JP	Nov-21	1	7,500	ISO TC85/SC5 Plenary and WG8 Nuclear Criticality Safety Meetings	TS	Provide brief trip summary report to NCSP Manager (Q1).	Continue to provide US leadership with ISO Nuclear Criticality Safety Standards (Annual Meeting)

Lab and Participant(s)	Destination	Date	Count	Costs ($)	Conference/Meeting Title	Task	Milestone	Justification
ORNL Guber	IRMM Mol, Belgium	Jun-22	1	10,000	Resonance region nuclear data measurements using GELINA facility at IRMM	ND, TS	Provide brief trip summary report to NCSP Manager (Q3).	Continues cross-section measurements to support the production of new cross-section evaluations per the schedule in Appendix B of the Five-Year Plan. Jesse Brown to support half of the visits to supporting succession planning.
ORNL Holcomb, Arbanas, or Pigni	Tokyo, JP	Sep-22	2	12,000	Fifth International Conference on Nuclear Data Covariances	ND, TS	Provide brief trip summary report to NCSP Manager (Q4).	This conference is within the mission of ORNL ND work and aligned with the NCSP Mission and Vision.
ORNL Guber, Brown	IRMM Mol, Belgium	Sep-22	2	20,000	Resonance region nuclear data measurements using GELINA facility at IRMM	ND, TS	Provide brief trip summary report to NCSP Manager (Q4).	Continues cross-section measurements to support the production of new cross-section evaluations per the schedule in Appendix B of the Five-Year Plan. Jesse Brown to support half of the visits to supporting succession planning.
ORNL Marshall, Bowen, Clarity, Wieselquist, Bekar, NCG GL	OECD/NEA Paris, France	Jul-22	6	36,000	WPNCS Annual Meeting and associated subgroup meetings	TS, IE, AM	Provide brief trip summary report to NCSP Manager (Q4).	AM collaboration; provide relationship between IAEA and ISO with respect to NCS standards.
ORNL Bowen	Aldermaston, United Kingdom	TBD-2022	3	6,000	JOWOG29/30 Meetings	AM, IE, IPD, ND, TE, TS	Provide brief trip summary report to NCSP Manager (Q4).	Participate in JOWOG meetings as NCSP execution manager.
ORNL Pigni	Vienna, Austria	TBD-22	1	6,000	IAEA International Nuclear Data Evaluation Network (INDEN)	ND	Provide brief trip summary report to NCSP Manager (Q3).	IAEA International Nuclear Data Evaluation Network (INDEN), Vienna, 1 week. International nuclear data evaluation collaboration. Represent NCSP and ORNL interests in international nuclear data evaluation.
ORNL Wiarda, Holcomb, McDonnell	Paris, France	TBD-22	3	18,000	IRSN Meetings	AM, IE, IPD, ND, TS	Provide brief trip summary report to NCSP Manager (Q3).	Coordinate joint IRSN-ORNL work per 5YP such as the Pu SlideRule; Collaborate with IRSN on the resonance evaluation of the isotopes for the NCSP.
SNL Ames, Harms, Lutz	OECD/NEA Paris, France	Oct-21	3	18,000 (in person) or 0 (Virtual)	ICSBEP, IRPhE, and SINBAD Technical Review Meetings	IE, TS	Provide brief trip summary report to NCSP Manager (Q2).	ICSBEP, IRPhE, and SINBAD Technical Review Meetings.

APPENDIX D: Baseline Budget Needs for Execution Year FY2022-FY2024

Baseline Budget Needs for Execution Year FY2022

Baseline budget need for the FY2022 Nuclear Criticality Safety Program (NCSP) is $29,387K with 95% of funding supporting NCSP FTE's, equating to approximately 58 national laboratory or facility contractor employees, who provide programmatic needs as outlined in the NCSP *The Mission and Vision of the United States Department of Energy Nuclear Criticality Safety Program for the Fiscal Years 2019-2028.* All tasks are approved based on their contribution to the achievement of the five- and ten-year goals as outlined in the Mission and Vision document. NCSP includes the following five technical program elements plus support infrastructure, with each having the major deliverables for FY2022.

