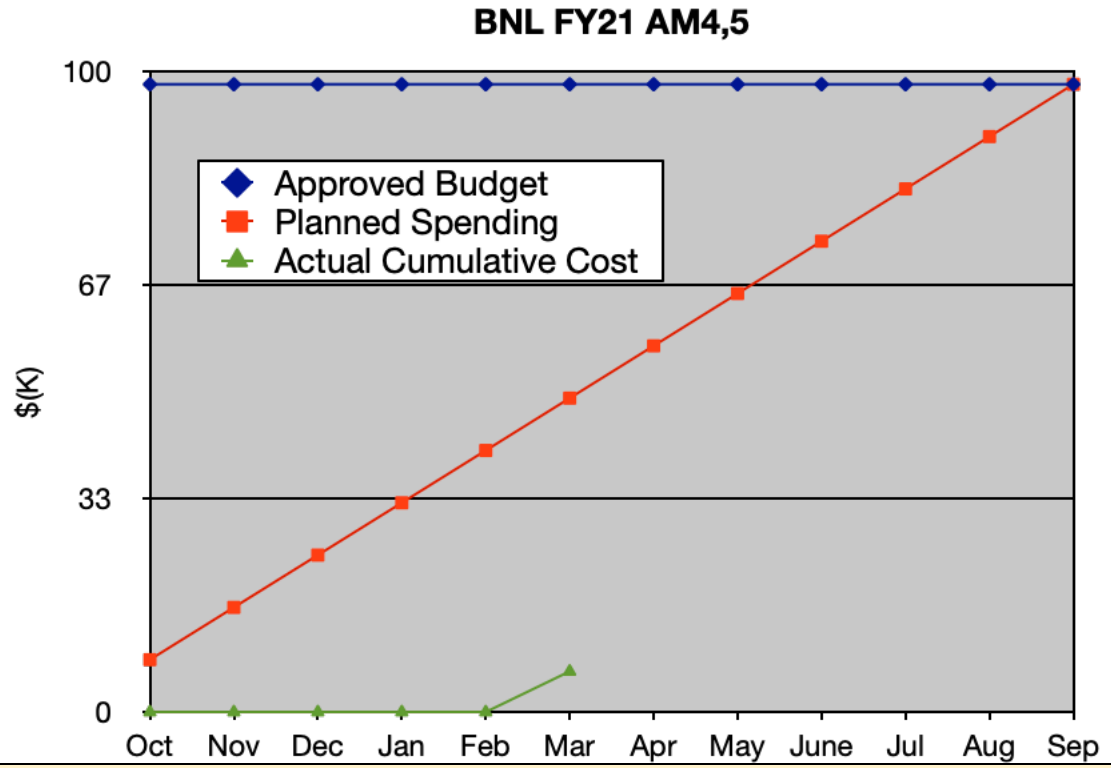
NUCLEAR CRITICALITY SAFETY PROGRAM (NCSP)

FY2021 2nd QUARTER REPORTS

NCSP Quarterly Progress Report (FY-2021 Q2)

NCSP Element and Subtask: AM4, 5 **M&O Contractor Name**: BNL **Point of Contact Name:** David Brown **Point of Contact Phone:** 631-344-2814	**Reference:** DP0909020 **Date of Report:** Apr., 2021

BUDGET



1. Carryover into FY 2021 = $ 2.483
2. Approved FY 2021 Budget = $ 98,000
3. Actual spending for 1st Quarter FY 2021 = $0
4. Actual spending for 2nd Quarter FY 2021 = $6,347
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	Provide status on generating a draft document defining the TNSL code or software interface. (AM4)		Drafting the GNDS-2.0 specifications is taking longer than expected; a TNSL covariance format is among the pending changes. Otherwise, the TNSL format has been created and is being tested at LLNL in FUDGE. Elements of this new format have been back-ported to the

			ENDF-6 format by NNL and several new evaluations using this new format have been proposed.
Q1	Provide status on completing an ENDF/B-VIII.0 library with FUDGE. (AM5)		Until FUDGE has "officially" implement GNDS-2.0, we cannot use it to generate ENDF/B-VIII.0 in the new format.
Q2	Provide status on generating a draft document defining the TNSL code or software interface. (AM4)		The GNDS-2.0 specifications are on track for approval at the 2021 WPEC Expert Group Meeting, including TNSL formats that support NCSP activities.
Q2	Provide status on completing an ENDF/B-VIII.0 library with FUDGE. (AM5)		Until FUDGE has "officially" implement GNDS-2.0, we cannot use it to generate ENDF/B-VIII.0 in the new format. This format should be approved in May.
Q3	Provide status on generating a draft document defining the TNSL code or software interface. (AM4)		
Q3	Provide status on completing an ENDF/B-VIII.0 library with FUDGE. (AM5)		
Q4	Provide status on generating a draft document defining the TNSL code or software interface. (AM4)		
Q4	Provide status on completing an ENDF/B-VIII.0 library with FUDGE. (AM5)		
ACCOMPLISHMENTS			

- AM4 - Thermal Scattering and Self-Shielding in GNDS/FUDGE
  - n/a
- AM5 - FUDGE Generation of a Complete ENDF/B-VIII.0 Library for Testing in Production Codes
  - M. Vorabbi presented work from FY20 at the 2021 NCSP Technical Program Review: “Alternate approach for calculating URR PDFs”

PUBLICATIONS

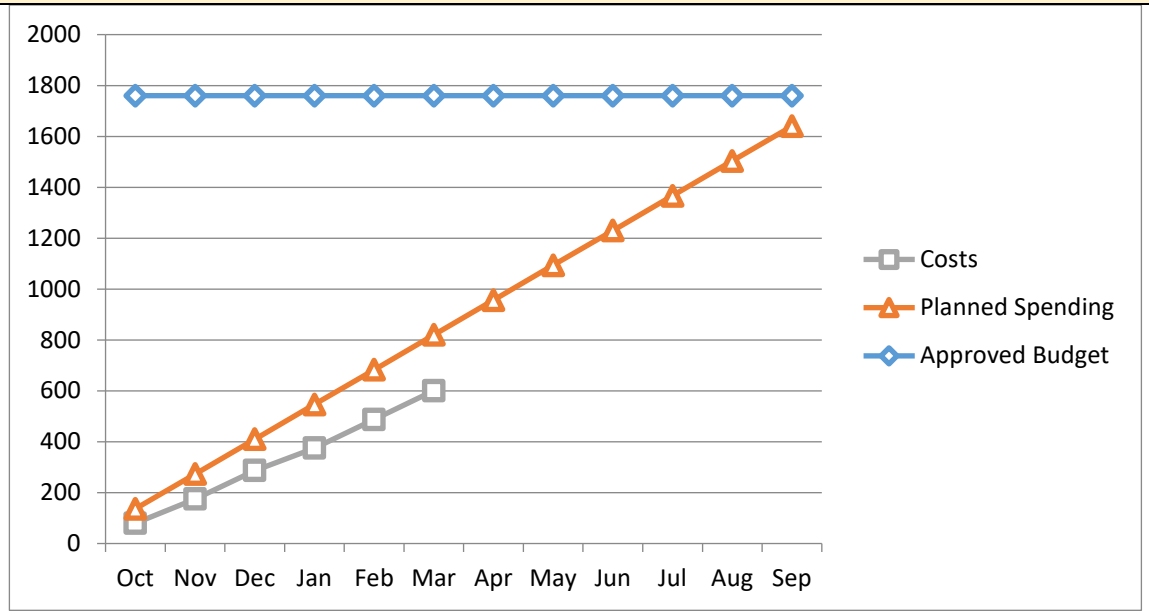
Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

Quarter	Publication Reference example) J., "Excluding Benchmark Statistical Outliers in Nuclear Criticality Safety Validation: A Comparison Study of Upper Subcritical Limits for Plutonium Systems using Whisper-1.1", LA-UR-18-27731, October 1, 2019	Sent to NCSP? Yes/no	If no, status of submittal
Q1	n/a		
Q2			
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2021 Q2)

NCSP Element and Subtask: AM1, 2, 3, 4, 5, 7 **M&O Contractor Name**: LANL **Point of Contact Name:** Joetta Goda/Bob Little **Point of Contact Phone:** 505-667-2812/505-665-3487	**Reference:** DP0909020 **Date of Report:** April 16, 2021

BUDGET



1. Carryover into FY 2021 = $ 425,000.00
2. Approved FY 2021 Budget = $ 1,335,000.00
3. Actual spending for 1st Quarter FY 2021 = $287,054
4. Actual spending for 2nd Quarter FY 2021 = $313,672 (YTD = $ 600,726)
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $0

(Note that $300k of FY21 funding from AM was moved to IE to allow AM to spend down carryover. Overall AM spend plan does not change.)

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	Provide a status report on MCNP6 user support (AM1)		
Q1	Provide status reports on LANL participation in US and International analytical methods collaborations (AM1)		
Q1	Provide reports on summer intern work accomplished (AM1)		

NCSP Quarterly Progress Report (FY-2021 Q2)

Q1	Continue to distribute MCNP6 with automated acceleration and convergence testing to NCSP early-adopters and collect feedback (AM1)		
Q1	Provide a status report on NJOY user support (AM2)		
Q1	Provide status reports on LANL participation in US and International analytical methods collaborations (AM2)		
Q1	Provide status in NCSP Quarterly Progress Reports (AM3)		RPI subcontract delayed
Q1	Provide status reports on LANL participation in US and International analytical methods collaborations (AM4)		
Q1	Provide status reports on LANL participation in US and International analytical methods collaborations (AM5)		
Q1	Provide status in NCSP Quarterly Progress Reports (AM7)		
Q2	Provide a status report on MCNP6 user support (AM1)		
Q2	Provide status reports on LANL participation in US and International analytical methods collaborations (AM1)		
Q2	Provide status of all MCNP6 and Whisper progress at the NCSP Technical Program Review (AM1)		
Q2	Provide MCNP6 Criticality training course (AM1)		Scheduled for Q3
Q2	Provide a status report on NJOY user support (AM2)		
Q2	Release modernized and integrated versions of THERMR and LEAPR with documentation (AM2)		Modernized version of LEAPR has been incorporated and is part of the upcoming NJOY21 1.3.0 release. Modernized version of THERMR is nearly complete, waiting only for compatibility with ENDFtk. This is expected to be finalized during Q3.

Q2	Provide status reports on LANL participation in US and International analytical methods collaborations (AM2)		
Q2	Provide status in NCSP Quarterly Progress Reports (AM3)		RPI subcontract delayed
Q2	Provide status reports on LANL participation in US and International analytical methods collaborations (AM4)		
Q2	Provide status reports on LANL participation in US and International analytical methods collaborations (AM5)		
Q2	Provide status in NCSP Quarterly Progress Reports (AM7)		
Q3	Provide a status report on MCNP6 user support (AM1)		
Q3	Provide status reports on LANL participation in US and International analytical methods collaborations (AM1)		
Q3	Issue an MCNP V&V report, including MCNP6 automated acceleration and convergence (AM1)		
Q3	Provide a status report on NJOY user support (AM2)		
Q3	Provide status reports on LANL participation in US and International analytical methods collaborations (AM2)		
Q3	Provide status in NCSP Quarterly Progress Reports (AM3)		
Q3	Provide status reports on LANL participation in US and International analytical methods collaborations (AM4)		
Q3	Provide status reports on LANL participation in US and International analytical methods collaborations (AM5)		
Q3	Provide status in NCSP Quarterly Progress Reports (AM7)		

Q4	Provide a status report on MCNP6 user support (AM1)		
Q4	Provide status reports on LANL participation in US and International analytical methods collaborations (AM1)		
Q4	Release MCNP 6.3 to RSICC (AM1)		
Q4	Provide MCNP6 Criticality training course (AM1)		
Q4	Develop and demonstrate long-term strategy for distributing all Los Alamos supported ACE files (AM1)		
Q4	Provide a status report on NJOY user support (AM2)		
Q4	Provide status reports on LANL participation in US and International analytical methods collaborations (AM2)		
Q4	Demonstrate modernized ACER capabilities for processing fast neutron files with NJOY21 (AM2)		
Q4	Provide status in NCSP Quarterly Progress Reports (AM3)		
Q4	Provide data files and report for h-h2o and graphite on-the-fly S(alpha,beta) temperature effects. (AM3)		
Q4	Provide status reports on LANL participation in US and International analytical methods collaborations (AM4)		
Q4	Issue report on detailed review, comparisons, and updates to the Sensitivity-Uncertainty Comparison Study (pending carryover funding). (AM4)		
Q4	Provide status reports on LANL participation in US and International analytical methods collaborations (AM5)		

Q4	Issue final report on all LANL results related to the ICSBEP Benchmark Comparison Study (AM5)		
Q4	Provide status in NCSP Quarterly Progress Reports (AM7)		
Q4	Deliver final modified version of Whisper to LANL with an ANS conference paper to disseminate the work (AM7)		

ACCOMPLISHMENTS

- AM1 - MCNP® Maintenance and Support, Uncertainty Analysis Development, and Modernization
  - Education
    - Online MCNP6 classes: See separate summary of MCNP classes.
    - Milestone: Provide MCNP6 Criticality training course – scheduled for Q3.
    - Thesis advisor for UNM graduate student working in area of criticality calculations.
    - Preparation for SU classes on April 27 & 28.
  - R&D Work, continued to investigate & develop:
    - Region-dependent sensitivity-uncertainty data for NCS validation (UNM).
    - Subcritical multiplication methods investigation and impact of correlated fission multiplicity models in criticality calculations (UNM).
    - OECD-NEA-WPNCS-Subgroup-6 on statistical testing for automated criticality source convergence (F.B. Brown lead): Final report is at OECD-NEA, being prepared for publication.
    - Further investigation and usage of partial c_k similarity metrics for experiment design and optimization.
    - MCNP6.3 in use at LANL, and for R&D at SNL & UNM.
  - MCNP Support & Maintenance
    - Support MCNP6 users. MCNP Forum, email, direct interactions, etc.
    - Provide status of all MCNP6 and Whisper progress at the NCSP TPR – Milestone complete (AM1).
    - Presentation on MCNP6.3 physics improvements at NCSP TPR.
    - Continue to modernize MCNP coding & update the code manual & user manual.
  - MCNP Data Libraries
    - Two presentations on thermal scattering data verification and validation were made at the TPR.
  - Reports & Publications
    - K.D. Spencer, J.L. Alwin, “Whisper Results of a PuCl ‘Solution’ System Using LLNL TEX Cl Benchmark Model,” LA-UR-21-20156
    - M.E. Rising, J.L. Alwin, F.B. Brown, C.M. Perfetti, B. Riedel, et al., “ MCNP6 Recent Updates on Modernization, R&D, and Release Plans,” presentation for NCSP TPR, LA-UR-21-21534
    - P.A. Grechanuk, M.E. Rising, T.S. Palmer, “Application of Machine Learning Algorithms to Identify Problematic Nuclear Data,” prepared for Nuclear Science and Engineering, LA-UR-21-20494

        - M.E. Rising, "Sensitivity Tool Needs for Modern Nuclear Data Validation," prepared for Workshop for Applied Nuclear Data Activities (WANDA 2021), LA-UR-21-20511
        - M.E. Rising, "Recent and Future Improvements to MCNP6 for Isotope Production Applications," prepared for Workshop for Applied Nuclear Data Activities (WANDA 2021), LA-UR-21-20515
        - A.C. Trahan, M.E. Rising, M.M. Watson, "Development of MCNP Training Modules for Safeguards Practitioners," prepared for Institute of Nuclear Materials Management, LA-UR-21-22485
        - F.B. Brown, "Physics Improvements for Criticality Calculations with MCNP6.3," presentation at NCSP TPR, LA-UR-21-21189
- AM2 - NJOY Development and Maintenance, Uncertainty Analysis Development, and Modernization
    - Presented NJOY Status at TPR
    - NJOY21 regression tests have been updated to reflect modern RECONR implementation
    - Modernized version of LEAPR has been incorporated and is part of the upcoming NJOY21 1.3.0 release
    - ENDFtk v0.2.0 release: extension of the ENDFtk API to python (a memo accompanying the release is pending)
    - Released NJOY2016.61: When processing new incident charged particle ENDF files, NaN values were discovered in the ACE files. This appeared to be due to an array index overflow. A parameter for the size was added so that we can more easily resize the array, and an error message was added to detect similar issues in the future.
    - A number of updates are in the works for the next quarters:
        - Update to ACER to handle the new IAEA photonuclear data libraries (a prototype is available and has been tested by the IAEA)
        - Update to THERMR and ACER to handle the new combined coherent/incoherent elastic scattering format. This will require an update to the ACE format so the change will be performed in collaboration with the MCNP team
    - User Support
        - Following the CP2011/CP2020 work, we have addressed a number of questions concerning the ACE format for charged particle data. This resulted in further updates of the ACE format specifications document.
        - Provided input files to users for processing incident neutron files to produce ACE files
        - Various questions on the GitHub issues trackers
- AM3 - Development of an Adaptive-in-temperature Method for fast on-the-fly Sampling of Thermal Neutron Scattering Data in MCNP6
    - No progress to report. Subcontract with RPI is not in place yet.
- AM4 - Sensitivity/Uncertainty Comparison Study with a Focus on Upper Subcritical Limits
    - Coordinating cases of IEU, LEU, MIX for comparison with IRSN and ORNL.
- AM5 - Proposed Benchmark Intercomparison Study
    - Worked with IRSN to identify cause of discrepancies for cases in LCT, MIX and U233 series of benchmarks. Revised benchmarks and found significant improvement, working on report to document and inclusion into benchmark repository.
- AM7 - Incorporation of Benchmark Experiment Correlations into the Whisper Nuclear Criticality Safety Software
    - A conference publication on Uniformly Ordered Binary Decision Algorithm to be presented at the ANS Annual Meeting in June 2021 has been submitted to disseminate the work. Reviewer comments have been addressed and the talk is in the technical program.

- The work was presented at the NCSP technical program review.

PUBLICATIONS

Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

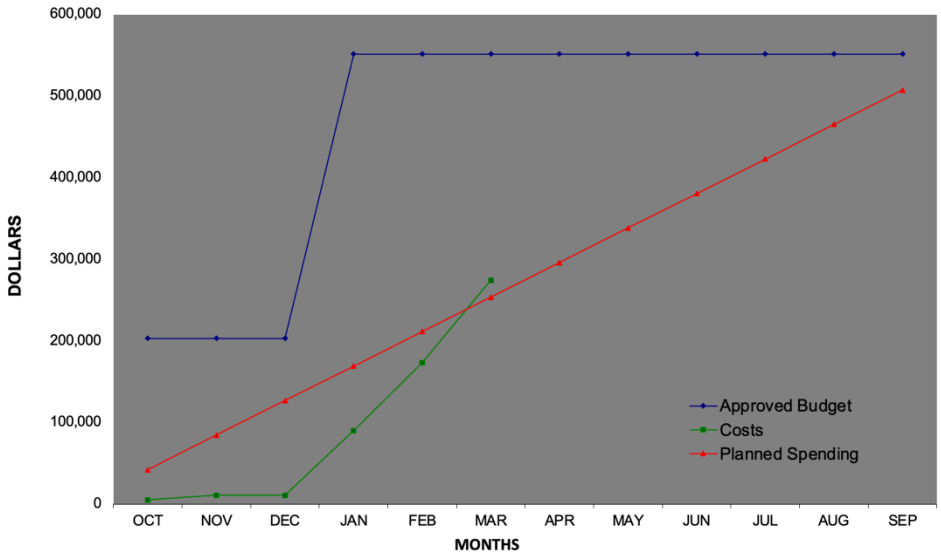
Quarter	Publication Reference	Sent to NCSP? Yes/no	If no, status of submittal
Q1	F.B. Brown & M.E. Rising, "Guide for Using ENDF/B-VIII.0 Nuclear Data with MCNP", LA-UR-20-30460 (2020).	Yes, will send.	
Q1	F.B. Brown (Ed.), "Statistical Tests for Diagnosing Fission Source Convergence and Undersampling in Monte Carlo Criticality Calculations", final report for OECD-NEA-WPNCS Subgroup-6, to be published by OECD-NEA in 2021.	No, will send next quarter.	Sent with Q2 Report
Q1	J.L. Alwin, F.B. Brown, M.J. Lazaric, B.R. Murphy, K.D. Spencer, "Comparison Study of Upper Subcritical Limits Derived Using Sensitivity/Uncertainty Tools Case Studies of Benchmarks & Applications", LA-UR-20-28129.	Yes, submitted in Q4FY20	
Q1	J.L. Alwin, F.B. Brown, J. Clarity, I. Duhamel, F. Fernex, et al, "S/U Comparison Study with a Focus on USLs", ANS Winter meeting, LA-UR-20-24758, LA-UR-20-28222.	Yes, submitted in Q3FY20	
Q1	R.H. Mendleski, K.Y. Spencer, E. Moll, R.F. Sartor, J.L. Alwin, W. Haeck, "Validation of MCNP Critical Benchmark Models of PU-MET-FAST-016", ANS Winter Meeting, LA-UR-20-29300, LA-UR-20-25118.	Yes, will send.	
Q1	J.D. Hutchinson, T.A. Smith, N.A. Kleedtke, N.W. Thompson, R.C. Little, M.R. Rising, J.L. Alwin, T.J. Grove, I.J. Michaud, "Sensitivity Studies, Gap Analysis, and Benchmark Experiment Optimization", ANS Winter Meeting, LA-UR-20-29405, LA-UR-20-24750.	Yes, will send.	
Q1	C.M. Kostelac, N. Thompson, R.G. Sanchez, J.D. Hutchinson, K.Y. Spencer, W. Haeck, J.L. Alwin, "Validation and Independent Uncertainty Analysis of the MIX-SOL-THERM-003 ICSBEP Benchmark", ANS Winter Meeting, LA-UR-20-29459, LA-UR-20-24749.	Yes, will send.	
Q1	D.T. Wise, B. Madahar, K.Y. Spencer, J.L. Alwin, W. Haeck, "Validation of MCNP Critical Benchmark Models of Moderated Highly Enriched Uranium Slabs, ANS Winter Meeting, LA-UR-20-29255, LA-UR-20-24771.	Yes, will send.	
Q1	"Analytic Insights into the Neutronic Characteristics of Neutron Moderators from MCNP Calculations," D. Kent Parsons and Cecile Toccoli, LA-UR-20-24442.	Yes, submitted in Q3FY20	
Q1	"Verification of the Re-Released ENDF/B VIII.0 Based Thermal Scattering Libraries," D. Kent Parsons, Cecile Toccoli, and Jeremy L. Conlin, LA-UR-20-24679.	Yes, submitted in Q3FY20	
Q2	"Uniformly Ordered Binary Decision Algorithm for Benchmark Experiment Correlations in Whisper Validation," Brian Kiedrowski, presented at TPR.	TPR – You have	