- Analytical Methods (~9.3 FTEs supported)
    - Criticality Safety Computer Codes SCALE and MCNP support. Maintain RSICC who distributes all software. Development of NCS excursion analysis capability, thermal scattering and self-shielding capabilities in GNDS/FUDGE, and continued work on benchmark intercomparison studies. International collaborations: SCALE, NJOY, MCNP, AMPX work with AWE and IRSN.
- Information Preservation and Dissemination (~2.5 FTEs supported)
    - NCSP website upgrade and maintenance. Three new ICSBEP evaluations and publications (OECD/NEA collaboration) are planned to be completed in FY2022. Provide experimental uncertainty correlations.
- Integral Experiments (~32 FTEs supported)
    - A total of 36 critical/subcritical experiments at various stages of design and execution are planned in FY2022 (NCERC and SNL). Permanent party staff at NCERC is supported. International collaborations with AWE and IRSN are included with the planned experiments for FY2022 (see Appendix E and F).
- Nuclear Data (~8 FTEs supported)
    - Nuclear data evaluations and measurements prioritized for FY2022 are listed in Appendix B. RPI refurbishment (NR collaboration) continues despite some cost overruns for ancillary equipment. Produce new scattering law data (NCSU and RPI/ORNL collaboration). Modernization of SAMMY resonance analysis software. International collaborations with IRSN are included with the planned experiments for FY2022 (see Appendix E and F). Nuclear data measurements to be performed at IRMM/GELINA led by ORNL.
- Training and Education (~2.8 FTE supported)
    - Two 2-week courses at scheduled with a week of lecture at the National Atomic Testing Museum and hands-on experiments at NCERC and Sandia.
    - One 1-week managers course at Sandia. This course will be used to pilot new Criticality Safety Officer (CSO) training material. One 1-week managers course at NCERC. This course will be used to continue criticality safety training for CSOs and managers.
- NCSP Technical Support (~4.6 FTE supported)
    - Daily execution of the NCSP (ORNL) and support for the CSSG and travel support for two NDAG members. Each site is provided succession planning funds for maintaining key capabilities and NCSP expertise.

The approved Over target budget for FY2022 NCSP is $2,648K that would support to address key Mission and Vision goals not addressed within the current budget target:

- Complete tasks in the 5-year plan (898K)
- Additional funding to support a minimum of two 2-week hands-on NCSP courses ($500K)
- Radiation Safety Information Computational Center (RSICC) to support code package distribution costs for university students ($700K)
- RPI accelerator refurbishment ($150K)
- Subcritical assembly at ORNL for use with the CSO/manger/fissile material handler courses ($400K)

Baseline Budget Needs for Execution Year FY2023

Baseline budget need for the FY2023 Nuclear Criticality Safety Program (NCSP) is $30,770K with 95% of funding supporting NCSP FTE's, equating to ~61.5 national laboratory or facility contractor employees, who provide programmatic needs as outlined in the NCSP *The Mission and Vision of the United States Department of Energy Nuclear Criticality Safety Program for the Fiscal Years 2019-2028.* All tasks are approved based on their contribution to the achievement of the five- and ten-year goals as outlined in the Mission and Vision document.

NCSP includes the following five technical program elements plus support infrastructure, with each having the major deliverables for FY2023:

- Analytical Methods (~10 FTEs supported)
    - Criticality Safety Computer Codes SCALE and MCNP support. Maintain Radiation Safety Information Computational Center who distributes all software. Development of NCS excursion analysis capability, thermal scattering and self-shielding capabilities in GNDS/FUDGE, and continued work on benchmark intercomparison studies. International collaborations: SCALE, NJOY, MCNP, AMPX work.
- Information Preservation and Dissemination (~1.7 FTEs supported)
    - NCSP website upgrade and maintenance. About six new ICSBEP evaluations and publications (OECD/NEA collaboration) are planned to be completed in FY2023.
- Integral Experiments (~32.4 FTEs supported)
    - The 36 critical/subcritical experiments at various stages of design and execution planned in FY2022 (NCERC and SNL) will continue in FY2023. Some newly proposed experiments may be added to the NCSP manager's priority list. Permanent party staff at NCERC is supported. International collaborations with AWE and IRSN are included with the planned experiments for FY2022 (see Appendix E and F).
- Nuclear Data (~8.4 FTEs supported)
    - Nuclear data evaluations and measurements prioritized for FY2023 are listed in Appendix B. RPI refurbishment (NR collaboration) continues despite some cost overruns for ancillary equipment. Produce new scattering law data (NCSU and RPI/ORNL collaboration). Modernization of SAMMY resonance analysis software. International collaborations with IRSN are included with the planned experiments for FY2023 (see Appendix E and F). Nuclear data measurements to be performed at IRMM/GELINA led by ORNL.
- Training and Education (~3.7 FTE supported)
    - Two 2-week courses at scheduled with a week of lecture at the National Atomic Testing Museum and hands-on experiments at NCERC and Sandia.
    - One 1-week managers course at Sandia and at NCERC. This course will be used to continue criticality safety training for CSOs and managers.
- NCSP Technical Support (~5.4 FTEs supported)
    - Daily execution of the NCSP (ORNL) and support for the CSSG and travel support for two NDAG members. Each site is provided succession planning funds for maintaining key capabilities and NCSP expertise.

The approved Over target budget for FY2023 NCSP is $3,318K that would support high priority tasks to address key Mission and Vision goals not addressed within the current budget target:

- Complete tasks in the NCSP 5-year plan ($1568K)
- Additional funding to support a minimum of two 2-week hands-on NCSP courses ($500K)
- Additional RSICC funding ($700K)
- RPI accelerator refurbishment ($150K)
- Subcritical assembly at ORNL for Use with CSO/FMH Courses ($400K)

Baseline Budget Needs for Execution Year FY2024

Baseline budget need for the FY2024 Nuclear Criticality Safety Program (NCSP) is $30,842K with 95% of funding supporting NCSP FTE's, equating to ~61.7 national laboratory or facility contractor employees, who provide programmatic needs as outlined in the NCSP *The Mission and Vision of the United States Department of Energy Nuclear Criticality Safety Program for the Fiscal Years 2019-2028.* All tasks are approved based on their contribution to the achievement of the five- and ten-year goals as outlined in the Mission and Vision document.

NCSP includes the following five technical program elements plus support infrastructure, with each having the major deliverables for FY2024:

- Analytical Methods (~8.7 FTEs supported)
    - Criticality Safety Computer Codes SCALE and MCNP support. Maintain Radiation Safety Information Computational Center who distributes all software. Development of NCS excursion analysis capability, thermal scattering and self-shielding capabilities in GNDS/FUDGE, and continued work on benchmark intercomparison studies. International collaborations: SCALE, NJOY, MCNP, AMPX work.
- Information Preservation and Dissemination (~1.5 FTEs supported)
    - NCSP website upgrade and maintenance. Numerous experiments current in execution phase are planned be in the ICSBEP evaluations development phase in FY2024.
- Integral Experiments (~32.8 FTEs supported)
    - Experiments proposed in FY2022 and FY2023 will continue, and new experiments are likely to be added to the NCSP manager's priority list for FY2024. Permanent party staff at NCERC is supported. International collaborations with AWE and IRSN are included with the planned experiments for FY2024 (see Appendix E and F).
- Nuclear Data (~8.2 FTEs supported)
    - Nuclear data evaluations and measurements prioritized for FY2022 are listed in Appendix B. RPI refurbishment (NR collaboration) continues despite some cost overruns for ancillary equipment. Produce new scattering law data (NCSU and RPI/ORNL collaboration). Modernization of SAMMY resonance analysis software. International collaborations with IRSN are included with the planned experiments for FY2024 (see Appendix E and F). Nuclear data measurements to be performed at IRMM/GELINA led by ORNL.
- Training and Education (~3.5 FTE supported)
    - Two 2-week courses at scheduled with a week of lecture at the National Atomic Testing Museum and hands-on experiments at NCERC and Sandia.
    - One 1-week managers course at Sandia and at NCERC. This course will be used to continue criticality safety training for CSOs and managers.
- NCSP Technical Support (~7.0 FTEs supported)
    - Daily execution of the NCSP (ORNL) and support for the CSSG and travel support for two NDAG members. Each site is provided succession planning funds for maintaining key capabilities and NCSP expertise.