Q2	"Verification of the Re-Released ENDF/B VIII.0 Based Thermal Scattering Libraries, D. Kent Parsons, Cécile Toccoli and Jeremy L. Conlin, presented at TPR.	TPR – You have	
Q2	"Physics Improvements for Criticality Calculations with MCNP6.3," F.B. Brown, presentation at NCSP TPR, LA-UR-21-21189.	TPR – You have	
Q2	"Analytic Insights into the Neutronic Characteristics of Neutron Moderators from MCNP Calculations, D. Kent Parsons and Cécile Toccoli, presented at TPR.	TPR – You have	
Q2	"NJOY21 Release: RECONR, THERMR, and LEAPR," Jeremy Lloyd Conlin, Amelia Jo Trainer, Wim Haeck, and Nathan Gibson, presented at TPR.	TPR – You have	
Q2	"MCNP6 Recent Updates on Modernization, R&D, and Release Plans," M.E. Rising, J.L. Alwin, F.B. Brown, C.M. Perfetti, B. Riedel, et al., presentation for NCSP TPR, LA-UR-21-21534.	TPR – You have	
Q2	"Whisper Results of a PuCl 'Solution' System Using LLNL TEX Cl Benchmark Model," K.D. Spencer, J.L. Alwin, LA-UR-21-20156,	Yes	
Q2	"Application of Machine Learning Algorithms to Identify Problematic Nuclear Data," P.A. Grechanuk, M.E. Rising, T.S. Palmer, prepared for Nuclear Science and Engineering, LA-UR-21-20494.	Yes	
Q2	"Sensitivity Tool Needs for Modern Nuclear Data Validation," M.E. Rising, prepared for Workshop for Applied Nuclear Data Activities (WANDA 2021), LA-UR-21-20511.	Yes	
Q2	"Recent and Future Improvements to MCNP6 for Isotope Production Applications," M.E. Rising, prepared for Workshop for Applied Nuclear Data Activities (WANDA 2021), LA-UR-21-20515.	Yes	
Q2	"Development of MCNP Training Modules for Safeguards Practitioners," A.C. Trahan, M.E. Rising, M.M. Watson, prepared for Institute of Nuclear Materials Management, LA-UR-21-22485.	Yes	
Q2	"Uniformly Ordered Binary Decision Algorithm for Benchmark Experiment Correlations in Whisper Validation," Brian C. Kiedrowski, prepared for ANS Summer meeting.	Yes	
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2021 Q2)

NCSP Element and Subtask: AM2, 3, 4, 5, 6, 8 **M&O Contractor Name**: LLNL **Point of Contact Name:** David Heinrichs **Point of Contact Phone:** (925) 424-5679	**Reference:** DP0909020 **Date of Report:** April, 2021

BUDGET



1. Carryover into FY 2021 = $ 120,596
2. Approved FY 2021 Budget = $ 551,596
3. Actual spending for 1st Quarter FY 2021 = $ 10,752
4. Actual spending for 2nd Quarter FY 2021 = $ 263,847
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $ 44,128 (8%)

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	Provide status in NCSP Quarterly Progress Report (AM2)		
Q1	Provide status in NCSP Quarterly Progress Report (AM3)		
Q1	Provide a status report on generating a draft document defining the TNSL code or software interface. (AM4)		

NCSP Quarterly Progress Report (FY-2021 Q2)

Q1	Provide status in NCSP Quarterly Progress Report (AM5)		
Q1	Provide status in NCSP Quarterly Progress Report (AM6)		
Q1	Provide status in NCSP Quarterly Progress Report (AM8)		
Q2	Provide status in NCSP Quarterly Progress Report (AM2)		Focus continues on analysis of IER268 (PDV) experimental results.
Q2	Provide status in NCSP Quarterly Progress Report (AM3)		
Q2	Provide a status report on generating a draft document defining the TNSL code or software interface. (AM4)		
Q2	Provide status in NCSP Quarterly Progress Report (AM5)		
Q2	Provide status in NCSP Quarterly Progress Report (AM6)		
Q2	Provide status in NCSP Quarterly Progress Report (AM8)		
Q3	Provide status in NCSP Quarterly Progress Report (AM2)		
Q3	Provide status in NCSP Quarterly Progress Report (AM3)		
Q3	Provide a status report on generating a draft document defining the TNSL code or software interface. (AM4)		
Q3	Provide status in NCSP Quarterly Progress Report (AM5)		
Q3	Provide status in NCSP Quarterly Progress Report (AM6)		
Q3	Provide status in NCSP Quarterly Progress Report (AM8)		
Q4	Provide status in NCSP Quarterly Progress Report (AM2)		

Q4	Provide status in NCSP Quarterly Progress Report (AM3)		
Q4	Provide a status report on generating a draft document defining the TNSL code or software interface. (AM4)		
Q4	Provide status in NCSP Quarterly Progress Report (AM5)		
Q4	Provide status in NCSP Quarterly Progress Report (AM6)		
Q4	Provide status in NCSP Quarterly Progress Report (AM8)		