The approved Over target budget for FY2024 NCSP is $3,947K that would support high priority tasks to address key Mission and Vision goals not addressed within the current budget target:

- Complete tasks in the NCSP 5-year plan ($2,197K)
- Additional funding to support a minimum of two 2-week hands-on NCSP courses ($500K)
- Additional RSICC funding ($700K)
- RPI accelerator refurbishment ($150K)
- Subcritical assembly at ORNL for Use with CSO/FMH Courses ($400K)

APPENDIX E: International Collaboration with the Institut de Radioprotection et de Sûreté Nucléaire (IRSN) for FY2022

IRSN has an active and growing program of collaboration with the NCSP that aims to underpin and enhance IRSN's nuclear criticality safety. IRSN will provide its expertise and capabilities to support the NCSP's mission and vision so that the collaboration is mutually beneficial to both organizations.

	REFERENCE		IRSN Contribution / POC			
IRSN Reference	**Task Title**	**DOE Reference**	**FY 2022 IRSN Contribution**	**IRSN Technical POC**	**DOE Technical POC**	**DOE LAB**
ANALYTICAL METHODS						
IRSN-AM5	Update of the slide rule	ORNL-AM6 LLNL-AM3 AWE-AM1	Contribution to doses computation benchmarks, comparison with COG and SCALE results	M. DULUC	D. BOWEN D. HEINRICHS R. JONES	ORNL LLNL AWE
IRSN-AM8	Analytical Methods Working Group	LANL-AM1 ORNL-AM2 LLNL-AM3	IRSN participation to NCSP Analytical Methods Working Group, NDAG meeting, and TPR meeting	S. PIGNET	J. ALWIN B.J. MARSHALL D. HEINRICHS	NCSP
IRSN-AM9	Cross sections processing validation	ORNL-AM3	AMPX training - Development of an interface between GAIA and AMPX and test interface capabilities.	R. ICHOU	A. HOLCOMB D. BOWEN	ORNL
IRSN-AM13	Benchmark intercomparison study	(FY21 5 YP) LLNL-AM5 ORNL-AM10 LANL-AM5 FY22-02	Definition of common set of developed benchmark models. Extension 2022-2024	N. LECLAIRE	D. HEINRICHS B.J. MARSHALL J. ALWIN	LLNL ORNL LANL
IRSN-AM14	Sensitivity/Uncertainty comparison study with a focus on Upper Subcritical Limits	(FY21 5 YP) ORNL-AM9 LANL-AM4	Definition of test cases Calculations and intercomparison Technical report	A. BARDELAY	J. ALWIN B.J. MARSHALL	LANL ORNL
IRSN-AM18	Use of Thermal/Epithermal Integral Experiment (TEX) for potential cross section adjustments	Proposal FY22-31 (Not funded for FY2022)	Use of IRSN MACSENS adjustment code for benchmarking	N. LECLAIRE	D. BOWEN C. PERCHER	ORNL LLNL
INTEGRAL EXPERIMENTS						
IRSN-IE6 **IER 306**	Rh experiment	SNL-IE1	Design optimization to accommodate Rh cost	N. LECLAIRE	G. HARMS	SNL
IRSN-IE7 **IER 305**	Mo experiment	SNL-IE1	Contribution to ICSBEP evaluation of baseline experiments.	N. LECLAIRE	G. HARMS	SNL
IRSN-IE11 **IER 297**	TEX - Hf baseline experiments (HEU)	LLNL-IE4	Contribution to ICSBEP evaluation of the baseline experiments	M. BROVCHENKO	C. PERCHER	LLNL
IRSN-IE11 **IER 532**	TEX-Hf experiments	LLNL-IE4	Contribution to the analysis of the experiments (CED-4)	M. BROVCHENKO	C. PERCHER	LLNL

	REFERENCE		IRSN Contribution / POC			
IRSN Reference	**Task Title**	**DOE Reference**	**FY 2022 IRSN Contribution**	**IRSN Technical POC**	**DOE Technical POC**	**DOE LAB**
IRSN-IE27 **IER 498**	GODIVA CAAS benchmark	ORNL-IE1	Participation in the design. Provide IRSN materials for irradiation	F. TROMPIER	D. BOWEN R. CUMBERLAND	ORNL
IRSN-IE28 **IER 406**	Cf-252 CAAS benchmark	LLNL-IE1	Participation in the experiments. Provide IRSN materials for irradiation	F. TROMPIER	D. HEINRICHS	LLNL
IRSN-IE30 **IER 538**	Full dosimetry exercise around GODIVA	LLNL-IE1	Participation to the experiment. Provide IRSN materials for irradiation, analysis of results	F. TROMPIER	D. HEINRICHS	LLNL AWE
IRSN-IE34 **IER 488**	MUSIC (HEU) critical and Subcritical measurements.	LANL-IE3	Analysis of results, contribution to CED4	W. MONANGE	J. HUTCHINSON	LANL
IRSN-IE36 **FY20-25**	ICSBEP/SINBAD Shielding benchmarks for shipping containers	LLNL-IE1 AWE-IE8	Participation in the design and to the experiments	M. BROVCHENKO	D. HEINRICHS R. JONES	LLNL AWE
IRSN-IE41 **IER 499**	Thermal/Epithermal Experiments (TEX) with Chlorine and Lithium	LLNL-IE1	Participation in CED reports.	M. BROVCHENKO	D. HEINRICHS	LLNL
IRSN-IE42 **IER 121**	Neptunium Subcritical Observations (NeSO) experiment	LANL-IE3	Independent review of the ICSBEP evaluation.	W. MONANGE	J. HUTCHINSON	LANL
IRSN-IE45 **IER 517**	Integral Experiments for Validation of Molybdenum Neutron Cross Sections on the whole energy spectrum	LANL-IE3	Participation in experiments design and CED reports. In 2022, participation to CED1 review	N. LECLAIRE	N. THOMPSON D. HAYES T. CUTLER	LANL
IRSN-IE46 **IER 518** **FY20-29**	High Multiplication Subcritical (Multiplicity) Benchmark Experiments	LLNL-IE1 SNL-IE1 LANL-IE3	Participation in experiments. IRSN will provide detectors for comparison.	W. MONANGE	D. HEINRICHS G. HARMS J. HUTCHINSON	LLNL SNL LANL
IRSN-IE47 **IER 537**	Copper Critical Experiment	LANL-IE3	Participation in CED reports. IRSN is interested to understand results of various experiments (ZEUS experiments results and IRSN-IE48) Contribution to CED2 review	J-B. CLAVEL	T. CUTLER K. AMUNDSON	LANL
IRSN-IE48 **IER 520**	TEX Pu-240 Experiment	LLNL-IE1	Technical exchanges on design. Participation to the experiments, review of CED-4a	M. BROVCHENKO	C. PERCHER	LLNL
IRSN-IE49 **IER 479**	TEX low temperature	LLNL-IE1	Contribution to design, supplying materials if needed	M. BROVCHENKO	C. PERCHER	LLNL
IRSN-IE50	Thermal/Epithermal Experiments (TEX) with U-238 in Reflection and Interaction	Proposal FY22-13 (Unfunded low Priority Experiment for FY2022)	Contribution to design. IRSN supplies materials if needed	M. BROVCHENKO	C. PERCHER	LLNL LANL