ACCOMPLISHMENTS

- AM3 – Slide Rule Application
  - Completed Phase 4, "Update of the Nuclear Criticality Slide Rule Calculations: Plutonium Configurations – Delayed Gamma," calculations for a bare sphere with H/Pu=10 as a function of time and distance as presented to the AMWG on February 22, 2021 in LLNL-PRES-819569, "LLNL Analytical Methods Update," page 8. The 2010 European Activation File (EAF-2010) is now available in COG 11.3 replacing ACTL92 for activation and subsequent decay calculations.
- AM4 - Thermal Scattering and Self-Shielding in GNDS/FUDGE
  - HF thermal scattering law data is now available in COG using data from ENDF/B-VIII.0 File 7 in both ENDF-6 and ACE formats. Preliminary COG results for HST039 (UF6+HF/H2O) are not much improved consistent with ORNL SCALE results. Progress on the unresolved resonance region (URR) was presented at the NDAG meeting on Feb. 22, 2021, in "Alternate approach for calculating URR PDFs," presented by Matteo Vorabbi (BNL).
- AM5 - Proposed Benchmark Intercomparison Study
  - A total of 3,327 high-precision COG (k-eff) ICSBEP benchmark results using ENDF/B-VII.1, ENDF/B-VIII.0 and JEFF-3.3 have been provided to Nicolas Leclaire (IRSN) for inclusion in the study as follows:

```
 PU:  766     U233: 193     MIX: 356
HEU: 1021     IEU:  190     LEU: 801
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    COG input files were also provided to Scott McKinley (LLNL) for translation to MERCURY input for additional LLNL participation in the study.
- AM6 - Proposed 1D Multipoint Analytical Benchmark Intercomparison
  - COG/FUDGE results for "Part 1" of the analytic benchmark by Sobes et al. were completed and were presented in LLNL-PRES-819569, "LLNL Analytical Methods Update," pages 3-6, at the AMWG Meeting on Feb. 22, 2021.
- AM8 - FUDGE Generation of a Complete ENDF/B-VIII.0 Library for Testing in Production Codes
  - Library generation completed for an elevated temperature ICSBEP benchmark including thermal neutron scattering laws for HF and H2O.

PUBLICATIONS

Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

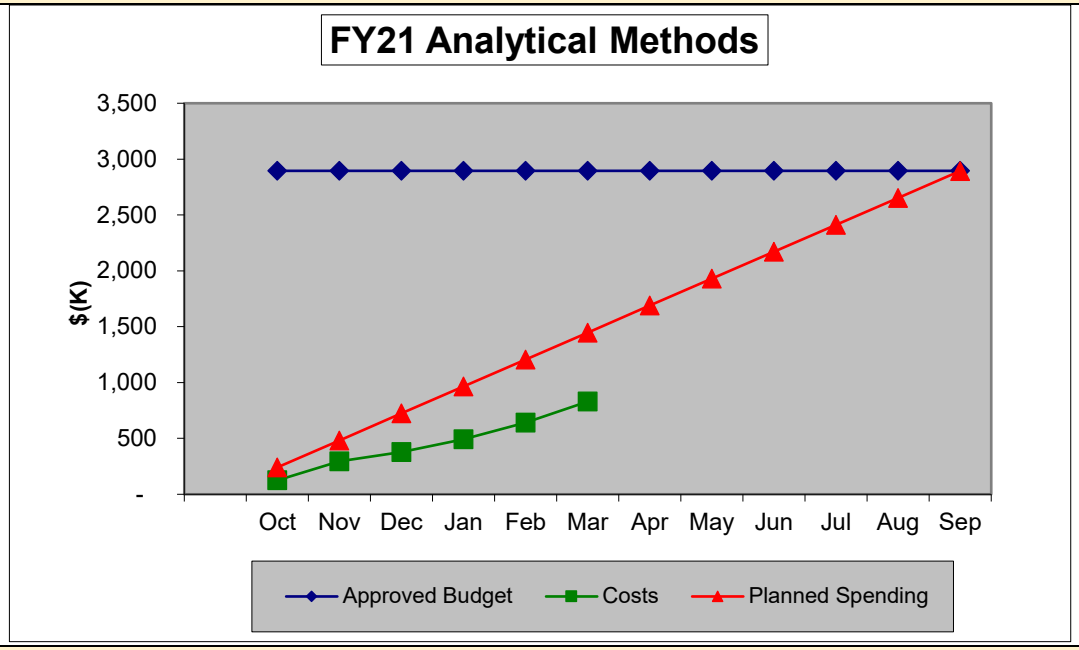
Quarter	Publication Reference	Sent to NCSP? Yes/no	If no, status of submittal

Q1	C. M. Mattoon, "Status of Fudge, November 30, 2020: CSEWG," LLNL-PRES-816458.	Yes	
Q1	B. Ganapol, "Solution of the Monoenergetic Neutron Transport Equation in a Half Space via Singular Eigenfunction Expansion," Transactions of the American Nuclear Society, Vol. 123, pp. 685-689, 2020 ANS Virtual Winter Meeting, November 16-19, 2020	No	Copyrighted material
Q2	D. Heinrichs et al., "LLNL Analytical Methods Update," LLNL-PRES-819569, February 22, 2021.	Yes	
	M. Vorabbi, "Alternate approach for Calculating URR PDFs," December 3, 2020.	No	To be provided by BNL.
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2021 Q2)

NCSP Element and Subtask: AM1, 2, 3, 6, 9, 10, 11, 15, 17 **M&O Contractor Name**: ORNL **Point of Contact Name:** Doug Bowen **Point of Contact Phone:** (865) 576-0315	**Reference:** DP0909010 **Date of Report:** April, 2021

BUDGET



1. Carryover into FY 2021 = $ 418K
2. Approved FY 2021 Budget = $ 2,895K (includes carryover)
3. Actual spending for 1st Quarter FY 2021 = $378K
4. Actual spending for 2nd Quarter FY 2021 = $452
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	Continue distribution of available and newly packaged software to the NCS community requesters (at no direct cost to them) and provide distribution totals quarterly. (AM1)		
Q1	Provide status on RSICC activities in NCSP Quarterly Progress Reports. (AM1)		

Q1	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. (AM2)		
Q1	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM2)		
Q1	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM3)		
Q1	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM6)		
Q1	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM9)		
Q1	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM10)		
Q1	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM11)		
Q1	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM15)		
Q1	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM17)		
Q2	Continue distribution of available and newly packaged software to the NCS community requesters (at no direct cost to them) and provide distribution totals quarterly. (AM1)		
Q2	Provide status on RSICC activities in NCSP Quarterly Progress Reports. (AM1)		
Q2	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. (AM2)		
Q2	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM2)		
Q2	Issue an annual SCALE maintenance report to the NCSP Manager. (AM2)		

Q2	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM3)		
Q2	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM6)		
Q2	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM9)		
Q2	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM10)		
Q2	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM11)		
Q2	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM15)		
Q2	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM17)		
Q3	Continue distribution of available and newly packaged software to the NCS community requesters (at no direct cost to them) and provide distribution totals quarterly. (AM1)		
Q3	Provide status on RSICC activities in NCSP Quarterly Progress Reports. (AM1)		
Q3	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. (AM2)		
Q3	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM2)		
Q3	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM3)		
Q3	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM6)		
Q3	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM9)		
Q3	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM10)		

Q3	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM11)		
Q3	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM15)		
Q3	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM17)		
Q4	Continue distribution of available and newly packaged software to the NCS community requesters (at no direct cost to them) and provide distribution totals quarterly. (AM1)		
Q4	Provide status on RSICC activities in NCSP Quarterly Progress Reports. (AM1)		
Q4	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. (AM2)		
Q4	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM2)		
Q4	Publish annual newsletter to users to communicate software updates, user notices, generic technical advice, and training course announcements. (AM2)		
Q4	Document AMPX modernization and technical support for SCALE CE, multigroup, and covariance libraries and report status annually to the NCSP Manager. (AM3)		
Q4	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM3)		
Q4	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM6)		
Q4	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM9)		
Q4	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM10)		

Q4	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM11)		
Q4	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM15)		
Q4	Provide status on ORNL activities in NCSP Quarterly Progress Report (AM17)		

ACCOMPLISHMENTS

- AM1 - Radiation Safety Information Computational Center (RSICC)
  - Distributed 779 software packages
  - 142 SCALE, 366 MCNP®, and 1 COG package distributed.
  - RSICC quarterly report issued.
  - Quarter 1 – University Requests – 384; NCSP Direct Requests – 17
  - Quarter 2 - University Requests – 421; NCSP Direct Requests – 14

FY2021 University Distributions		
Month	MCNP®	SCALE
October	100	39
November	26	14
December	36	20
January	20	11
February	111	44
March	65	26

  - You may note that slightly more than half of the distributions of MCNP® and SCALE are to U.S. university students in nuclear engineering department or programs.

- AM2 - SCALE/KENO/TSUNAMI Maintenance and Support/Cross-Section Generation/Modernization/etc.
  - **Planning** was initiated for Q3 and Q4 projects which will include.
    - CSAS criticality safety code
      - Improved source convergence diagnostics.
      - Improved tallies.

        - VADER trending code
            - Histogram and Q-Q plot for graphical normality assessment
            - Extreme value theorem methods
            - Correlated trending and nontrending methods
        - TSUNAMI sensitivity analysis code
            - Confidence bounds for USL in TSURFER
            - Method development for scattering sensitivity calculations
            - Smaller memory-footprint CE Sensitivity method in TSUNAMI-Shift
            - MG Sensitivity method in Shift with domain decomposition
        - VALID validation suite expansion plans
            - add ~45 PU-MET-FAST/PU-MET-MIXED cases
            - add ~42 HEU-MET-FAST/INTER cases
            - add ~87 LEU-COMP-THERM cases (split effort for more HALEU validation with NRC)
        -
    - VALID ICSBEP model expansion
        - Revision of QA process document
        - Strategy developed to make SCALE VALID models available on an open repository (will be available Q3/Q4)
        - VALID expansion cases in Q1/Q2 mostly through review
    - TSUNAMI improvements to sensitivity methods including the F* mesh diagnostics and 3d map generation
    - VADER addition of the trending method with single-sided lower tolerance band method described in NUREG/CR-6698
    - CSAS KENO primers now available on SCALE website at https://www.ornl.gov/scale/scale/criticality-safety-reports (as noted at TPR)
    - Miscellaneous maintenance efforts for CSAS, TSUNAMI, and AMPX

- AM3 - AMPX Maintenance & Modernization
    - TSL updates:
        - After discovering a difference of processing for selected few thermal moderators in NJOY and AMPX, updated the ENDF library files and generated new CE libraries for use in SCALE.
        - Source of difference between NJOY and AMPX found to be an error in the ENDF specification. The issue has been submitted to NNDC for review.
    - Update the code fabulous to allow for f-factors for the lower and upper scattering matrix for elastic scattering in the thermal range. A test multigroup library with these data was generated. This extension will allow to generate better shielded cross section in SCALE MG calculations.
    - Doro Wiarda attended the “Consultancy Meeting on Model Code Output & Application Nuclear Data Form Structure” organized by the IAEA and gave an update of the progress of the support for GNDS in AMPX and future plans
    - Gave AMPX status report at the online TPR hosted by ORNL

- AM6 – Slide Rule Application
  - Attended a meeting in January to discuss remaining tasks and roadmap for the project,
  - Reviewed IRSN documents regarding fission rates and estimation of fission yields,
  - Completed analysis of the selected plutonium case, "Case 2: Unreflected Plutonium System with H/Pu ratio of 10", and sent results to IRSN (see the attached document),
  - Waiting for a new meeting to discuss the results of the Case 2 with other participants.
  - A follow up meeting with IRSN is scheduled on April 13th to discuss calculation results.

- AM9 - Sensitivity / Uncertainty Comparison Study with a Focus on Upper Subcritical Limits
  - No work was performed on this task in Q2.

- AM10 – Proposed Benchmark Intercomparison Study
  - No work was performed on this task in Q2.

- AM11 – Proposed 1D Multipoint Analytical Benchmark Intercomparison
  - This task has been cancelled.

- AM15 – The Effects of Temperature on the Propagation of Nuclear Data Uncertainty in Nuclear Criticality Safety Calculations
  - Attended the 2021 Technical Program Review and reported on current progress of the project, showing capabilities of method for 23-Na that match previous results at the same temperature
  - Implemented preliminary code that splits up the evaluation of cross section sensitivity to resonance parameters over energy regions which should allow for simpler processing of large evaluations
  - Worked on benchmarking current performance to address issues with memory performance for large nuclides

- AM17 – Expansion of the Verified, Archived, Library of Inputs and Data (VALID)
  - Funding was just received so work will begin in Q3.

PUBLICATIONS

Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

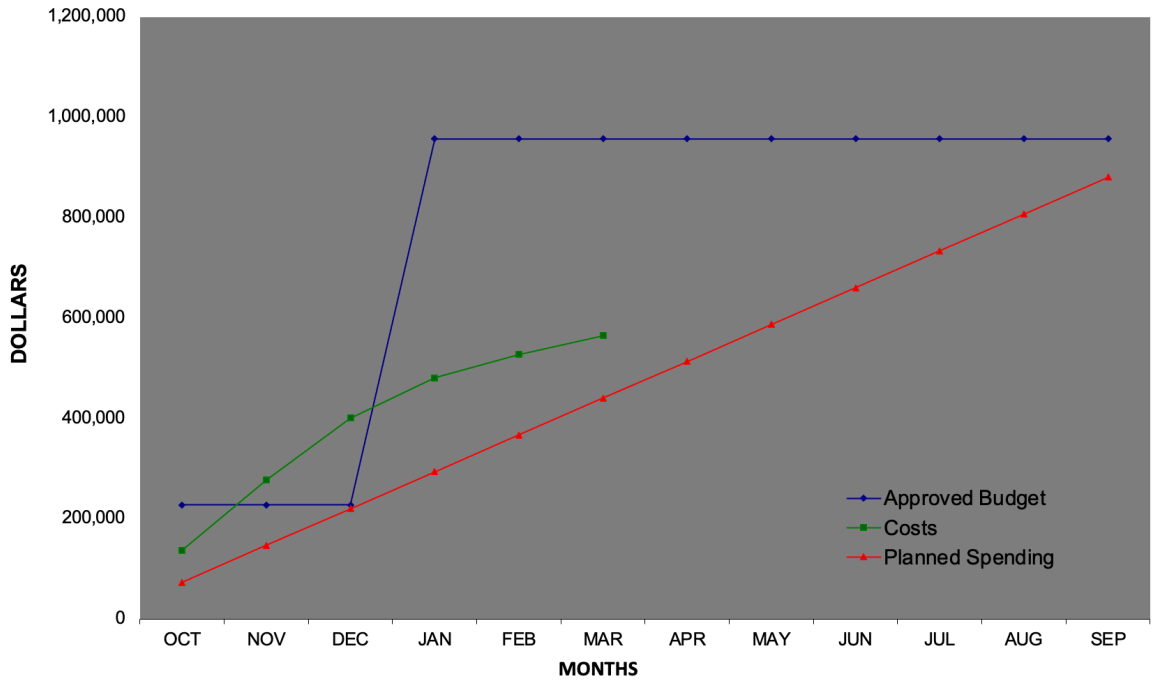
Quarter	Publication Reference Example:	Sent to NCSP? Yes/no	If no, status of submittal

	J., "Excluding Benchmark Statistical Outliers in Nuclear Criticality Safety Validation: A Comparison Study of Upper Subcritical Limits for Plutonium Systems using Whisper-1.1", LA-UR-18-27731, October 1, 2019		
Q1	Pulled from ORNL RES publication tracking system	Yes	
Q2	Pulled from ORNL RES publication tracking system	Yes	
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2021 Q2)

NCSP Element and Subtask: IPD1, 2, 4, 5, 6, 7 **M&O Contractor Name**: LLNL **Point of Contact Name:** David Heinrichs **Point of Contact Phone:** (925) 424-5679	**Reference:** DP0909020 **Date of Report:** April, 2020

BUDGET



1. Carryover into FY 2021 = $ 54,942
2. Approved FY 2021 Budget = $ 956,942
3. Actual spending for 1st Quarter FY 2021 = $ 400,994
4. Actual spending for 2nd Quarter FY 2021= $ 164,210
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $ 76,555 (8%)

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	Manage all aspects of the DOE NCSP participation in the ICSBEP as required to		OECD NEA has approved the 2019 edition of the ICSBEP Handbook and plans to ship ISO files to the DVD manufacturer the week of January 11,

	ensure the finalizing and publishing ICSBEP evaluations per IE schedule. (IPD1)		2021. DVDs should be available for distribution to NCSP users in late January or early February 2021.
Q1	Provide status reports on LLNL participation in US and International IPD collaborations (including ICSBEP) and provide a brief summary report to NCSP Manager on items of NCSP interest. (IPD1)		
Q1	Maintain, operate, and modernize the NCSP website, databases, and provide user assistance as required. (IPD2)		
Q1	Provide a status report for the evaluation of the LLNL "Hot Box" for inclusion in the ICSBEP Handbook. (IPD4)		
Q1	Provide status report on progress (IPD5)		
Q1	Provide status report on progress (IPD6)		
Q1	Provide the NCSP manager an update of NDA website support. (IPD7)		
Q2	Manage all aspects of the DOE NCSP participation in the ICSBEP as required to ensure the finalizing and publishing ICSBEP evaluations per IE schedule. (IPD1)		
Q2	Provide status reports on LLNL participation in US and International IPD collaborations (including ICSBEP) and provide brief summary report to NCSP Manager on items of NCSP interest. (IPD1)		
Q2	Maintain, operate, and modernize the NCSP website, databases, and provide user assistance as required. (IPD2)		
Q2	Provide a status report for the evaluation of the LLNL "Hot Box" for inclusion in the ICSBEP Handbook. (IPD4)		
Q2	Provide status report on progress (IPD5)		

Q2	Provide status report on progress (IPD6)		
Q2	Provide the NCSP manager an update of NDA website support. (IPD7)		
Q3	Manage all aspects of the DOE NCSP participation in the ICSBEP as required to ensure the finalizing and publishing ICSBEP evaluations per IE schedule. (IPD1)		
Q3	Provide status reports on LLNL participation in US and International IPD collaborations (including ICSBEP) and provide brief summary report to NCSP Manager on items of NCSP interest. (IPD1)		
Q3	Maintain, operate, and modernize the NCSP website, databases, and provide user assistance as required. (IPD2)		
Q3	Provide a status report for the evaluation of the LLNL “Hot Box” for inclusion in the ICSBEP Handbook. (IPD4)		
Q3	Provide status report on progress (IPD5)		
Q3	Provide status report on progress (IPD6)		
Q3	Provide the NCSP manager an update of NDA website support. (IPD7)		
Q4	Manage all aspects of the DOE NCSP participation in the ICSBEP as required to ensure the finalizing and publishing ICSBEP evaluations per IE schedule. (IPD1)		
Q4	Provide status reports on LLNL participation in US and International IPD collaborations (including ICSBEP) and provide brief summary report to NCSP Manager on items of NCSP interest. (IPD1)		
Q4	Maintain, operate, and modernize the NCSP website, databases, and provide user assistance as required. (IPD2)		

Q4	Provide a status report for the evaluation of the LLNL "Hot Box" for inclusion in the ICSBEP Handbook. (IPD4)		
Q4	Provide status report on progress (IPD5)		
Q4	Provide status report on progress (IPD6)		
Q4	Provide the NCSP manager an update of NDA website support. (IPD7)		

ACCOMPLISHMENTS

- IPD1 - Conduct ICSBEP for Benchmarks of the 5-Year Plan and publish annual revision to the Handbook
  - LLNL received 100 DVD copies of the 2020 edition of the ICSBEP Handbook from NEA and distributed 73 to NCSP users on March 3, 2021.
  - NCSP evaluations in progress to resolve 2020 ICSBEP TRG comments include:
    - (a) IER230, LCT102, 7uPCX with pitch variations, Ames (SNL)
    - (b) IER299, HMF101, KRUSTY, Hutchinson (LANL)
    - (c) IER192, HMT004, Class Foils with Lucite, Snoj (JSI)
    - (d) IER528, PMM003, TEX-Pu-Ta, Percher (LLNL).
  - LLNL reviewed PMF001, Jezebel, Rev. 5, and provided comments to the evaluator, Jeff Favorite (LLNL).
  - LLNL reviewed HMF101, KRUSTY, and completed COG models of both the detailed and simplified benchmarks. Sample results to be completed in Q3.
  - NCSP evaluations in progress for the 2021 ICSBEP TRG Meeting are:
    - (a) IER489, U235 URR IE (LANL)
    - (b) IER297, TEX-HEU Baselines (LLNL)
    - (c) IER230, Characterize the Thermal Capabilities of 7uPCX (SNL).
- IPD2 - Maintain the NCSP Website and Systems
  - Maintained https://ncsp.llnl.gov updating documents, calendars, taskings, banners, photos, and images as directed. Added and updated foreign trip reports. Updated the list of available T&E courses. Provided weekly reports to NCSP Management on TPR registrants up to the date of the event. A webpage for the 2021 TPR agenda with presentations is in development for completion next quarter.
- IPD4 - Benchmark Evaluation of Hot Box, LLNL Historical Critical Configurations at High Temperature
  - A summary of progress to date was presented in LLNL-PRES-819574, page 10, at the NCSP TPR on Feb. 23, 2021.
- IPD5 - IT Support at NNSS
  - Supported NCERC with equipment inspections and approvals for IER302 (Dynamic Multiplication Measurements), IER332 (Non-NCSP ER class July 2015), IER337 (unknown), IER352 (unknown), IER354 (unknown), IER370 (unknown), IER466 (NCERC ops support), IER488 (MUSiC), IER492 (Non-NCSP Nuclear Smuggling Nuclear Detector Development May 2018), IER494 (Non-NCSP RTO TI Project Sep 2018), IER497 (CAAS/NAD Performance Testing), and IER525 (Hypatia).
  - Provided weekly NTS-LANL/NCERC system updates, monthly "authenticated" scans for NCERC network devices, and system upgrades as required.
  - Submitted a draft plan for "Weapons" (NTS-SLAN) security plan consolidation to LANL CSO. LANL decided in March to "drop" the inclusion of NTS-SLAN in the consolidated plan preferring to keep it separate. Reviewing Risk Analysis for NTS-SLAN security plan. Renewed NTS-SLAN accounts. Reviewed and updated NTS-SLAN documents for upload to ARCHER system.
  - Upgraded all TACLANES to comply with COMSEC requirements. Ordered in and deployed COMSEC encryption keys.
  - Deployed W-SLAN (LANL) network to DAF for Classified Parts Inventory Management System (CPIMS).

- IPD6 - Benchmark Evaluation of LLNL 'Pulsed Spheres'
  - A summary of progress to date was presented in LLNL-PRES-819574, page 11, at the NCSP TPR on Feb. 23, 2021. A SINBAD evaluation is in preparation as described in LLNL-ABS-820246, "Evaluation of Polyethylene and Blank Pulsed Sphere Experiments Using Deuteron Transport Feature in COG," submitted to the 14th International Conference on Radiation Shielding and 21st Topical Meeting of the ANS Radiation Protection and Shielding Division (ICRS 14/RPSD-2020), September 13-17, 2021, Seattle, WA; which may be further delayed due to on-going COVID-19 concerns.
- IPD7 - LLNL - NDA Website Support
  - Maintained https://nda.llnl.gov.

PUBLICATIONS

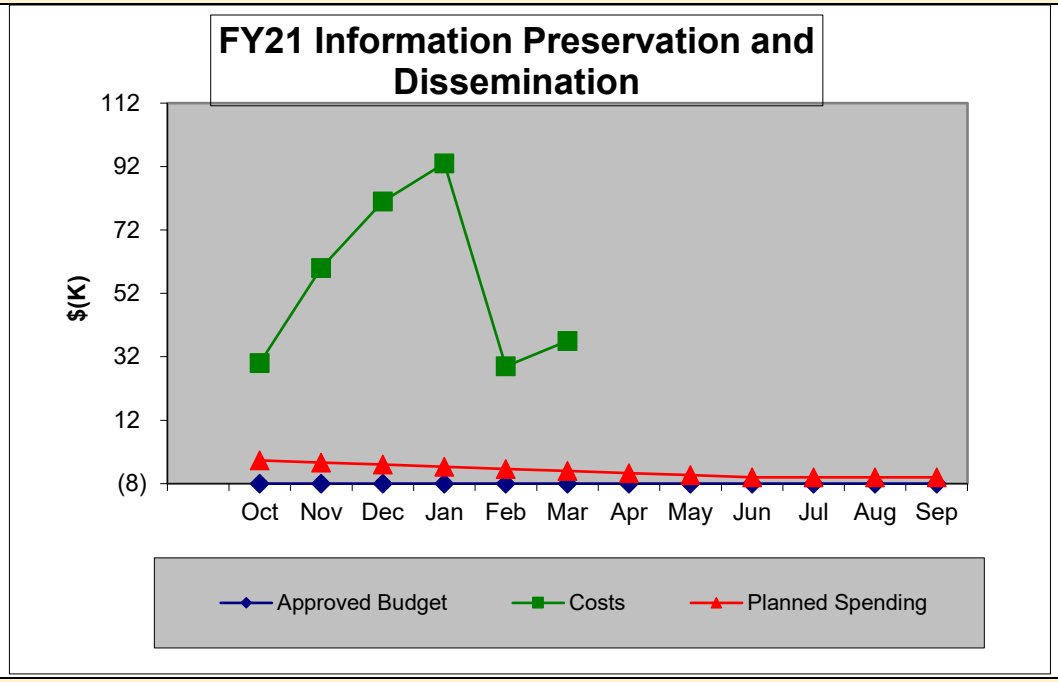
Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

Quarter	Publication Reference	Sent to NCSP? Yes/no	If no, status of submittal
Q1	Soon S. Kim et al., "Application of COG to Deuteron Transport Problems," Transactions of the American Nuclear Society, Vol. 123, pp. 1189-1191, ANS Virtual Winter Meeting, November 16-19, 2020.	No	Copyrighted material.
	David P. Heinrichs, "Report on the (on-line) 2020 ICSBEP Technical Review Group (WebEx) Meeting," LLNL-MI-816976, October 31, 2020.	Yes	
Q2	Dave Heinrichs, "LLNL Task Highlights and Budget," LLNL-PRES-819574, February 23-24, 2021.	Yes	
	Soon S. Kim et al., "Evaluation of Polyethylene and Blank Pulsed Sphere Experiments Using Deuteron Transport Feature in COG," LLNL-ABS-820246, March 5, 2021.	Yes	
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2021 Q2)

NCSP Element and Subtask: IPD5, 7 **M&O Contractor Name**: ORNL **Point of Contact Name:** Doug Bowen **Point of Contact Phone:** (865) 576-0315	**Reference:** DP0909010 **Date of Report:** April, 2021

BUDGET



1. Carryover into FY 2021 = $ -8K
2. Approved FY 2021 Budget = $-8K (includes carryover)
3. Actual spending for 1st Quarter FY 2021 = $81K
4. Actual spending for 2nd Quarter FY 2021 = $-44K (Negative due to cost corrections for HPRR benchmark work)
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	Provide a status report on progress made. (IPD5)		
Q1	Provide a status report on progress made. (IPD7)		
Q2	Provide a status report on progress made. (IPD5)		

Q2	Provide a status report on progress made. (IPD7)		
Q3	Provide a status report on progress made. (IPD5)		
Q3	Provide a status report on progress made. (IPD7)		
Q4	Provide a status report on progress made. (IPD5)		
Q4	Provide a status report on progress made. (IPD7)		

ACCOMPLISHMENTS

- IPD5 – Oak Ridge Health Physics Research Reactor CAAS Benchmark Evaluation
  - Work is nearly complete on the benchmark for this evaluation. An ORNL report developed last FY was modified for the format required for a SINBAD benchmark. Independent reviews in progress. Funding will come from carryover from completed tasks.
- IPD7 - Preserving the "Howard Dyer" Library at ORNL
  - This task is complete. A gap analysis was performed to ensure all the Dyer documents were scanned and saved as planned (QA check).

PUBLICATIONS

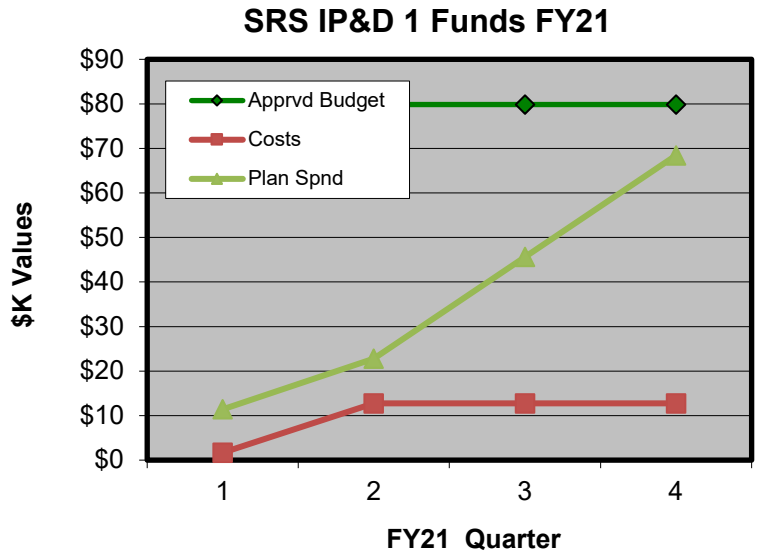
Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

Quarter	Publication Reference **example)** J., "Excluding Benchmark Statistical Outliers in Nuclear Criticality Safety Validation: A Comparison Study of Upper Subcritical Limits for Plutonium Systems using Whisper-1.1", LA-UR-18-27731, October 1, 2019	Sent to NCSP? Yes/no	If no, status of submittal
Q1	N/A		
Q2	N/A		
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2021 Q2)

NCSP Element and Subtask: IPD1 **M&O Contractor Name**: SRNS **Point of Contact Name:** David Erickson **Point of Contact Phone:** 803-557-9445	**Reference:** DP09090100 **Date of Report:** April, 15, 2021

BUDGET



1. Carryover into FY 2021 = $79.8K
2. Approved FY 2021 Budget = $ 0K
3. Actual spending for 1st Quarter FY 2021 = $1.7K
4. Actual spending for 2nd Quarter FY 2021 = $11.1K
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	Provide status reports on SRS progress with CritView. (IPD1)		
Q1	NCSP Approved Scope for FY21. (IPD1)		Did not complete in Q1. In Q2 the scope was defined and approved.
Q2	Provide status reports on SRS progress with CritView. (IPD1)		
Q2	TBD based on Approved Scope. (IPD1)		Identified two interns to support FY-21 activities.

Q3	Provide status reports on SRS progress with CritView. (IPD1)		
Q3	TBD based on Approved Scope. (IPD1)		
Q4	Provide status reports on SRS progress with CritView. (IPD1)		
Q4	Provide updated CritView database for user testing. (IPD1)		

ACCOMPLISHMENTS

- IPD1 – ARH-600 Reissue (CritView)

PUBLICATIONS

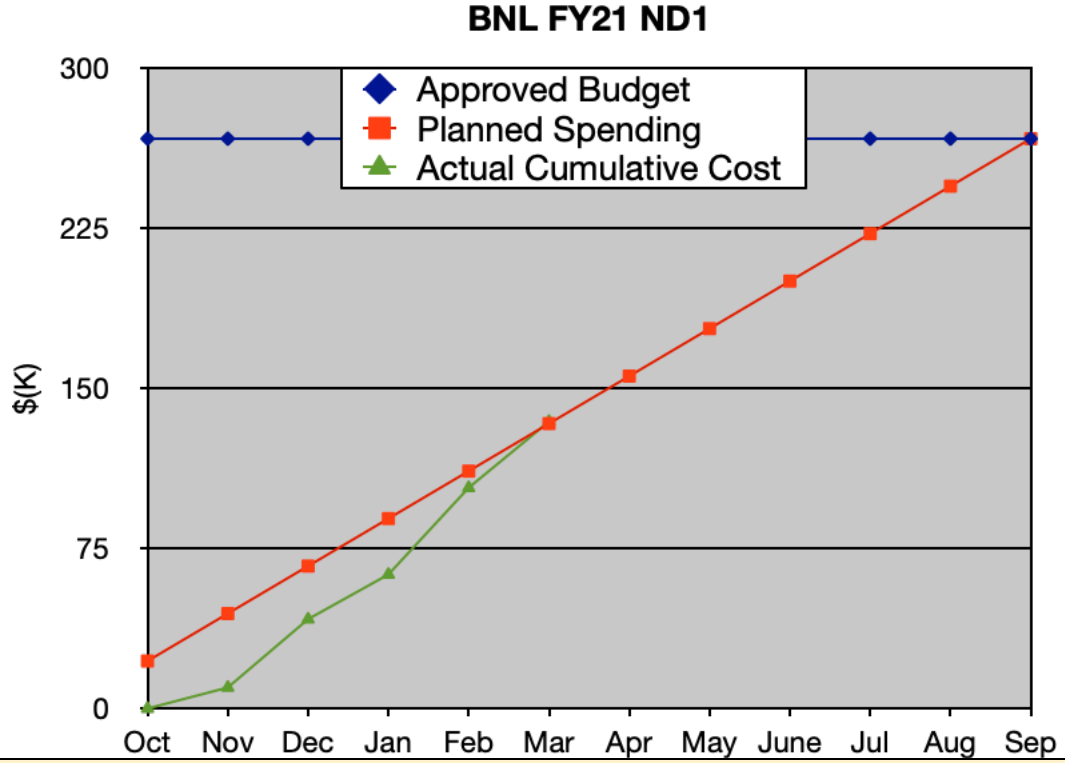
Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

Quarter	**Publication Reference** **example)** J., "Excluding Benchmark Statistical Outliers in Nuclear Criticality Safety Validation: A Comparison Study of Upper Subcritical Limits for Plutonium Systems using Whisper-1.1", LA-UR-18-27731, October 1, 2019	**Sent to NCSP? Yes/no**	**If no, status of submittal**
Q1			
Q2			
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2021 Q2)

NCSP Element and Subtask: ND1 **M&O Contractor Name**: BNL **Point of Contact Name:** David Brown **Point of Contact Phone:** 631-344-2814	**Reference:** DP0909020 **Date of Report:** Apr., 2021

BUDGET



1. Carryover into FY 2021 = $ 13,325
2. Approved FY 2021 Budget = $ 267,000
3. Actual spending for 1st Quarter FY 2021 = $42,871
4. Actual spending for 2nd Quarter FY 2021 = $92,602
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	Maintain and upgrade ADVANCE code system by performing data verification of new NCSP evaluations and performing quality assurance on the data as required and provide status reports on all nuclear data support activities to the NCSP Manager. (ND1)		CSEWG is deciding on a review process for all ENDF evaluations. Currently, all submitted evaluations are stored in the `phase1' branch and this branch is checked by ADVANCE. To move to the `phase2' branch for integral validation, evaluations must pass through an as-yet-undefined peer review process. We had planned to work this

			process out at the 2020 mini-CSEWG which was postponed due to COVID-19.
Q1	If mandated by CSEWG, release new ENDF library. (ND1)		Release of a beta version of the next ENDF library (ENDF/B-VIII.1) was discussed and approved by the CSEWG Executive Committee. A timeline for this beta release has not been decided. CSEWG has set a target date of February 2023 for the final release of ENDF/B-VIII.1.
Q2	Maintain and upgrade ADVANCE code system by performing data verification of new NCSP evaluations and performing quality assurance on the data as required and provide status reports on all nuclear data support activities to the NCSP Manager. (ND1)		Working on updating ADVANCE to use latest FUDGE and NJOY21. Addition of A. Cuadra and A. Varuttamaseni to project will temporarily slow updates as they come up to speed.
Q2	If mandated by CSEWG, release new ENDF library. (ND1)		No change since last quarter
Q3	Maintain and upgrade ADVANCE code system by performing data verification of new NCSP evaluations and performing quality assurance on the data as required and provide status reports on all nuclear data support activities to the NCSP Manager. (ND1)		
Q3	If mandated by CSEWG, release new ENDF library. (ND1)		
Q4	Maintain and upgrade ADVANCE code system by performing data verification of new NCSP evaluations and performing quality assurance on the data as required and provide status reports on all nuclear data support activities to the NCSP Manager. (ND1)		
Q4	If mandated by CSEWG, release new ENDF library. (ND1)		

ACCOMPLISHMENTS

- ND1 - National Nuclear Data Center (NNDC) Support to the NCSP
  - D. Brown presented work from FY20 at the 2021 NCSP Technical Program Review: “NNDC Support to the NCSP”

PUBLICATIONS

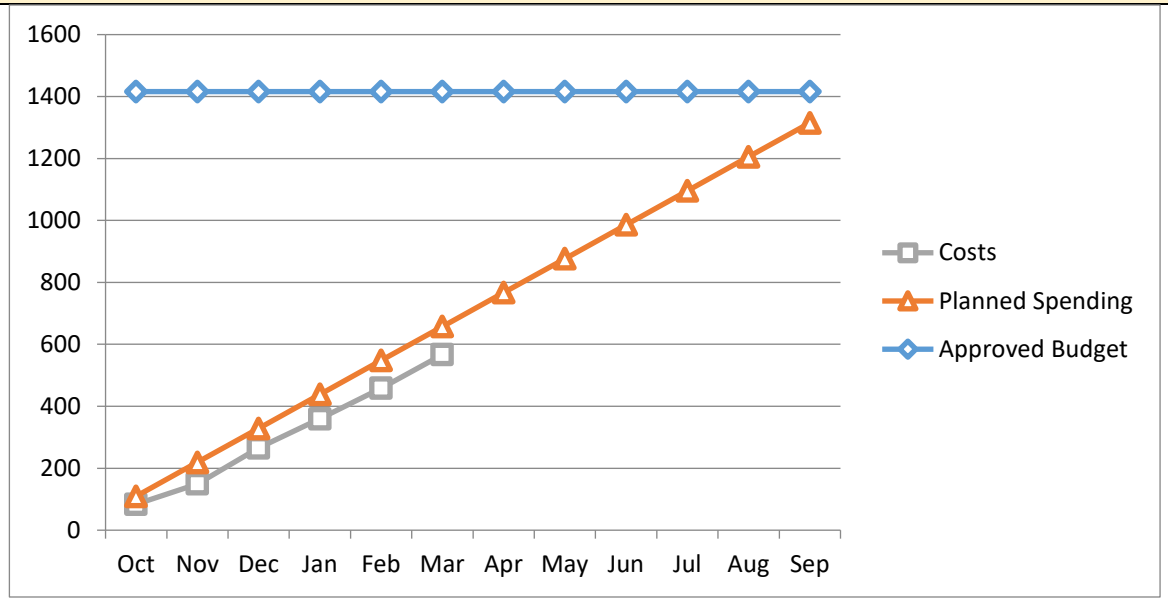
Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

Quarter	Publication Reference example) J., "Excluding Benchmark Statistical Outliers in Nuclear Criticality Safety Validation: A Comparison Study of Upper Subcritical Limits for Plutonium Systems using Whisper-1.1", LA-UR-18-27731, October 1, 2019	Sent to NCSP? Yes/no	If no, status of submittal
Q1			
Q2			
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2021 Q2)

NCSP Element and Subtask: ND1, 2, 3, 4 **M&O Contractor Name**: LANL **Point of Contact Name:** Joetta Goda/Bob Little **Point of Contact Phone:** 505-667-2812/505-665-3487	**Reference:** DP0909020 **Date of Report:** April 15, 2021

BUDGET



1. Carryover into FY 2021 = $ 30,000.00
2. Approved FY 2021 Budget = $ 1,386,000.00
3. Actual spending for 1st Quarter FY 2021 = $265,680
4. Actual spending for 2nd Quarter FY 2021 = $301,006 (YTD = $566,686)
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $0

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	Provide status reports on LANL participation in US and International Nuclear Data collaborations. (ND1)		
Q1	Conduct CSEWG Evaluation and Covariance sessions. (ND1)		
Q1	Report data testing results with ENDF/B-VIII.0 and additional beta release cross sections at CSEWG. (ND1)		

Q1	Provide status report on progress (ND2)		
Q1	Provide status report on progress (ND3)		
Q1	Complete review of previous "thin" target U233 measurements and finalize specifications for new "thick" U233 target (ND3)		Completed early during FY20 – see Q3 ND report.
Q1	Provide status report on progress (ND4)		
Q2	Provide status reports on LANL participation in US and International Nuclear Data collaborations. (ND1)		
Q2	Provide status report on progress (ND2)		
Q2	Provide status report on progress (ND3)		
Q2	Provide status report on progress (ND4)		
Q3	Provide status reports on LANL participation in US and International Nuclear Data collaborations. (ND1)		
Q3	Provide status report on progress (ND2)		
Q3	Provide status report on progress (ND3)		
Q3	Complete fabrication of new "thick" U233 target (ND3)		Completed early – see Q1 ND report.
Q3	Provide status report on progress (ND4)		
Q4	Provide status reports on LANL participation in US and International Nuclear Data collaborations. (ND1)		
Q4	Deliver nuclear data evaluations as indicated in Appendix B of the Five Year plan. (ND1)		
Q4	Provide status report on progress (ND2)		
Q4	Start taking Pu240 PFNS data (ND2)		
Q4	Provide status report on progress (ND3)		
Q4	Acquire initial U233 thick-target data (ND3)		
Q4	Provide status report on progress (ND4)		

Q4	Finalize the analysis, submit the results for publication, and make the data available to IRSN and EXFOR. (ND4)		

ACCOMPLISHMENTS

- ND1 – Nuclear Data Evaluation and Testing
  - Light nuclei:
    - 7Li system
      - 6Li excited states [6Li*(3+, 2.19 MeV); 6Li**(0+, 3.56 MeV)] included in system configuration
      - 4He(t,n)6Li*, 6Li(n,n')6Li*, 6Li(n,n')6Li** data (angle integrated and differential) included in fit
    - 10Be system
      - Follow-on work for 'new' ('ENDF/B-VIII.1') FY20 updated evaluation (9Be excited state [9Be*(5/2-; 2.49 MeV)] data included)
        - Plot comparisons made to ENDF/B-VII.1, ENDF/B-VIII.0 and ENDF/B-VIII.1
        - Pencil beam studies in MCNP
        - Comparison of theoretical excitation function against Danon quasi-integral testing
        - Perturbative criticality study (with Mike Herman LANL, using CRATER code)
        - Pulsed Be spheres testing (with Denise Neudecker LANL, using MCNP)
    - Work currently done under other funding that relates to NCSP interests:
      - 17O system
        - Ongoing review and update of evaluation
          - Analysis and reconstruction of Walton 1957 data
        - Including new data [e.g. Gazeeva 2020 4He(13C,n)]
        - 13C and 16O excited states
          - include (n,n') and (a,n') data
    - Presentation:
      - Mark Paris & Gerry Hale, “EDA R-Matrix Evaluations, Report on n+9Be, n+16O,” International Nuclear Data Evaluation Network on Light Elements (INDEN-LE), online meeting hosted by the IAEA, 3/17/21.

  - Progress on nubar and PFNS and consistent nubar/PFNS evaluations:
    - We have started testing updates to BeoH within CGMF (changes to the discrete and continuum states look promising; the spin cut-off factor is a decently good avenue as well, but in CGMF we also see a strong change in <nu>).
    - We calculated parameter sensitivities for <nu> within CGMF for 239Pu(n,f) from thermal to 20 MeV; these sensitivities, along with parameter uncertainties, are intended to test fitting on an observable that already fairly closely matches the current ENDF evaluation; this way, we can understand what pitfalls may show up before moving to a modeled observable that is farther from the data.

        - Made progress on 239Pu(n,f) nu-bar evaluation: Included Marini et al. data (to be submitted) and included CGMF model via Kalman filter and sensitivities mentioned in the last bullet. Required some re-programming of codes. Partly documented in LA-UR-21-21474 (NCSP TPR presentation).
        - Included 239Pu(n,f)/235U(n,f) and correlated to 238U(n,f)/235U(n,f) niffteTPC data in standards database. Still to do: final report for standards. Documented in LA-UR-21-21474 (NCSP TPR presentation).
        - Made progress on 239Pu PFNS evaluation: Continued on requested fine-tuning and benchmarking of Pu-239 PFNS evaluation. Still to do: including CGMF model.
        - Publication:
            - T. Kawano, S. Okumura, A. E. Lovell, I. Stetcu, and P. Talou, "Influence of non-statistical properties in nuclear structure on emission of prompt fission neutrons", arXiv:2104.00879 [nucl-th] (2021). Submitted to Phys. Rev. C. (https://arxiv.org/pdf/2104.00879).
    - Ta181 evaluation
        - Work continued on further improving of neutron spectra using Multi Step Direct and Multistep Compound models which provide clear advantage over the classical exciton model of pre-equilibrium emission. Proper description of neutron emission spectra is essential for correct description of other channels such as (n,2n) and (n,p). It has been also realized that reactions to the isomeric states in various isotopes of tantalum are of importance to the radchem and should therefore be given proper attention. Work has also started on the Engelbrecht-Weidenmuller transformation to check the effect of Direct and Hauser-Feschbach interference potentially affecting inelastic cross sections at energies of interest to criticality safety.
    - Data Testing
        - Publication:
            - "Which nuclear data can be validated with LLNL pulsed-sphere experiments?", Denise Neudecker, Oscar Cabellos, Alexander R. Clark, Wim Haeck, Robert Capote, Andrej Trkov, Morgan C. White, and Michael E. Rising, Annals of Nuclear Energy, 2021 (First revised version included in report section and transmitted to NCSP).
- ND2 – Prompt Fission and Neutron Spectra (PFNS) Measurement of Plutonium-240
    - LLNL is hoping for a late August/early September delivery of the PPAC. Further delays will put the schedule for execution of the experiment at risk.
- ND3 – Unresolved and Fast Measurements of U233 (n, gamma)
    - Partial summaries of the progress on this task were provided in a presentation during the TPR and in the NCSP Spring Newsletter.
    - Recent Data Analysis
        - Following detector calibration, the next data analysis step consists in defining Pulse Shape Discrimination (PSD) windows to separate the neutrons and gammas from NEUANCE. These windows have been defined, providing good separation, and will be used to identify fission events with NEUANCE.
    - Next Steps
        - The next step in the analysis consists in searching for coincidences between neutrons and gammas with NEUANCE to identify the fission events, and then a second coincidence method between DANCE and NEUANCE will be used to tag the fissions and suppress them in the calculation of the capture cross section.

- A second measurement of the U-233 capture cross section, using the thick target (~ 20 mg) has been planned for June-July 2021, to complete the statistics needed above 10 keV.

- ND4 – 95-Mo Neutron Capture and Transmission Measurements
  - The programs and data files used to make resonance spin and parity assignments have been located and verified. The section of a forthcoming journal article describing the techniques used and accompanying figures has been drafted.
- Several LANL ND presentations were made during the TPR:
  - "Optimal Experiment Design and Nuclear Data Validation with Diverse Benchmarks," Alex Clark.
  - "Towards a Consistent Evaluation of Fission Observables," Amy Lovell.
  - "Evaluations of the 239Pu fission source term," Denise Neudecker.
  - "Measurements of 233U(n,g) with DANCE," Esther Leal Cidoncha.
  - "LANL Evaluation Progress in FY 2020," Ionel Stetcu and Mark Paris.
  - "R-Matrix Evaluation and Benchmarking of n+^{9}Be," Mark Paris (NDAG).
- Several LANL ND presentations were made during the Workshop for Applied Nuclear Data Activities (WANDA 2021):
  - "EMPIRE-3.2 Nuclear Reaction Code System," Mike Herman.
  - "HPC for Fission Modeling in Support of Nuclear Data," Ionel Stetcu.
  - "Example on how to (intelligently) augment the nuclear-data pipeline with machine learning," Denise Neudecker.
  - "Evaluation of Energy Dependent Fission Product Yields," Toshihiko Kawano.

PUBLICATIONS

Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

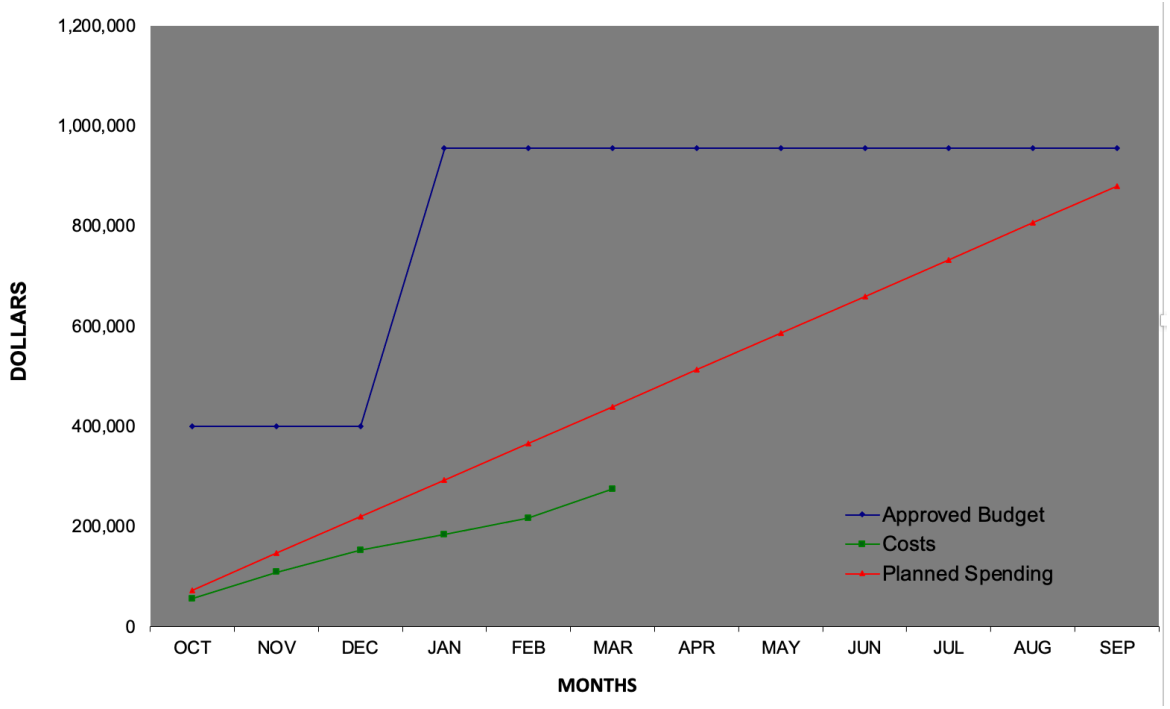
Quarter	Publication Reference	Sent to NCSP? Yes/no	If no, status of submittal
Q1	"Which nuclear data can be validated with LLNL pulsed-sphere experiments?", Denise Neudecker, Oscar Cabellos, Alexander R. Clark, Wim Haeck, Robert Capote, Andrej Trkov, Morgan C. White, and Michael E. Rising, submitted to Annals of Nuclear Energy, 2021, LA-UR-20-28636.	Yes – will send.	
Q1	J.L. Alwin, F.B. Brown, W. Haeck, M.E. Rising, K.D. Spencer, "Procedure for Creating, Reviewing, & Submitting Input Files into Benchmark Library", LA-UR-20-29183	Yes - will send.	
Q1	W. Haeck, K.Y. Spencer, J.L. Alwin, "Benched: Upgrading and Updating the Los Alamos Benchmark Suite for the 21st Century", ANS Winter Meeting, LA-UR-20-29471, LA-UR-20-24777.	Yes – will send.	
Q1	P.A. Grechanuk, M.E. Rising, T.S. Palmer, "Application of Machine Learning to Identify Problematic Nuclear Data", to be submitted to *Nucl. Sci. Eng*. (2021).	No – will send in Q2.	Sent with Q2 report.

Q1	Amy Lovell, "Towards a Consistent Evaluation of Fission Observables: Status, Challenges, and Plans for Consistent Modeling and Evaluation of Fission Data: Nubar, PFNS, and FPY," presented at NDAG, LA-UR-20-29811.	Yes - will send.	
Q1	Denise Neudecker, "Additional information to CSEWG talk on Average Prompt-fission Neutron Multiplicity and PFNS Evaluations for 239Pu, "LA-UR-20-29720.	Yes - will send	
Q2	Mark Paris & Gerry Hale, "EDA R-Matrix Evaluations, Report on n+9Be, n+16O," International Nuclear Data Evaluation Network on Light Elements (INDEN-LE), online meeting hosted by the IAEA, 3/17/21.	Yes	
Q2	T. Kawano, S. Okumura, A. E. Lovell, I. Stetcu, and P. Talou, "Influence of non-statistical properties in nuclear structure on emission of prompt fission neutrons", arXiv:2104.00879 [nucl-th] (2021). Submitted to Phys. Rev. C. (https://arxiv.org/pdf/2104.00879).	Yes	
Q2	"Which nuclear data can be validated with LLNL pulsed-sphere experiments?", Denise Neudecker, Oscar Cabellos, Alexander R. Clark, Wim Haeck, Robert Capote, Andrej Trkov, Morgan C. White, and Michael E. Rising, Annals of Nuclear Energy, 2021 (First revised version).	Yes	
Q2	"Optimal Experiment Design and Nuclear Data Validation with Diverse Benchmarks," Alex Clark, presented at TPR.	TPR – You have	
Q2	"Towards a Consistent Evaluation of Fission Observables," Amy Lovell, presented at TPR.	TPR – You have	
Q2	"Evaluations of the 239Pu fission source term," Denise Neudecker, presented at TPR.	TPR – You have	
Q2	"Measurements of 233U(n,g) with DANCE," Esther Leal Cidoncha, presented at TPR.	TPR – You have	
Q2	"LANL Evaluation Progress in FY 2020," Ionel Stetcu and Mark Paris, presented at TPR.	TPR – You have	
Q2	"R-Matrix Evaluation and Benchmarking of n+^{9}Be," Mark Paris, presented at NDAG during TPR week.	TPR – You have	
Q2	"EMPIRE-3.2 Nuclear Reaction Code System," Mike Herman, presented at WANDA 2021.	Yes	
Q2	"HPC for Fission Modeling in Support of Nuclear Data," Ionel Stetcu, presented at WANDA 2021.	Yes	
Q2	"Example on how to (intelligently) augment the nuclear-data pipeline with machine learning," Denise Neudecker, presented at WANDA 2021.	Yes	
Q2	"Evaluation of Energy Dependent Fission Product Yields," Toshihiko Kawano, presented at WANDA 2021.	Yes	
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2021 Q2)

NCSP Element and Subtask: ND1a, 1b, 2, 3, 5, 6, 7, 8, 9, 10, 11 **M&O Contractor Name**: LLNL **Point of Contact Name:** David Heinrichs **Point of Contact Phone:** (925) 424-5679	**Reference:** DP0909020 **Date of Report:** April, 2021

BUDGET



1. Carryover into FY 2021 = $ 268,257
2. Approved FY 2021 Budget = $ 956,257
3. Actual spending for 1st Quarter FY 2021 = $ 153,005*
4. Actual spending for 2nd Quarter FY 2021= $ 122,912*
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $ 76,501 (8%)

*NCSU costs are estimated. LLNL costs are actuals.

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	Provide status on nuclear data activities to NCSP Manager (ND1a, 1b)		On hold pending restart of Criticality Slide Rule project for plutonium systems
Q1	Provide status on nuclear data activities to NCSP Manager (ND2)		

Q1	Provide status on nuclear data activities to NCSP Manager (ND3)		
Q1	Provide status on nuclear data activities to NCSP Manager (ND5)		
Q1	Provide status on nuclear data activities to NCSP Manager (ND6)		Task complete.
Q1	Provide status on nuclear data activities to NCSP Manager (ND7)		
Q1	Provide status on nuclear data activities to NCSP manager (ND8)		
Q1	Provide status on nuclear data activities to NCSP manager (ND9)		
Q1	Provide status on nuclear activities to NCSP manager (ND10)		
Q1	Provide status report PPAC target fabrication progress (ND11)		
Q1	Fabricate the Pu240 PPAC targets and fission detector components (ND11)		
Q2	Provide status on nuclear data activities to NCSP Manager (ND1a, 1b)		
Q2	Provide status on nuclear data activities to NCSP Manager (ND2)		
Q2	Provide status on nuclear data activities to NCSP Manager (ND3)		
Q2	Provide status on nuclear data activities to NCSP Manager (ND5)		
Q2	Provide status on nuclear data activities to NCSP Manager (ND6)		Task complete.
Q2	Provide status on nuclear data activities to NCSP Manager (ND7)		
Q2	Provide status on nuclear data activities to NCSP manager (ND8)		
Q2	Provide status on nuclear data activities to NCSP manager (ND9)		

Q2	Provide status on nuclear data activities to NCSP manager (ND10)		
Q2	Provide status report PPAC target fabrication progress (ND11)		
Q2	Assemble and test the Pu240 fission detector (ND11)		Task delayed – see accomplishments.
Q3	Provide status on nuclear data activities to NCSP Manager (ND1a, 1b)		
Q3	Provide status on nuclear data activities to NCSP Manager (ND2)		
Q3	Provide status on nuclear data activities to NCSP Manager (ND3)		
Q3	Provide status on nuclear data activities to NCSP Manager (ND5)		
Q3	Provide status on nuclear data activities to NCSP Manager (ND6)		
Q3	Provide status on nuclear data activities to NCSP Manager (ND7)		
Q3	Provide status on nuclear data activities to NCSP manager (ND8)		
Q3	Provide status on nuclear data activities to NCSP manager (ND9)		
Q3	Provide status on nuclear data activities to NCSP manager (ND10)		
Q3	Provide status report PPAC target fabrication progress (ND11)		
Q4	Provide status on nuclear data activities to NCSP Manager (ND1a, 1b)		
Q4	Provide status on nuclear data activities to NCSP Manager (ND2)		
Q4	Deliver thermal neutron scattering data evaluations as indicated in Appendix B of the 5-Year Plan. (ND2)		
Q4	Provide status on nuclear data activities to NCSP Manager (ND3)		

Q4	Provide status on nuclear data activities to NCSP Manager (ND5)		
Q4	Provide status on nuclear data activities to NCSP Manager (ND6)		
Q4	Provide status on nuclear data activities to NCSP Manager (ND7)		
Q4	Provide status on nuclear data activities to NCSP manager (ND8)		
Q4	Provide status on nuclear data activities to NCSP manager (ND9)		
Q4	Provide status on nuclear data activities to NCSP manager (ND10)		
Q4	Provide status report PPAC target fabrication progress (ND11)		
Q4	Provide an update on the development and testing of NeTS modules for selected materials such as light water, graphite, etc. (ND10)		

ACCOMPLISHMENTS

- ND1 – Delayed Fission Gamma Multiplicity and Spectra
  - A summary of progress to date was presented in LLNL-PRES-819569, page 8, "COG Slide Rule Results for Pu DFG," and LLNL-PRES-819574, page 13, "ND Highlights – Delayed Fission Gammas (Pu),) at the NCSP AMWG and TPR meetings on Feb. 22-23, 2021, respectively.
- ND2 - Generation and Benchmarking of Thermal Neutron Scattering Cross Sections in Support of Advanced Nuclear Reactor Concepts
  - NCSU initiated the TSL evaluation of uranium metal. At this stage, atomistic analysis using both DFT and classical MD based methods is proceeding. For classical MD, the EAM potential was selected for the analysis. Therefore, calculations of the vibrational DOSs are proceeding using the dynamical matrix and VACF resulting from both techniques. TSL data (with Sd) for graphite and beryllium have been generated. Benchmark of HF TSL is progressing.
- ND3 - Development and Implementation of an Advanced and Rigorous Computational Platform for Thermal Neutron Scattering Analysis
  - NCSU continued the development of the *FLASSH* advanced platform for TSL evaluation. *FLASSH* has been updated to improve output cross section generation using the evaluated TSL. In addition, improved routines for calculating angular binning in support of ACE file generation were completed. These developments were also benefited the liquid physics module of FLASSH, where a more accurate convolution grid capability was introduced. Improved *FLASSH* input/output capabilities were also introduced.
- ND5 - Development and Implementation of a Modern Doppler Broadening Approach Including Atomic Binding Effects
  - NCSU completed the development of the ability to use the exact lattice structure in Doppler analysis. This ability resulted in relaxing the cubic assumption typically used in TSL analysis. In combination with the Sd component, TSLs can now be generated, with minimal approximation, and used in Doppler analysis. Testing is proceeding for U238 and UO2 materials including the examination of the resonance parameters used in the broadening operation.
- ND6 - Evaluate Neutron Radiative Capture Gamma Production in Cadmium

- This task is complete as reported to NDAG in Q1 and at the TPR in LLNL-PRES-819574, pages 15-18, ND Highlights – Cadmium Capture Gammas," on February 23, 2021. LLNL evaluated and recommends accepting Belgya EXFOR data for Cd-113 into ENDF/B-VIII.1 together with JEFF-3.3 data for the other cadmium isotopes

- ND7 - 'Alpha-N' Benchmark Measurements
  - A summary of progress to date was presented in LLNL-PRES-819574, pages 19-22, "ND Highlights – (α,n) Benchmarks," at the TPR on Feb. 23, 2021. An 241Am-Li source has been transferred from DAF-E to LLNL for trial measurements in low scatter facilities (e.g., B255, B262 and B334).
- ND8 - Study: Fission TPC Measurement of the U-233/U-235 (n,f) Cross Section Ratio
  - U-233/U-235 target fabrication is estimated to cost $60,000 and developing cost and schedule requirements for the (n,f) ratio measurement and analysis is in progress with input from LANL (Little, et al.).
- ND9 – Scoping Study: Li-6 Doped Liquid Scintillator Array for Fission Correlations
  - On hold pending carry-over constraints.
- ND10 – Development and Implementation of Machine Learning Methods for Thermal Scattering Law Evaluations
  - NCSU continued work on the development of neural network analysis for TSL representation. A feedforward neural network (FNN) approach is currently under testing for the representation of the TSL of H in H2O. The architecture of the FNN is being examined using 1-D, 2-D, and 3-D analysis of the TSL phase space. This includes the choice of the optimum hidden layer structure and the appropriate activation function. The analysis is currently being performed using the PyTorch DL framework (version 1.7.1).
- ND11 - Fabricate the Pu240 PPAC targets and fission detector components
  - A summary of progress to date was presented in LLNL-PRES-819574, page 23, "240Pu Fission Parallel Plate Avalanche Counter," at the TPR on Feb. 23, 2021. Rubber cement used to glue the thin Al foil to the Al frame had to be replaced by a heat resistant adhesive to accommodate high temperature (> 400 °C) annealing of the foil and frame (after 240Pu is deposited on the foil) delaying completion of fabrication.

PUBLICATIONS

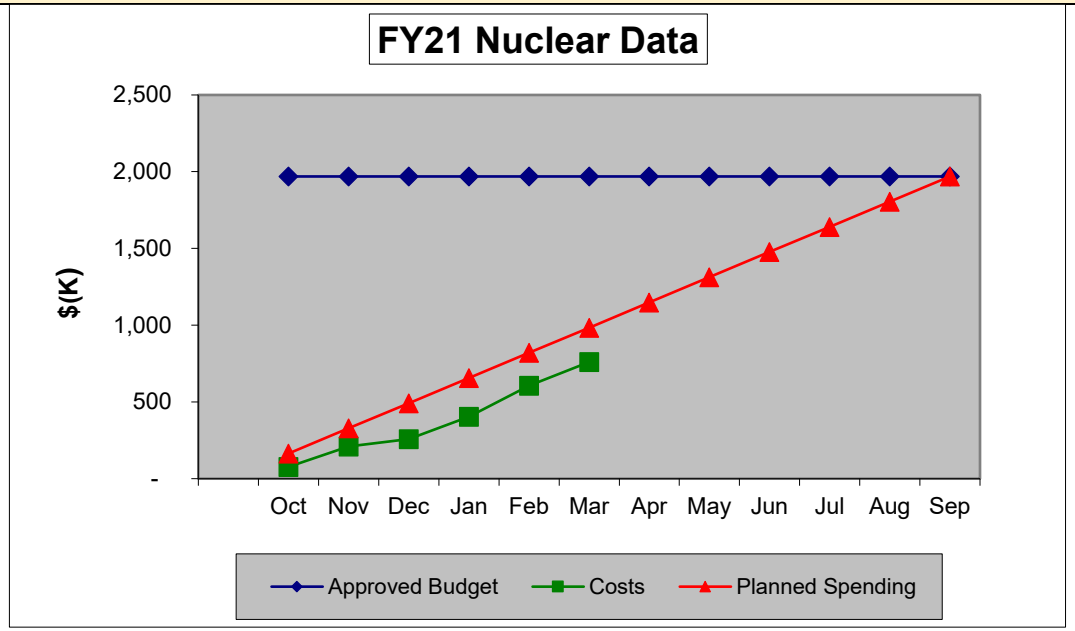
Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

Quarter	Publication Reference	Sent to NCSP? Yes/no	If no, status of submittal
Q1	Bret Beck et al., "LLNL Report: Presented (on-line) to the Nuclear Data Advisory Group on December 3, 2020," LLNL-PRES-817232.	Yes	
	A. I. Hawari et al., "Thermal Neutron Scattering Law Benchmark and Validation at NCSU."	Yes	
	A. I. Hawari et al., "Thermal Scattering Law Evaluations and Progress at NCSU."	Yes	
Q2	Dave Heinrichs and Catherine Percher, "LLNL Task Highlights and Budget," LLNL-PRES-819574, February 23-24, 2021.	Yes	
	Ayman Hawari, "Accomplishments of Thermal Neutron Scattering Research at NCSU."	Yes	
	N. C. Fleming, A. I. Hawari, "Structure-Dependent Doppler Broadening Using a Generalized Thermal Scattering Law," Journal of Nuclear Engineering, April 8, 2021.	Yes	
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2021 Q2)