	REFERENCE		IRSN Contribution / POC			
IRSN Reference	**Task Title**	**DOE Reference**	**FY 2022 IRSN Contribution**	**IRSN Technical POC**	**DOE Technical POC**	**DOE LAB**
IRSN-IE51	Thermal/Epithermal Experiments (TEX) Aluminum in Reflection and Interaction	Proposal FY22-14 (Unfunded low Priority Experiment for FY2022)	Contribution to design. IRSN supplies materials if needed	M. BROVCHENKO	C. PERCHER	LLNL LANL
IRSN-IE52 **IER 552**	Pulse Neutron Experiments for Resonance Parameter Evaluation of Absorbing Materials	LLNL-IE1 (Funded as low priority IER for FY2022)	Evaluation and support for experiments	L. LEAL	C. PERCHER/D. SIEFMAN	LLNL
IRSN-IE53 **IER 551**	True Intermediate Energy System with Pu-239 and Pu-240	LANL IE3 (Funded as low priority IER for FY2022)	Contribution to design and CED report	M. BROVCHENKO	J. GODA D. BOWEN	LANL ORNL
INFORMATION PRESERVATION AND DISSEMINATION						
IRSN-IPD1	ICSBEP reviewing	LLNL-IPD1	IRSN ICSBEP reviewing tasks are reported in the IE tasks	S. PIGNET	D. HEINRICHS	LLNL
IRSN-IPD2	LFE Database	ORNL-IPD4	Sharing experience on French LFE database	M. DULUC		ORNL
NUCLEAR DATA						
IRSN-ND1	Contribution to new evaluations	ORNL-ND1 NNL-ND1 RPI-ND1	Contribution to new evaluations and validation in accordance with the milestone schedule in Appendix B	L. LEAL	D. BOWEN T. TRUMBULL	ORNL NNL RPI
IRSN -ND5	Improvement of nuclear data evaluation in the low energy region by using experimental data other than cross sections measurements	Proposal FY22-37 (Not funded for FY2022)	Evaluation of unstable isotopes	L. LEAL	D. BOWEN V. SOBES	ORNL UTK NNL
IRSN -ND6	Improved Pu-239 neutron total cross section data and evaluation at low energies	LANL-ND5	Evaluation to be started in FY2023	L. LEAL	B. LITTLE/P. KOEHLER	LANL
TRAINING AND EDUCATION						
IRSN-TE1	Hands-on criticality safety training	ORNL-TE1 LANL-TE3 LLNL-TE1 SNL-TE1	IRSN attendance to NCSP classes. Possible lectures by IRSN working with NCSP training and education coordinator.	S. PIGNET	D. BOWEN	NCSP

APPENDIX F: International Collaboration with the Atomic Weapons Establishment (AWE) for FY2022

AWE has an active and growing program of collaboration with the NCSP that aims to underpin and enhance AWE's nuclear criticality safety and associated technologies. AWE will provide its expertise and capabilities to support the NCSP's mission and vision so that the collaboration is mutually beneficial to both organisations.