NCSP Element and Subtask: ND1, 3, 4, 6, 10 **M&O Contractor Name**: ORNL **Point of Contact Name:** Doug Bowen **Point of Contact Phone:** (865) 576-0315	**Reference:** DP0909010 **Date of Report:** April, 2021

BUDGET



1. Carryover into FY 2021 = $91K
2. Approved FY 2021 Budget = $ 1,969K (includes carryover)
3. Actual spending for 1st Quarter FY 2021 = $258K
4. Actual spending for 2nd Quarter FY 2021 = $502
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	Provide status reports on all activities in NCSP Quarterly Progress Reports (ND1)		
Q1	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 (ND1)		

Q1	Complete cross-section measurement and evaluation deliverables per the nuclear data schedule in Appendix B of the 5 Year Plan (ND1)		COVID-19 has delayed cross section measurements at GELINA.
Q1	Provide status reports on all activities in NCSP Quarterly Progress Reports (ND3)		
Q1	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 (ND3)		
Q1	Complete cross-section measurement and evaluation deliverables per the nuclear data schedule in Appendix B of the 5 Year Plan (ND3)		
Q1	Provide status reports on all activities in NCSP Quarterly Progress Reports (ND4)		
Q1	Provide status reports on all activities in NCSP Quarterly Progress Reports (ND6)		
Q1	Provide status reports on all activities in NCSP Quarterly Progress Reports (ND10)		
Q2	Provide status reports on all activities in NCSP Quarterly Progress Reports (ND1)		
Q2	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 (ND1)		
Q2	Complete cross-section measurement and evaluation deliverables per the nuclear data schedule in Appendix B of the 5 Year Plan (ND1)		COVID-19 has delayed cross section measurements at GELINA.
Q2	Provide status reports on all activities in NCSP Quarterly Progress Reports (ND3)		
Q2	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 (ND3)		
Q2	Complete cross-section measurement and evaluation deliverables per the nuclear data schedule in Appendix B of the 5 Year Plan (ND3)		
Q2	Provide status reports on all activities in NCSP Quarterly Progress Reports (ND4)		
Q2	Provide status reports on all activities in NCSP Quarterly Progress Reports (ND6)		
Q2	Provide status reports on all activities in NCSP Quarterly Progress Reports (ND10)		
Q3	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (ND1)		
Q3	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 (ND1)		
Q3	Complete cross-section measurement and evaluation deliverables per the nuclear data schedule in Appendix B of the 5 Year Plan (ND1)		
Q3	Provide status reports on all activities in NCSP Quarterly Progress Reports (ND3)		
Q3	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 (ND3)		
Q3	Complete cross-section measurement and evaluation deliverables per the nuclear data schedule in Appendix B of the 5 Year Plan (ND3)		

Q3	Provide status reports on all activities in NCSP Quarterly Progress Reports (ND4)		
Q3	Provide status reports on all activities in NCSP Quarterly Progress Reports (ND6)		
Q3	Provide status reports on all activities in NCSP Quarterly Progress Reports (ND10)		
Q4	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (ND1)		
Q4	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 (ND1)		
Q4	Complete cross-section measurement and evaluation deliverables per the nuclear data schedule in Appendix B of the 5 Year Plan (ND1)		
Q4	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (ND3)		
Q4	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 (ND3)		
Q4	Complete cross-section measurement and evaluation deliverables per the nuclear data schedule in Appendix B of the 5 Year Plan (ND3)		
Q4	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (ND4)		
Q4	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (ND6)		

Q4	Document SAMMY modernization progress and report status annually to the NCSP Manager (ND6)		
Q4	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (ND10)		

ACCOMPLISHMENTS

- ND1 - Nuclear Data Measurement and Evaluation
  - Continue to work and mentor new staff for data analysis of experimental data.
  - The publication for the new Cr evaluation was finalized and submitted to Nucl. Data Sheets for publication and accepted.
  - Participated in NDAG meeting and reported Zr experimental activities at the NCSP TPR.
  - For the evaluation of copper isotopes (63Cu and 65Cu), the summary of previous work was presented at the NCSP Technical Program Review. A letter report is under preparation, as well.
  - Continuing work to improve the evaluation of the copper isotopes has focused on understanding the correct treatment of the elastic scattering angular distributions. In the current ENDF/B-VIII.0 evaluation, there is a discontinuity in the angular distribution data for both isotopes at the transition from the resolved resonance region to the high energy region. This is being investigated with both R-matrix analysis and the statistical model in order to resolve the discontinuity and to improve the agreement with integral benchmark experiments.
  - 233U: The work on 233U evaluation is in progress in the extension of the resolved resonance region up to about 2.5 keV. This is performed together with the statistical analysis of energy levels and reduced-width amplitudes. The manuscript about the preliminary work performed was submitted for publication in January and the comments of the reviewers were collected and, in the process, to be included in the manuscript. The work on the 233U evaluation was presented at the NCSP TPR in February (https://res.ornl.gov/pub/preview/152106). In March updates to n+16O evaluation performed previously within NCSP was presented at the INDEN meeting (https://res.ornl.gov/pub/preview/154188).
  - 181Ta: Meeting regularly with staff at Nuclear Naval Laboratory, a beta ENDF file of the tantalum evaluation in the RRR+URR is ready to be released to the ENDF repository for testing purposes mainly in the merging of the high energy component.
  - Cerium: Statistical checks showed a potential discrepancy in resonances above 80 keV. Efforts are underway to try to identify and correct this discrepancy. Biweekly meetings with ORNL team members are held to help track down source of issue. ORNL Letter Report is underway to further describe evaluation procedure & results. An update on the evaluation process was given at the FY21 Technical Program Review. Task is expected to be completed on schedule per the 5-year plan.
  - Polystyrene: Analysis of SEQUOIA experimental data is ongoing. Preliminary modeling efforts have begun. An update on the measurement & evaluation process was given at the FY21 Technical Program Review. Measurements & evaluation are expected to be completed on schedule per the 5-year plan.

- Complete cross-section measurement and evaluation deliverables per the nuclear data schedule in Appendix B of the 5-year plan.

- Travel to JRC-Geel was canceled and planned Zr-90 experiments are delayed due to COVID-19 (behind schedule). GELINA refurbishment and improvement in the target hall during FY21 Q2, thus, no experiments were performed. GELINA is expected to resume operation after Easter break and Zr-90 experiments are schedules to start, implementing the new plan to perform experiments at JRC.
- Natural Zr data obtained during previous experimental campaigns were prepared for data reduction. The data cover various sample thickness transmission and capture data with different background filters in progress. Started data reduction on natural Zr.
- Resumed postponed (due to Ce-142 experimental data reduction) the finalization of La capture data reduction.

- Y12 ND1 – GELINA depleted Uranium target cost estimate and construction
  - MSC Inc. received all machined parts for the target assembly. Some issue with measuring the dimensions of some parts arose and are discussed with JRC. Waiting on JRC response.

- ND3 - Isotopic Sample Leases to Support ND1 ND Measurements
  - Ce-142 sample returned to NIDC ($1956.11)
  - New sample lease and analysis was delayed by COVID restrictions
  - New ORNL analysis and leasing is planned to continue in Q3 (as permitted by COVID restrictions)

- ND4 - Thermal Neutron Total Cross Section Measurements for Improvement of Criticality Calculations and Propagation of Scattering Kernel Uncertainties
  - Joint task with RPI (RPI-ND2)
  - RPI has recently completed cross section measurements of polyethylene & polystyrene
  - ORNL work on project will commence in Q3

- ND6 – SAMMY Nuclear Data Evaluation Code Modernization
  - Work continued in breaking up SAMMY into a callable API for use in external fitting routines. Before each internal (or external) adjustment steps the varied parameters, calculated cross section and derivatives are placed into an in-memory structure shareable inside and outside of SAMMY, of course reusing structures and memory already in use.
  - Fixed several defects
    - Print out all sections in the LST file, which previously did not print out all sections
    - Ensure that direct capture component is added for all isotopes in the problem not only to the first one.
  - In the resolved range there may be some parameters for distant resonances that may be varied but do not realistically influence the result. For these parameters the derivatives do not need to be calculated but can upon user request. The code to handle this feature was revamped and a lot of bookkeeping was moved to C++. In addition, errors in the code that allows to fit all gamma width in a spin group together was fixed. This feature, while useful, greatly complicates the bookkeeping. This update also remedies previous defects that prevented users to run problems where all derivatives were wanted. The problem would terminate, but now will run to completion.
  - Work started on modernizing the in-memory handling of the derivatives. Specifically, we developed a C++ resource for the derivatives and started to use it in the code.

- Converted some f77 files to f90 and converted them to Fortran modules. The advantage is that the compiler will report a mismatch in the parameter list for function calls.

- ND10 - Monte Carlo Evaluation of Differential and Integral Data
  - ORNL ND10 Bayesian Monte Carlo (BMC) method aims to improve conventional differential cross section and integral benchmark data evaluation methods, in order to improve understanding of nuclear criticality safety margins.
  - Application of the BMC method to U-233 resolved resonance range using SAMMY has demonstrated the need for explicitly accounting for nuclear data imperfections.
  - A mathematical framework explicitly accounting for nuclear data imperfections has been derived for the BMC, including exact analytical solutions for a special case of linear models and normal probability density functions.
  - A prototype BMC implementation of the framework explicitly accounting for nuclear data imperfections has successfully confirmed derived analytical results, with a robust implementation of it in the SCALE API framework planned to commence in Q3.
  - Recent successes of the BMC method have been presented by Dr. Jesse Brown in a presentation titled "Bayesian Monte Carlo Evaluation for Differential and Integral Benchmark Data" at the NCSP Technical Program Review Meeting, February 22-26, 2021: https://ncsp.llnl.gov/TPRAgendas/2021/58_Bayseian_TPR-2021.pdf
  - ORNL ND10 activities continue to be closely coordinated with NCSP ORNL Tasks ND1, ND4, ND6, in order to maximize synergies among them.

PUBLICATIONS

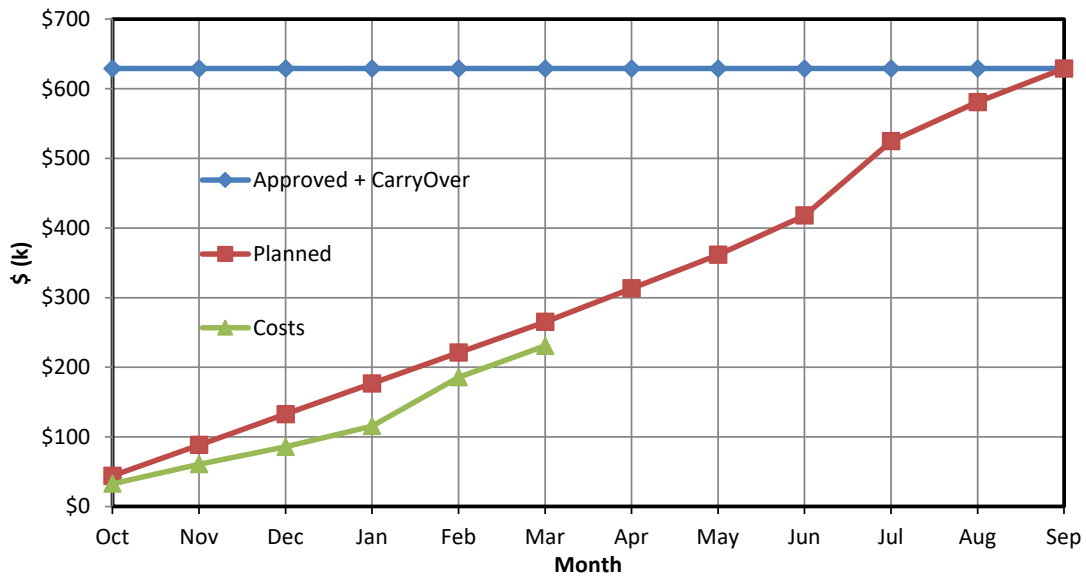
Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

Quarter	Publication Reference **Example:** J., "Excluding Benchmark Statistical Outliers in Nuclear Criticality Safety Validation: A Comparison Study of Upper Subcritical Limits for Plutonium Systems using Whisper-1.1", LA-UR-18-27731, October 1, 2019	Sent to NCSP? Yes/no	If no, status of submittal
Q1	Received and sent separately	yes	
Q2	Pulled from RES	yes	
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2021 Q2)

NCSP Element and Subtask: ND1, 2, 3 **M&O Contractor Name**: RPI **Point of Contact Name:** Yaron Danon **Point of Contact Phone:** 518-276-4008	**Reference:** DP0909020 **Date of Report:** 4, 2021

BUDGET



1. Carryover into FY 2021 = $ 183,029
2. Approved FY 2021 Budget = $ 446,000
3. Actual spending for 1st Quarter FY 2021 = $85,716
4. Actual spending for 2nd Quarter FY 2021 = $144.978
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports. (ND1)		
Q1	Provide status reports on NNL 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. (ND1)		

NCSP Quarterly Progress Report (FY-2021 Q2)

Q1	Complete analysis of measurement from FY-20 (ND1)		Completed analysis of preliminary Cr-nat capture experiment
Q1	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports. (ND2)		
Q1	Provide status reports on NNL 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. (ND2)		No travel using NCSP funds
Q1	Complete neutron output testing (ND2)		Demonstrated a working cold moderator
Q1	Provide status report LINAC refurbishment activities in NCSP Quarterly Progress Reports (ND3)		
Q1	Complete RF window qualification (ND3)		Delayed from Q1 completed in Q2 one of the RF windows failed during the test and the vendor is working on resolving the problem for production of the rest.
Q1	Complete of SOL 1 Accelerator Section RF Conditioning. (ND3)		Delayed to Q3 - need to resolve the issue with the RF windows and possible cooling connection design flaw.
Q2	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports. (ND1)		
Q2	Provide status reports on NNL 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. (ND1)		
Q2	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports. (ND2)		
Q2	Provide status reports on NNL 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. (ND2)		

Q2	Perform thermal cross section measurements for moderators (ND2)		Completed measurements on both polyethylene and polystyrene
Q2	Provide status report LINAC refurbishment activities in NCSP Quarterly Progress Reports (ND3)		
Q2	Complete TPV Accelerator Section RF Conditioning. (ND3)		Likely to be delayed to Q4 or Q1 or FY22.
Q3	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports. (ND1)		
Q3	Provide status reports on NNL 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. (ND1)		
Q3	Complete nuclear data measurements (transmission/capture or scattering) per the nuclear data schedule in Appendix B of the 5 year plan. (ND1)		
Q3	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports. (ND2)		
Q3	Provide status reports on NNL 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. (ND2)		
Q3	Complete thermal cross section measurements (ND2)		
Q3	Provide status report LINAC refurbishment activities in NCSP Quarterly Progress Reports (ND3)		
Q4	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports. (ND1)		

Q4	Provide status reports on NNL 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. (ND1)		
Q4	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 of the 5 year plan (ND1)		
Q4	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports. (ND2)		
Q4	Provide status reports on NNL 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. (ND2)		
Q4	Complete documentation (PhD thesis) and publication (ND2)		
Q4	Provide status report LINAC refurbishment activities in NCSP Quarterly Progress Reports (ND3)		
Q4	Complete Medium Voltage Electrical Distribution Upgrade (ND3)		

ACCOMPLISHMENTS

- ND1 – Resonance Region Nuclear Data Measurement Capability at RPI
  - Performed preliminary radiative capture measurement using an enriched Fe-54 sample.
  - Analyzed preliminary data to design a full production experiment on Fe-54 sample.
- ND2 – Thermal Neutron Scattering Measurement for Improvement of Criticality Calculations and Propagation of Scattering Kernel Uncertainties
  - Sustained operation of cold moderator at 29K with LINAC heating, achieving neutron production gain up to 6 below 0.01 eV.
  - Completed total thermal cross section measurements of polyethylene and polystyrene; extended measurement capability to 0.005 meV.
- ND3 - LINAC 2020 Nuclear Data Capabilities Maintenance Plan
  - RF windows test completed for two windows, one window failed the test. The window was sent to the vendor to develop a mitigation plan for repair/replace of RF window(s).

PUBLICATIONS

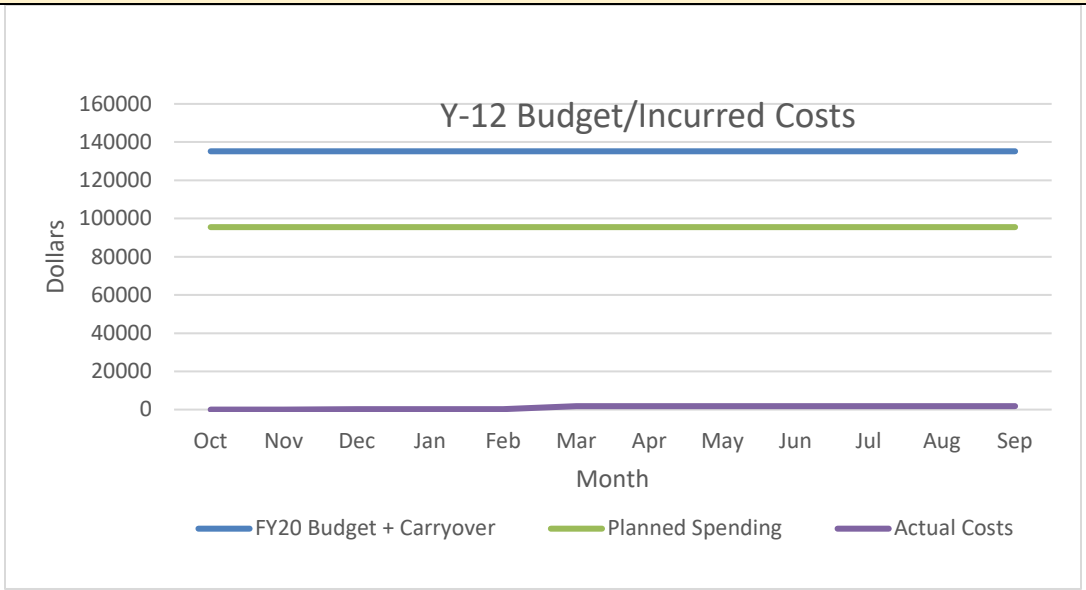
Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

Quarter	Publication Reference example) J., "Excluding Benchmark Statistical Outliers in Nuclear Criticality Safety Validation: A Comparison Study of Upper Subcritical Limits for Plutonium Systems using Whisper-1.1", LA-UR-18-27731, October 1, 2019	Sent to NCSP? Yes/no	If no, status of submittal
Q1	D. Fritz, Y. Danon, “A Cold Moderator For Sub-Thermal Neutron Flux Enhancement At The RPI-LINAC”, Transactions of the American Nuclear Society, Vol. 123, 2020 ANS Virtual Winter Meeting, November 16-19, (2020).	Yes (in Q1)	
Q2	D. Fritz, Y. Danon, and E. Liu, “Cold Polyethylene Sub-Thermal Neutron Flux Enhancement” submitted to the Journal of Neutron Research (2021).	No	Pending publication
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2021 Q2)

NCSP Element and Subtask: ND1 **M&O Contractor Name**: Y12 **Point of Contact Name:** Kevin Reynolds **Point of Contact Phone:** (865) 241-9067	**Reference:** DP0909020 **Date of Report:** April, 2021

BUDGET



1. Carryover into FY 2021 = $ 105,193.05
2. Approved FY 2021 Budget = $ 30,000
3. Actual spending for 1st Quarter FY 2021 = $256.45 ($95,500 commit from GELINA work still outstanding)
4. Actual spending for 2nd Quarter FY 2021 = $1,538.68 ($95,500 commit from GELINA work still outstanding)
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	As necessary, provide a status report of the fabrication of a depleted uranium/molybdenum target per IRMM/GELINA specifications to the NCSP Manager. (ND1)		Part manufacturing proceeding. Partial delivery of parts received and they fit up well. Still awaiting final shipment but no issues expected. Photos sent in separate e-mail update.
Q2	As necessary, provide a status report of the fabrication of a depleted uranium/molybdenum target per		Still awaiting final delivery of parts for final fit up and assembly. (COVID impacts)

	IRMM/GELINA specifications to the NCSP Manager. (ND1)		
Q3	As necessary, provide a status report of the fabrication of a depleted uranium/molybdenum target per IRMM/GELINA specifications to the NCSP Manager. (ND1)		
Q4	As necessary, provide a status report of the fabrication of a depleted uranium/molybdenum target per IRMM/GELINA specifications to the NCSP Manager. (ND1)		

ACCOMPLISHMENTS

- ND1 - Y-12 Fabrication of New Uranium Target for IRMM/GELINA for Cross-section Measurements

PUBLICATIONS

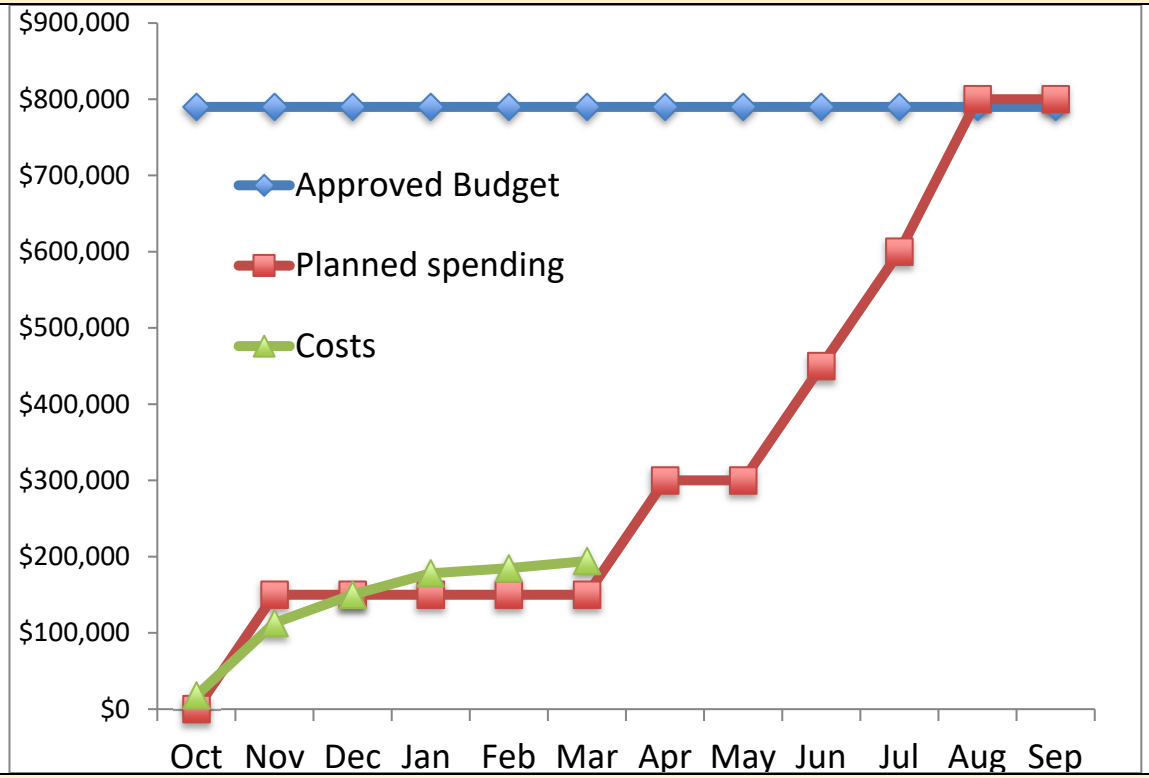
Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

Quarter	Publication Reference example)	Sent to NCSP? Yes/no	If no, status of submittal
Q1			
Q2			
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2021 Q2)

NCSP Element and Subtask: TE3, 4, 6 **M&O Contractor Name**: LANL **Point of Contact Name:** Joetta Goda **Point of Contact Phone:** 505-667-2812	**Reference:** DP0909020 **Date of Report:** April 14, 2021

BUDGET



1. Carryover into FY 2021 = $ 400,000
2. Approved FY 2021 Budget = $ 540,000
3. Actual spending for 1st Quarter FY 2021 = $148,617
4. Actual spending for 2nd Quarter FY 2021 = $47,729
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $0

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	Provide status reports on all training activities to the NCSP Manager (TE3)		

NCSP Quarterly Progress Report (FY-2021 Q2)

Q1	Provide status reports on all training activities to the NCSP Manager (TE4)		
Q1	Provide status reports on all training activities to the NCSP Manager, to include photos and content for the quarterly newsletter (TE6)		
Q2	Provide status reports on all training activities to the NCSP Manager (TE3)		Due to a Covid positive and required isolation of the remainder of the crew, the Feb 1 Hand's-On Week for the CSE Course was cancelled. Make-up course has been scheduled.
Q2	Provide status reports on all training activities to the NCSP Manager (TE4)		
Q2	Provide status reports on all training activities to the NCSP Manager, to include photos and content for the quarterly newsletter (TE6)		
Q3	Provide status reports on all training activities to the NCSP Manager (TE3)		
Q3	Provide status reports on all training activities to the NCSP Manager (TE4)		
Q3	Provide status reports on all training activities to the NCSP Manager, to include photos and content for the quarterly newsletter (TE6)		
Q4	Provide status reports on all training activities to the NCSP Manager (TE3)		
Q4	Provide status reports on all training activities to the NCSP Manager (TE4)		
Q4	In collaboration with ORNL, provide introductory 1-day S/U workshop training to one or more DOE sites in FY21. (TE4)		
Q4	Provide status reports on all training activities to the NCSP Manager, to include photos and content for the quarterly newsletter (TE6)		

ACCOMPLISHMENTS

- TE3 – Conduct Hands-On Criticality Safety Training Course at NCERC
  - NCSP Manager's Course coming up week of June 12 (Q3).
  - CSE Course week of Aug 16 (Q4).
  - Make-up courses added for weeks of July 12 and week of Aug 9 (Q4).

- TE4 – On-Site Introductory Training for the NCS Practitioner on Modern Approaches to Validation using Sensitivity and Uncertainty Analysis Tools
  - First course has been scheduled for Tuesday and Wednesday, April 27 and 28.
- TE6 – Development of University Pipeline for Criticality Safety Professionals
  - Funding a student through UNM. More info in an article for the quarterly newsletter.

PUBLICATIONS

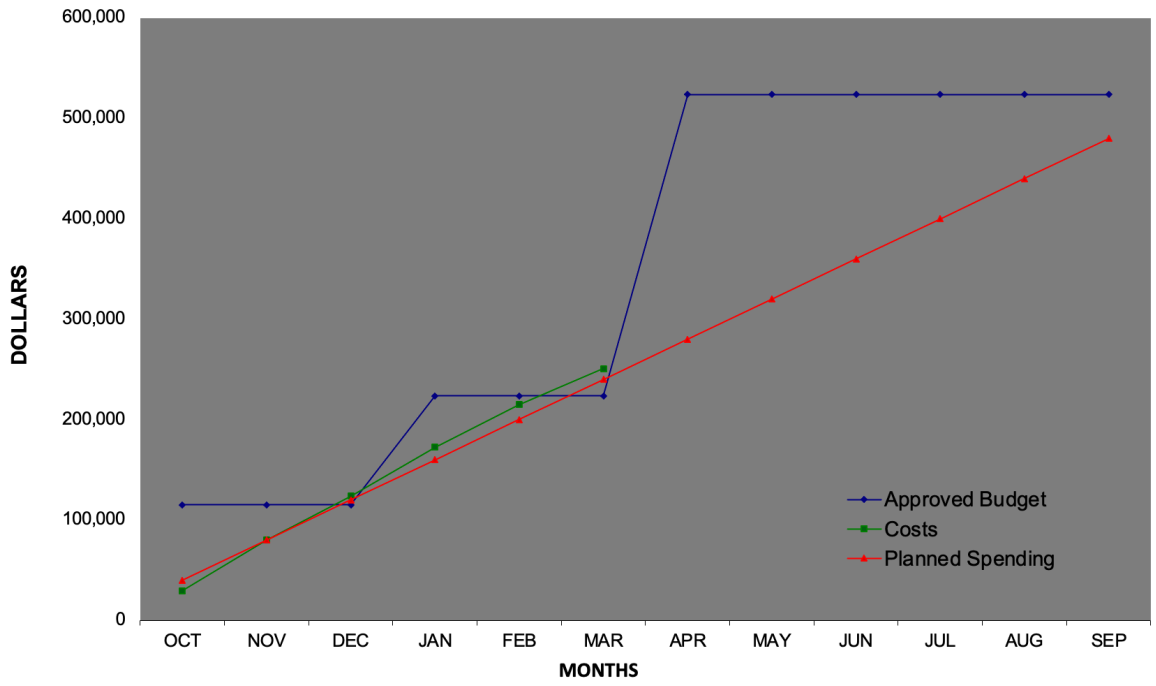
Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

Quarter	Publication Reference example) J., "Excluding Benchmark Statistical Outliers in Nuclear Criticality Safety Validation: A Comparison Study of Upper Subcritical Limits for Plutonium Systems using Whisper-1.1", LA-UR-18-27731, October 1, 2019	Sent to NCSP? Yes/no	If no, status of submittal
Q1			
Q2			
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2021 Q1)

NCSP Element and Subtask: TE1, 3, 6, 8 **M&O Contractor Name**: LLNL **Point of Contact Name:** David Heinrichs **Point of Contact Phone:** (925) 424-5679	**Reference:** DP0909020 **Date of Report:** April, 2021

BUDGET



1. Carryover into FY 2021 = $ 89,634+296,221* =$385,855
2. Approved FY 2021 Budget = $ 134,000 ($519,855 with carryover)
3. Actual spending for 1st Quarter FY 2021 = $ 123,883
4. Actual spending for 2nd Quarter FY 2021 =$ 126,773
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $ 43,500 (8%)

*Added $296K from carryover at the direction of the NCSP Manager, as TE1 was cut to $1K in the 5YP and to accommodate an extra class.

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	Provide status report on the activities to the NCSP manager (TE1)		
Q1	Provide status report on the activities to the NCSP manager (TE3)		

NCSP Quarterly Progress Report (FY-2021 Q1)

Q1	Provide status report on the activities to the NCSP manager (TE6)		
Q1	Provide status report on all training activities to the NCSP manager, to include photos and content for the quarterly newsletter. (TE8)		
Q2	Provide status report on the activities to the NCSP manager (TE1)		
Q2	Provide status report on the activities to the NCSP manager (TE3)		
Q2	Provide status report on the activities to the NCSP manager (TE6)		
Q2	Provide status report on all training activities to the NCSP manager, to include photos and content for the quarterly newsletter. (TE8)		
Q3	Provide status report on the activities to the NCSP manager (TE1)		
Q3	Provide status report on the activities to the NCSP manager (TE3)		
Q3	Provide status report on the activities to the NCSP manager (TE6)		
Q3	Provide status report on all training activities to the NCSP manager, to include photos and content for the quarterly newsletter. (TE8)		
Q4	Provide status report on the activities to the NCSP manager (TE1)		
Q4	Provide status report on the activities to the NCSP manager (TE3)		
Q4	Provide status report on the activities to the NCSP manager (TE6)		
Q4	Provide status report on all training activities to the NCSP manager, to include photos and content for the quarterly newsletter. (TE8)		

ACCOMPLISHMENTS

- TE1 – Conduct Hands-on Training at the DAF (TACS)
  - Prepared to provide one hands on training course with TACS (ultimately cancelled), including set-up trip

- Coordinated registration for all NCSP classes
- TE3 – Classroom Criticality Safety Training
  - Taught virtual 1st week criticality course in January 2021
- TE6 - Mobile (CAT III or IV material) Hands on Critical or Near Critical Demonstration Capability
  - A mobile ISSA Concept was presented at the TPR
- TE8 - Development of University Pipeline for Criticality Safety Professionals
  - Provided UC Berkeley Fall 2020 Pipeline course feedback

PUBLICATIONS

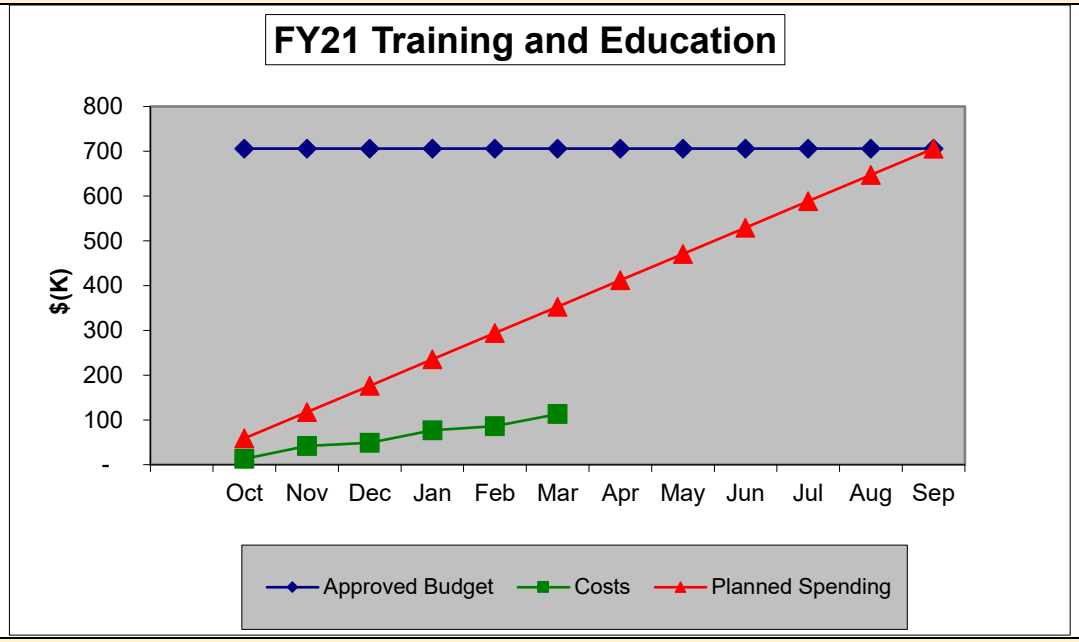
Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

Quarter	Publication Reference	Sent to NCSP? Yes/no	If no, status of submittal
Q1	N/A		
Q2	N/A		
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2021 Q2)

NCSP Element and Subtask: TE1, 3, 5, 11, 12 **M&O Contractor Name**: ORNL **Point of Contact Name:** Doug Bowen **Point of Contact Phone:** (865) 576-0315	**Reference:** DP0909010 **Date of Report:** April, 2021

BUDGET



1. Carryover into FY 2021 = $236K; FY2021 budget $470k
2. Approved FY 2021 Budget = $706K (includes carryover)
3. Actual spending for 1st Quarter FY 2021 = $49K
4. Actual spending for 2nd Quarter FY 2021 = $64K
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	Provide a status report in NCSP Quarterly Progress Reports on implementation of the NCS training program (TE1)		
Q1	Provide a status report to the NCSP manager. (TE3)		
Q1	Provide a status report to the NCSP manager. (TE5)		

NCSP Quarterly Progress Report (FY-2021 Q2)

Q1	Provide a status report to the NCSP manager. (TE11)		
Q1	Provide a status report to the NCSP manager. (TE12)		
Q2	Provide a status report in NCSP Quarterly Progress Reports on implementation of the NCS training program (TE1)		
Q2	Provide a status report to the NCSP manager. (TE3)		
Q2	Provide a status report to the NCSP manager. (TE5)		
Q2	Provide a status report to the NCSP manager. (TE11)		
Q2	Provide a status report to the NCSP manager. (TE12)		
Q3	Provide a status report in NCSP Quarterly Progress Reports on implementation of the NCS training program (TE1)		
Q3	Provide a status report to the NCSP manager. (TE3)		
Q3	Provide a status report to the NCSP manager. (TE5)		
Q3	Provide a status report to the NCSP manager. (TE11)		
Q3	Provide a status report to the NCSP manager. (TE12)		
Q4	Provide a status report in NCSP Quarterly Progress Reports on implementation of the NCS training program (TE1)		
Q4	Provide a status report to the NCSP manager. (TE3)		
Q4	Provide a status report to the NCSP manager. (TE5)		

Q4	Provide a status report to the NCSP manager. (TE11)		
Q4	Provide a status report to the NCSP manager. (TE12)		

ACCOMPLISHMENTS

- TE1 - Manage and Provide Instruction for the DOE Nuclear Criticality Safety Training & Education Program
  - In Q2, the lecture portion of the 2-week hands-on course was successfully completed virtually (22 students attended). Good feedback was provided by the students and instructors. All students passed week 1 of the course. Unfortunately, due to COVID-19 restrictions at Sandia National Laboratory and COVID-19 infections with NCERC staff, the second, hands-on, week of the 2-week course was postponed. Make up dates for Sandia are to be determined and, likely, 2 course weeks at Sandia will be needed to train staff who need the second half of the course. Make up dates in July and August (see NCSP website) are set and students for this course will be able to attend one of these two weeks. The April Manager's course at Sandia was postponed due to NM COVID restrictions. New dates are being proposed to complete this course in Q3 or Q4. The June NCERC CSO/Manager's Course in June is currently scheduled and on track. The August 2-week hands-on course is also scheduled and on track. Other efforts included archiving course materials, course planning, telecons, binder QA/printing, and course execution.
- TE3 - Hand-calculation Primer Expansion, LA-14244-M
  - In Q2, Bob Busch and Doug Bowen worked to generate a comprehensive outline for the project to include an ORNL report that appends the work Bowen generated in LA-14244-M, "Hand Calculational Primer," in 2007. One expansion effort will involve the generation of an web-based NCSET module that walks students through solving hand calculations. All data needed to solve the hand calculations is included in the module. A student will be used to perform the website development to link eventually to the NCSET module area of the NCSP website. A bibliography of all hand calculation references will be generated as well and a reference set to include on the NCSP website and the OSTI NCSP page, when available. A report draft is in progress that will provide a good follow-on report for the hand calc primer.
- TE5 - On-Site Introductory Training for the NCS Practitioner on Modern Approaches to Validation using Sensitivity and Uncertainty Analysis Tools
  - Scheduled two virtual classes for April 27 and April 28. The April 26 class will be scheduled for 9-4 EDT and the April 27 class for 9-4 MDT, so that practitioners across the country will have the class offered on something like reasonable hours. The classes are targeted at BWXT facilities in Lynchburg, VA, and Erwin, TN, and NCS engineers in Idaho. Other NCSP-supported NCS personnel will be invited to attend the classes, with not more than 25 students per session.
- TE11 - Revision of the LA-12808 Nuclear Criticality Safety Guide
  - In Q2, Travis Greene computed new critical mass curves along with bias/bias uncertainties as a function of fissile material density. Doug Bowen compiled new subcritical limits generated for ANS-8.15, ANS-8.1 (to be published by ORNL (Greene/Bowen in Nuclear Science and Engineering)), and ANS-8.12 (to be published by Stover et al in Nuclear Technology). The document will be restructured to be aligned with the NCS consensus standards, CSSG tasking reports, and other relevant references to ensure reference material and guidance exists the NCS community.
- TE12 - Design of a Subcritical/Critical Assembly at ORNL for Use with the CSO/FMH Courses

- Little work was completed in Q2 for the subcritical assembly task. In Q3, work will involve more ORNL staff (Y-12 fuel shipment work, safety basis, facility management, and criticality safety) to determine a location to house the subcritical assembly for training purposes. Additional computations will be completed to finalize the design of the assembly.

PUBLICATIONS

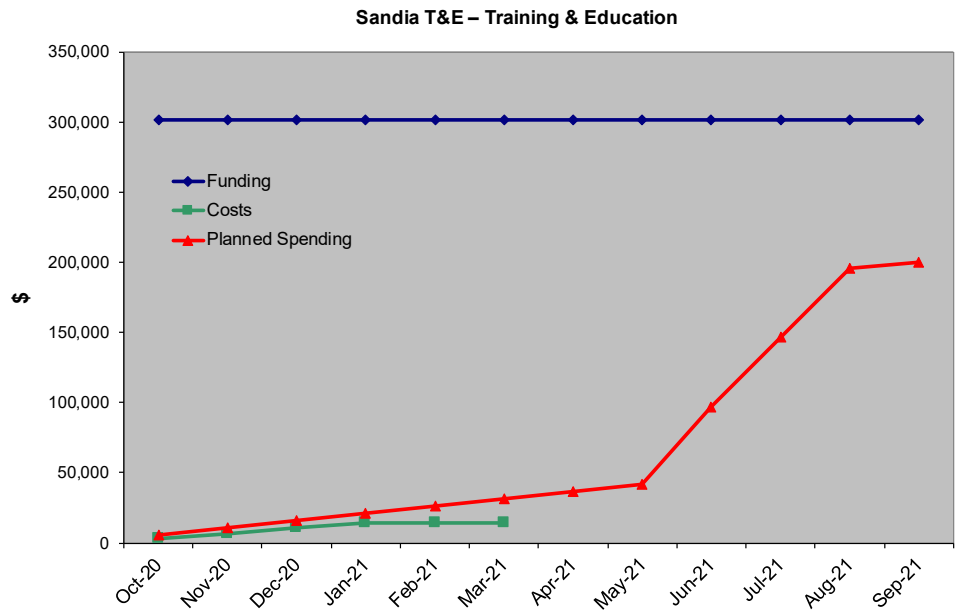
Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

Quarter	Publication Reference example) J., "Excluding Benchmark Statistical Outliers in Nuclear Criticality Safety Validation: A Comparison Study of Upper Subcritical Limits for Plutonium Systems using Whisper-1.1", LA-UR-18-27731, October 1, 2019	Sent to NCSP? Yes/no	If no, status of submittal
Q1	N/A		
Q2	N/A		
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2021 Q2)

NCSP Element and Subtask: TE1 **M&O Contractor Name**: Sandia National Laboratories (SNL) **Point of Contact Name:** Gary A. Harms **Point of Contact Phone:** (505)845-3244	**Reference:** DP0909020 **Date of Report:** March, 2021

BUDGET



1. Carryover into FY 2021 = $301,011
2. Approved FY 2021 Budget = $301,011
3. Actual spending for 1st Quarter FY 2021 = $10,437
4. Actual spending for 2nd Quarter FY 2021 = $4,151
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $

All spending is from FY20 carryover.

February and April classes were postponed. The current chart reflects the assumption of replacement classes occurring in June and July.

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	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. (TE1)		

Q2	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. (TE1)		
Q3	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. (TE1)		
Q4	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. (TE1)		

ACCOMPLISHMENTS

- TE1 - Prepare for and Conduct Hands-on Criticality Safety Training at SNL
  - Preparations were made for the January-February class for NCS professionals
  - The Sandia portion of the class was postponed by Sandia due to COVID-19 concerns
  - The Sandia portion of the class will be rescheduled
  - Sandia supported the HFER portion of the virtual classroom presentations for the January-February class for NCS professionals