Reference			AWE Contributions and POCs			
AWE Reference	**Task Description**	**NCSP Reference**	**AWE Contribution**	**AWE Technical POC**	**Collaborator POC**	**DOE Lab**
Analytical Methods						
AWE-AM1	Slide rule update	ORNL-AM6 LLNL-AM3 IRSN-AM5	Perform calculations; attend meetings; review analysis and reports	R. JONES	M. DULUC M. DUPONT/C. CELIK D. HEINRICHS	IRSN ORNL LLNL
INTEGRAL EXPERIMENTS						
AWE-IE2	Development of Passive Neutron Spectrometer (PNS)	LLNL-IE1	Fully commission TLD version of the PNS; Perform validation irradiations at NPL; develop unfolding tools for directionality	P. ANGUS	D. STONE	LLNL
AWE-IE3 **IER 406**	Cf-252 CAAS benchmark	LLNL-IE1	Perform/support PNS(TLD) measurements with a shadow cone	P. ANGUS	D. HEINRICHS F. TROMPIER	LLNL IRSN
AWE-IE5	Correction factor for dosimetry linked to orientation of the victim	LLNL-IE1	Participate in experiment design; use PNS data to determine directional components of neutron fields (Godiva, Flattop, LLNL RCL)	P. ANGUS	D. STONE F. TROMPIER	LLNL IRSN
AWE-IE6 **IER 514**	ICSBEP shielding benchmark for shipping containers	Proposal FY20-25 (Low Priority Experiment for FY2022)	Participate in experiment design; PNS(TLD) could be deployed as primary measurement device AWE to do some preliminary design	P. ANGUS	S. KIM	LLNL
AWE-IE7 **IER 153**	Measure fission neutron spectrum shape using threshold activation detectors	LANL-IE3	Provide input into foil selection; use AWE unfolding codes to provide independent analysis. TBC AWE to provide foil suggestions per MYERS	P. ANGUS	T. CUTLER B. MYERS	LANL

Reference			AWE Contributions and POCs			
AWE Reference	**Task Description**	**NCSP Reference**	**AWE Contribution**	**AWE Technical POC**	**Collaborator POC**	**DOE Lab**
AWE-IE8	Diagnostic development for measurement of correlated leakage radiations	LLNL-IE1	A feasibility study is being developed at AWE to ascertain suitable counting scenarios and methods. An experimental design will then be produced in the following years based upon the outcomes of this study.	N. KELSALL	D. HEINRICHS	LLNL
AWE-IE9 **IER 500**	AWE/LLNL NCT 5-year measurement campaign	LLNL-IE1	Participate in experiment design, measurements, and reporting.	N. KELSALL	D. HEINRICHS	LLNL
AWE-IE10	NAD Research & Development	LLNL-IE1	Develop prototypes, participate in design, execution, and reporting of dosimetry experiments.	P. ANGUS	F. TROMPIER	LLNL
AWE-IE11 **(IER 538)**	NAD Exercise	LLNL-IE1	Produce experiment design; participate in exercise; produce final report. Repeat even years.	P. ANGUS	D. STONE	LLNL
AWE-IE12	CIDAAS testing	Proposal FY19-20	Deploy AWE CIDAAS for test irradiation. Repeat odd years as needed.	T. BIRKETT	D. HEINRICHS D. STONE	LLNL
AWE-IE13	Characterization of AFRRI TRIGA reactor radiation field AWE will provide onsite measurement	LLNL-IE1	Provide support to experiment design.	P. ANGUS	A. ROMANYUKHA	LLNL
INFORMATION PRESERVATION AND DISSEMINATION						
AWE-IPD1	Conduct benchmark evaluations of legacy IEU integral experiments	LLNL-IPD1	Assess feasibility of sponsoring PhD; determine availability of data. This task requires no NCSP funding.	R. JONES	D. HEINRICHS	LLNL
TRAINING AND EDUCATION						
AWE-TE1	Hands-on criticality safety training	ORNL-TE1 LANL-TE3 LLNL-TE1 LLNL-TE3 SNL-TE1 IRSN-TE1	AWE personnel to attend training course	R. JONES	D. BOWEN B. MYERS D. HEINRICHS G. HARMS S. PIGNET(IRSN)	ORNL

NCSP

NUCLEAR CRITICALITY SAFETY PROGRAM

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