  - The April Hands-On criticality safety class for managers was postponed by Sandia due to COVID-19 concerns
  - The April Hands-On criticality safety class for managers will be rescheduled

PUBLICATIONS

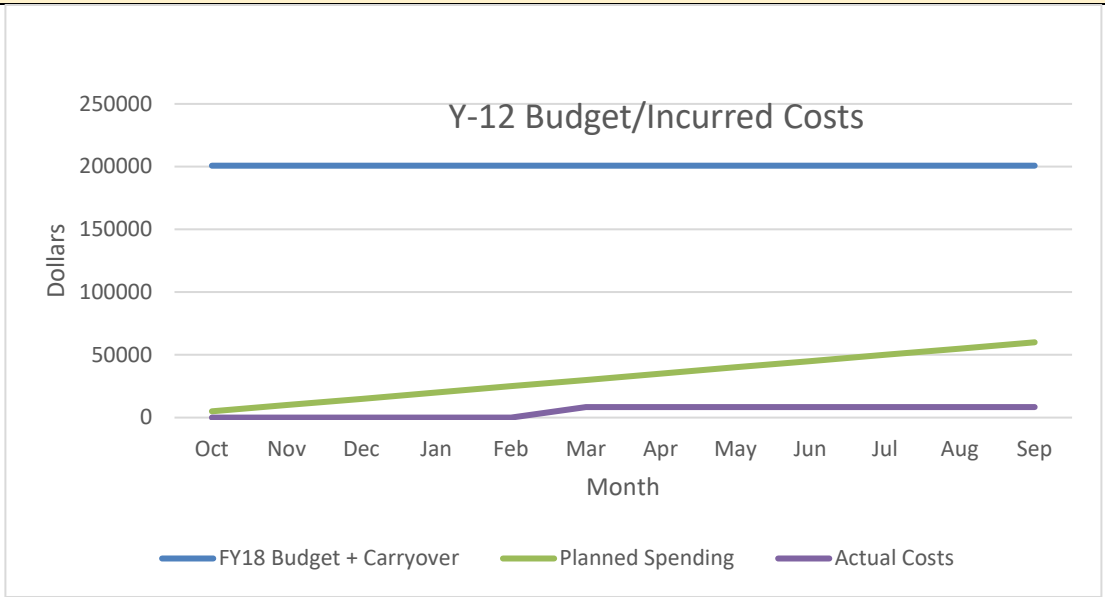
Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

Quarter	Publication Reference example) J., "Excluding Benchmark Statistical Outliers in Nuclear Criticality Safety Validation: A Comparison Study of Upper Subcritical Limits for Plutonium Systems using Whisper-1.1", LA-UR-18-27731, October 1, 2019	Sent to NCSP? Yes/no	If no, status of submittal
Q1			
Q2			
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2021 Q2)

NCSP Element and Subtask: TE1 **M&O Contractor Name**: Y12 **Point of Contact Name:** Kevin Reynolds **Point of Contact Phone:** (865) 241-9067	**Reference:** DP0909020 **Date of Report:** April, 2021

BUDGET



1. Carryover into FY 2021 = $200,759.84
2. Approved FY 2021 Budget = $ 0.00
3. Actual spending for 1st Quarter FY 2021 = $0.00
4. Actual spending for 2nd Quarter FY 2021 = $8,375.01
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	Conduct hands-on training classes at NFO and NCERC to support the training classes in accordance with the approved schedule. (TE1)		No travel.
Q2	Conduct hands-on training classes at NFO and NCERC to support the training classes in accordance with the approved schedule. (TE1)		No travel.

Q3	Conduct hands-on training classes at NFO and NCERC to support the training classes in accordance with the approved schedule. (TE1)		
Q4	Conduct hands-on training classes at NFO and NCERC to support the training classes in accordance with the approved schedule. (TE1)		

ACCOMPLISHMENTS

- TE1 - Conduct Hands-On Criticality Safety Training Course (Lecture support week 1 of 2-week hands-on course and course material development)

PUBLICATIONS

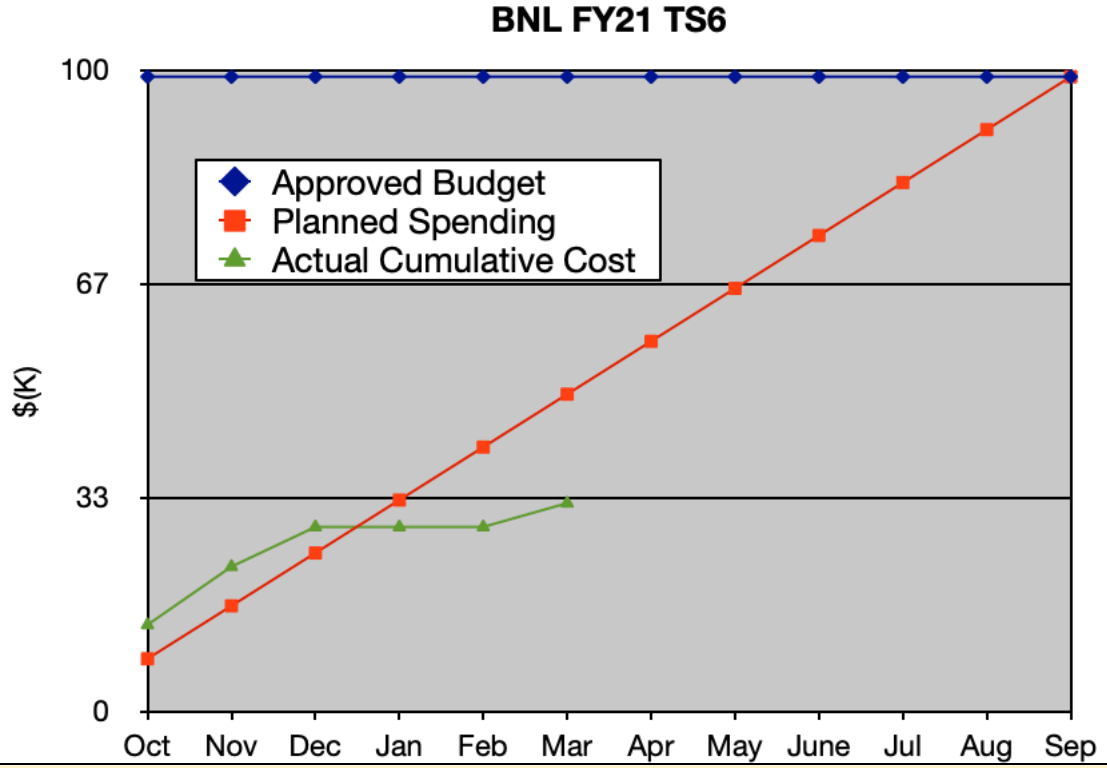
Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

Quarter	Publication Reference example)	Sent to NCSP? Yes/no	If no, status of submittal
Q1			
Q2			
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2021 Q2)

NCSP Element and Subtask: TS6 **M&O Contractor Name**: BNL **Point of Contact Name:** David Brown **Point of Contact Phone:** 631-344-2814	**Reference:** DP0909020 **Date of Report:** Apr., 2021

BUDGET



1. Carryover into FY 2021 = $ 5,413
2. Approved FY 2021 Budget = $ 99,000
3. Actual spending for 1st Quarter FY 2021 = $28,805
4. Actual spending for 2nd Quarter FY 2021 = $3,712
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	Provide NCSP Manager report of succession planning efforts. (TS6)		We are writing up the project now and are aiming for submission this quarter.
Q2	Provide NCSP Manager report of succession planning efforts. (TS6)		

Q3	Provide NCSP Manager report of succession planning efforts. (TS6)		
Q4	Provide NCSP Manager report of succession planning efforts. (TS6)		

ACCOMPLISHMENTS

- TS6 – ND Succession Planning
  - G. Nobre presented work from FY20 at the 2021 NCSP Technical Program Review: "Machine Learning for Neutron Resonance Evaluations"

PUBLICATIONS

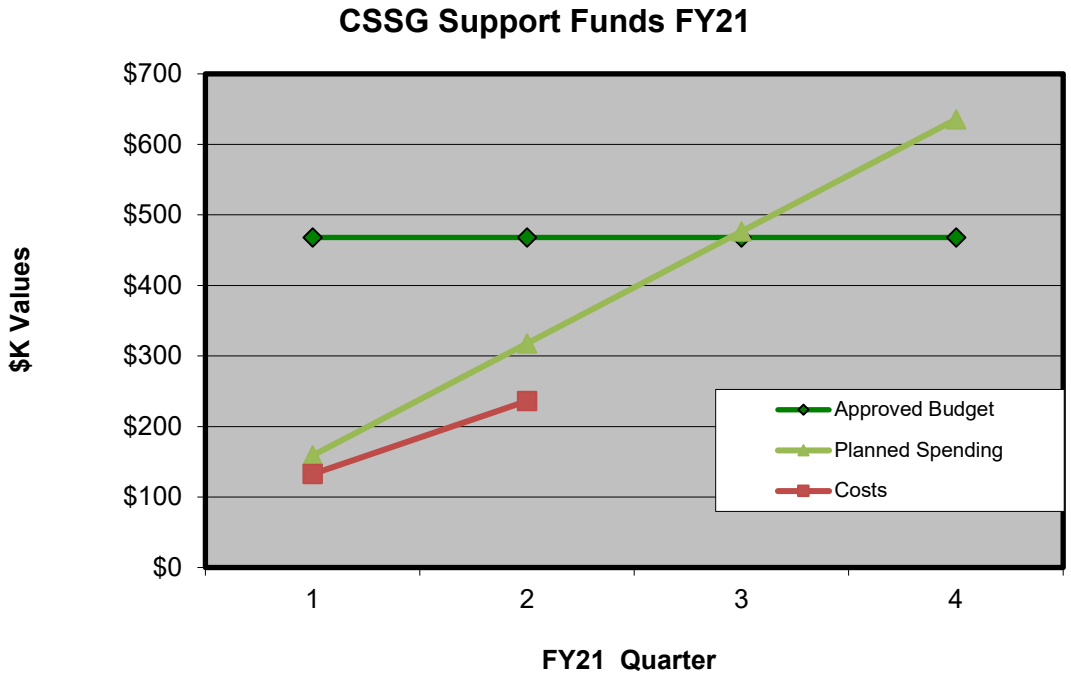
Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

Quarter	Publication Reference example) J., "Excluding Benchmark Statistical Outliers in Nuclear Criticality Safety Validation: A Comparison Study of Upper Subcritical Limits for Plutonium Systems using Whisper-1.1", LA-UR-18-27731, October 1, 2019	Sent to NCSP? Yes/no	If no, status of submittal
Q1			
Q2			
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2021 Q2)

NCSP Element and Subtask: TS1 **Task Title**: CSSG Support **Point of Contact Name:** David Hayes **Point of Contact Phone:** 505-667-4523	**Reference:** DP0909010 **Date of Report:** April 2021

BUDGET



1. Carryover into FY 2021 = $ 167,524
2. Approved FY 2021 Budget = $ 468,000
3. Actual spending for 1st Quarter FY 2021 = $132,521
4. Actual spending for 2nd Quarter FY 2021 = $103,685
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $0

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	Provide NCSP Manager report of activities. (TS1)		None
Q2	Provide NCSP Manager report of activities. (TS1)		None
Q3	Provide NCSP Manager report of activities. (TS1)		
Q4	Provide NCSP Manager report of activities. (TS1)		

ACCOMPLISHMENTS

- TS1 – Activities
  - CSSG Telecons
  - CSSG Meeting in conjunction with the NCSP TPR
  - Completion of Tasking 2021-02, *CSSG Review of FY22 NCSP Proposals*
  - Kickoff of Tasking 2021-01, *CSSG Review of Draft Revision to DOE-STD-1134*
  - Kickoff of New Member Committee
  - Review of CSSG Charter and Work Instructions

PUBLICATIONS

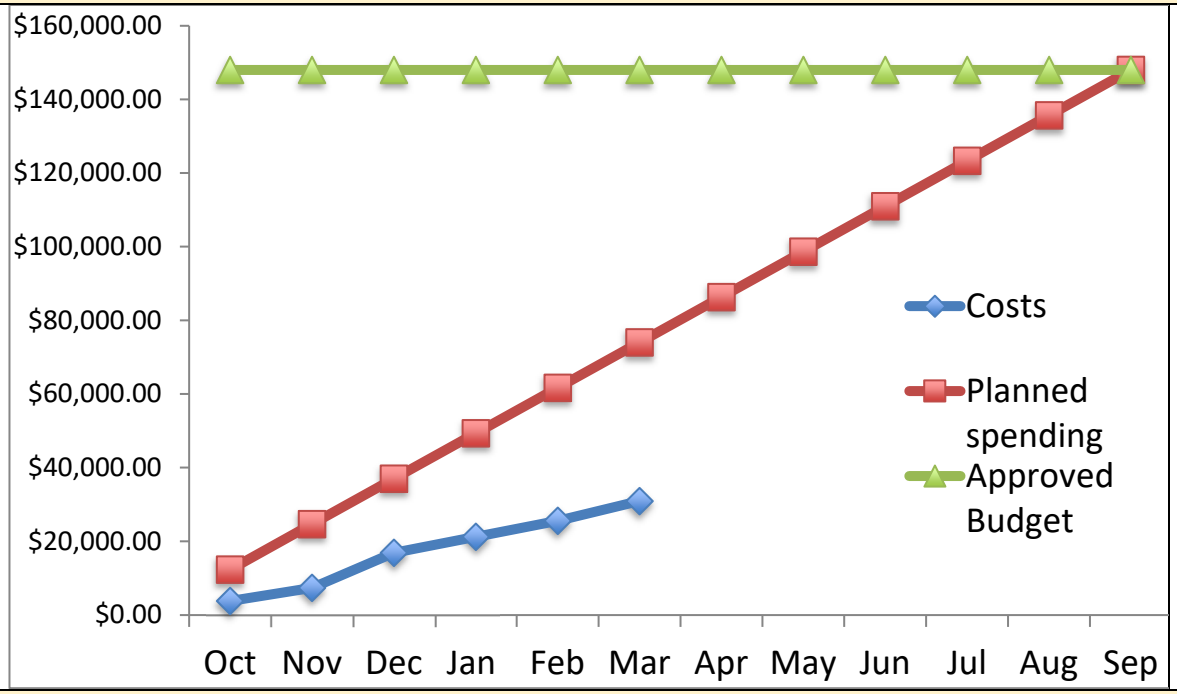
Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

Quarter	Publication Reference example) J., "Excluding Benchmark Statistical Outliers in Nuclear Criticality Safety Validation: A Comparison Study of Upper Subcritical Limits for Plutonium Systems using Whisper-1.1", LA-UR-18-27731, October 1, 2019	Sent to NCSP? Yes/no	If no, status of submittal
Q1	N/A		
Q2	N/A		
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2021 Q2)

NCSP Element and Subtask: TS4 **M&O Contractor Name**: LANL **Point of Contact Name:** Joetta Goda **Point of Contact Phone:** 505-667-2812	**Reference:** DP0909020 **Date of Report:** April 14, 2021

BUDGET



1. Carryover into FY 2021 = $ 0
2. Approved FY 2021 Budget = $ 148,000
3. Actual spending for 1st Quarter FY 2021 = $16,875
4. Actual spending for 2nd Quarter FY 2021 = $14,062
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $0

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	Provide NCSP Manager report on succession planning efforts. (TS4)		
Q2	Provide NCSP Manager report on succession planning efforts. (TS4)		
Q3	Provide NCSP Manager report on succession planning efforts. (TS4)		

Q4	Provide NCSP Manager report on succession planning efforts. (TS4)		

ACCOMPLISHMENTS

- TS4 – AM, IE, ND Succession Planning
  - Spend Rate will increase as students join for the summer.

PUBLICATIONS

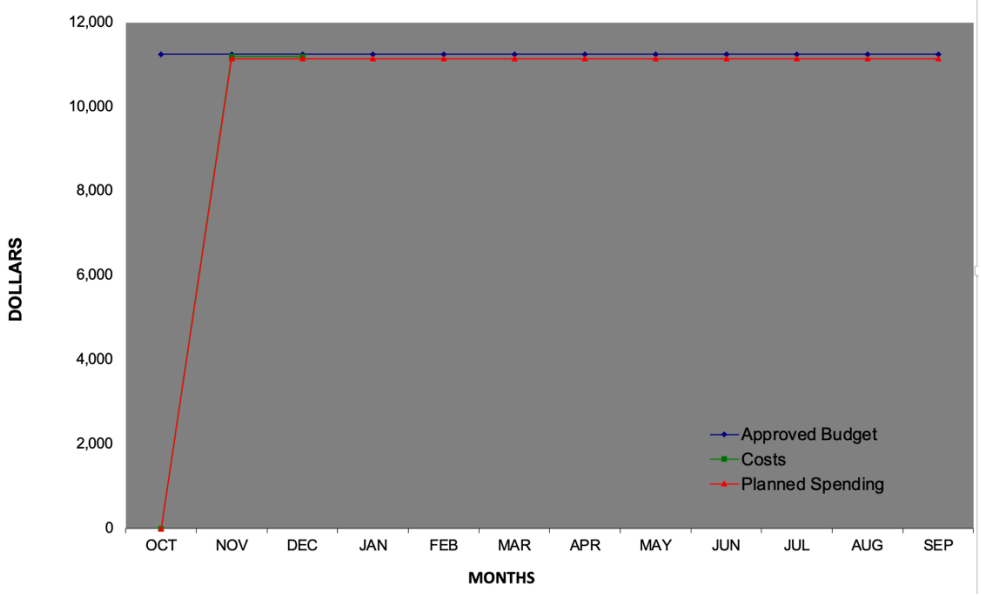
Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

Quarter	Publication Reference example) J., "Excluding Benchmark Statistical Outliers in Nuclear Criticality Safety Validation: A Comparison Study of Upper Subcritical Limits for Plutonium Systems using Whisper-1.1", LA-UR-18-27731, October 1, 2019	Sent to NCSP? Yes/no	If no, status of submittal
Q1			
Q2			
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2021 Q2)

NCSP Element and Subtask: TS5 **M&O Contractor Name**: LLNL **Point of Contact Name:** Catherine Percher **Point of Contact Phone:** (925) 423-9345	**Reference:** DP0909020 **Date of Report:** April, 2021

BUDGET



1. Carryover into FY 2021 = $ $11,255
2. Approved FY 2021 Budget = $ 11,255*
3. Actual spending for 1st Quarter FY 2021 = $ 11,255
4. Actual spending for 2nd Quarter FY 2021 =$ 0
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $0

*Activities funded by TS5 carryover exhausted in Q1.

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	Provide NCSP manager report on succession planning efforts. (TS5)		TS5 carryover exhausted in Q1. Succession planning activities to be funded in subsequent quarters by carryover in other elements.
Q2	Provide NCSP manager report on succession planning efforts. (TS5)		
Q3	Provide NCSP manager report on succession planning efforts. (TS5)		
Q4	Provide NCSP manager report on succession planning efforts. (TS5)		

ACCOMPLISHMENTS

- TS5 - AM, IE, ND Succession Planning
  - Percher succeeds Heinrichs as NCSP Task Manager for LLNL effective March 14, 2021.

PUBLICATIONS

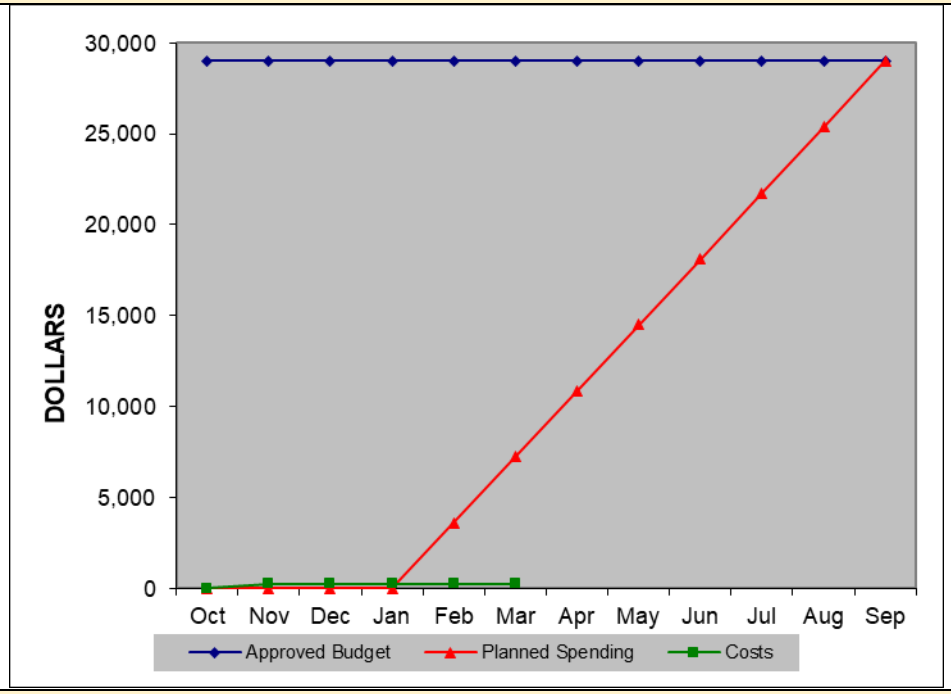
Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

Quarter	Publication Reference	Sent to NCSP? Yes/no	If no, status of submittal
Q1	Daniel Siefman, "Constrained Bayesian Optimization of Criticality Experiments: Presented to WPEC Subgroup 46," LLNL-PRES-816559, November 12, 2020.	Yes	
Q1	Daniel Siefman, "Constrained Bayesian Optimization of Criticality Experiments at LLNL" Presented to IEAE Consultancy Meeting on Machine Learning for Nuclear Data, LLNL-PRES-817545, December 10, 2020	Yes	
Q2			
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2021 Q1)

NCSP Element and Subtask: TS9 **M&O Contractor Name**: NNL **Point of Contact Name:** Mike Zerkle **Point of Contact Phone:** (412) 476-6188	**Reference:** DP0909020 **Date of Report:** April 16, 2021

BUDGET



1. Carryover into FY 2021 = $ 0*
2. Approved FY 2021 Budget = $ 29,000
3. Actual spending for 1st Quarter FY 2021 = $249
4. Actual spending for 2nd Quarter FY 2021 = $0
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $

*FY2020 carryover ($18k) transferred to the RPI LINAC Upgrade Project.

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	Provide status report on all NDAG chair activities in NCSP Quarterly Progress Reports (TS9)		None.
Q2	Provide status report on all NDAG chair activities in NCSP Quarterly Progress Reports (TS9)		None.

Q3	Provide status report on all NDAG chair activities in NCSP Quarterly Progress Reports (TS9)		
Q4	Provide status report on all NDAG chair activities in NCSP Quarterly Progress Reports (TS9)		

ACCOMPLISHMENTS

- TS9 – Support for NDAG Chair activities
  - Participated in WANDA2021 Meeting
    - Co-Chaired the "Expended Benchmarks for Nuclear Data Validation" session with Catherine Percher (LLNL) and Jesson Hutchinson (LANL).
    - Draft session summary (with Percher and Hutchinson) for use in a WANDA2021 review article to be submitted to a journal.
  - Coordinated NDAG review of NCSP FY22-FY26 ND and IE technical proposals.
  - Participated in CSSG review of NCSP FY22-FY26 technical proposals.
  - Participated in NCSP FY2020 Technical Program Review (virtual).
  - Chaired Feb 2021 NDAG Meeting (virtual).
  - ICSBEP Benchmark Evaluation support
    - Independent Reviewer support to resolve TRG comments on PMF001 Revision 5 (Jezebel), provided MC21 sample calculation results.
    - Technical Review Group support to finalize HMF101 (KRUSTY), provided MC21 sample calculation results.
  - CeDT support for several IERs

PUBLICATIONS

Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

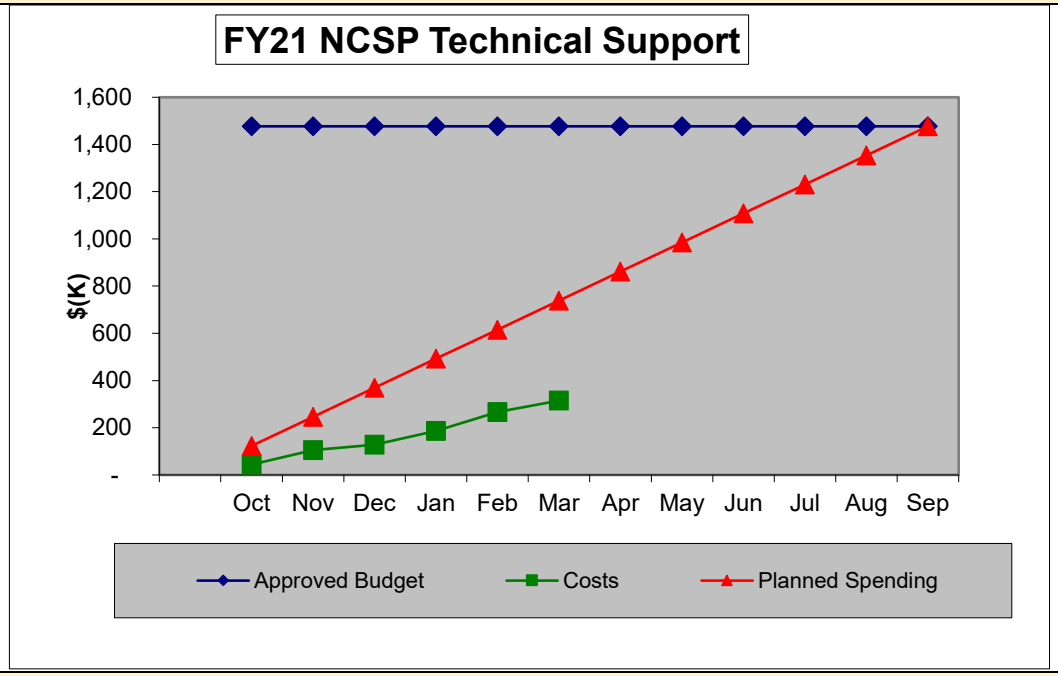
Quarter	Publication Reference example)	Sent to NCSP? Yes/no	If no, status of submittal
Q1			
Q2	1. M. Zerkle, C. Percher and J. Hutchinson, "Expended Benchmarks for Nuclear Data Validation," Proceedings of WANDA2021 (virtual), January 25 – February 3, 2021. 2. J. L. Wormald , N. C. Fleming , A. I. Hawari and M. L. Zerkle, "Generation of the Thermal Scattering Law of Uranium Dioxide with Ab Initio Lattice Dynamics to Capture Crystal Binding Effects on Neutron Interactions," *Nuclear Science and Engineering*, **195**:3, 227-238 (2021). https://doi.org/10.1080/00295639.2020.1820826	Yes Yes	

	3. J. Wormald, M. Zerkle, and J. Holmes, "Generation of the TSL for Zirconium Hydrides from Ab Initio Methods." *J. Nucl. Eng.* **2** (2021) 105-113. https://doi.org/10.3390/jne2020011	Yes	
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2021 Q2)

NCSP Element and Subtask: TS2, 7, 8, 11, 13 **M&O Contractor Name**: ORNL **Point of Contact Name:** Doug Bowen **Point of Contact Phone:** (865) 576-0315	**Reference:** DP0909010 **Date of Report:** April, 2021

BUDGET



1. Carryover into FY 2021 = $155K
2. Approved FY 2021 Budget = $1,477K
3. Actual spending for 1st Quarter FY 2021 = $128K
4. Actual spending for 2nd Quarter FY 2021 = $187K
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	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. (TS2)		

NCSP Quarterly Progress Report (FY-2021 Q2)

Q1	Manage 5-year plan development and maintenance and oversee the CEDT process and manage main 5-year plan and Integral Experiment Request Milestones. (TS2)		
Q1	Provide NCSP Manager annual report of succession planning efforts (TS7)		
Q1	Provide NCSP Manager a status report of progress on the new IER system in G2 (TS8)		
Q1	Provide the NCSP Manager a status report support provided to manage the CEdT process and assist CEDT manager as necessary to support IE 5-year plan objectives. (TS11)		
Q1	Provide the NCSP manager an update of NDA Technical Support Group and NDA Technical Infrastructure Project activities. (TS13)		
Q2	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. (TS2)		
Q2	Manage 5-year plan development and maintenance and oversee the CEDT process and manage main 5-year plan and Integral Experiment Request Milestones. (TS2)		
Q2	Provide NCSP Manager annual report of succession planning efforts (TS7)		
Q2	Provide NCSP Manager a status report of progress on the new IER system in G2 (TS8)		
Q2	Provide the NCSP Manager a status report support provided to manage the CEdT process and assist CEDT manager as necessary to support IE 5-year plan objectives. (TS11)		
Q2	Provide the NCSP manager an update of NDA Technical Support Group and NDA Technical Infrastructure Project activities. (TS13)		

Q3	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. (TS2)		
Q3	Manage 5-year plan development and maintenance and oversee the CEDT process and manage main 5-year plan and Integral Experiment Request Milestones. (TS2)		
Q3	Provide NCSP Manager annual report of succession planning efforts (TS7)		
Q3	Provide NCSP Manager a status report of progress on the new IER system in G2 (TS8)		
Q3	Provide the NCSP Manager a status report support provided to manage the CEdT process and assist CEDT manager as necessary to support IE 5-year plan objectives. (TS11)		
Q3	Provide the NCSP manager an update of NDA Technical Support Group and NDA Technical Infrastructure Project activities. (TS13)		
Q4	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. (TS2)		
Q4	Manage 5-year plan development and maintenance and oversee the CEDT process and manage main 5-year plan and Integral Experiment Request Milestones. (TS2)		
Q4	Organize and lead the Budget Execution Meeting and assist NCSP Manager in finalization of approved tasks for next FY (TS2)		
Q4	Publish final Five-Year Plan. (TS2)		
Q4	Provide NCSP Manager annual report of succession planning efforts (TS7)		

Q4	Provide NCSP Manager a status report of progress on the new IER system in G2 (TS8)		
Q4	Provide the NCSP Manager a status report support provided to manage the CEdT process and assist CEDT manager as necessary to support IE 5-year plan objectives. (TS11)		
Q4	Provide the NCSP manager an update of NDA Technical Support Group and NDA Technical Infrastructure Project activities. (TS13)		

ACCOMPLISHMENTS

- TS2 - Support for Lead Lab to Execute the NCSP
  - Prepare and maintain elements of NCSP Plan and associated activities:
    - Monitor Five-Year Plan progress,
    - Procured WebEx for NCSP support; Procured SMARTSHEET for NCSP work.
    - Review/revise task list, and
    - Schedule/participate in meetings and teleconferences.
    - Manage and provide oversight/coordinate efforts for the NCSP Information, Preservation, and Dissemination task element.
    - Manage and provide oversight/coordinate efforts for the NCSP Training and Education Program task element.
  - Participated in NCSP management team and other NCSP-related meetings, as required by the NCSP Manager.
  - Prepared Q1 QPRs into a single bookmarked PDF file for use in QPR. Conducted Q1 WebEx meeting.
  - Henley completed work on the FY21 Spring Newsletter
  - Henley worked with LLNL to maintain and update the NCSP website as necessary.
  - Participated in CSSG telecons and assisted with CSSG tasks as necessary.
  - Led and participated telecons and WebEx meetings as necessary to track NCSP MGT team actions and deliverables.
  - Working on NCSP website enhancements and fixes and updates for accomplishments, foreign travel reports, and planning calendars.
  - Continued to train Marsha Henley on NCSP MGT teamwork.
  - Henley worked to uploaded foreign travel reports to the NCSP website as needed.
  - Bowen/Henley compiled FY22-FY26 pre-decisional task list for NCSP manager review and approval, which included reviewing the CSSG and NDAG recommendations for FY22 NCSP proposals. Work began on Rev. 0 of the FY22 5-year plan.
  - Technical Program Review was hosted by ORNL virtually via Zoom and executed successfully
    - Henley worked with LLNL to create a registration website and to collect papers for the meeting agenda
    - Bowen worked with NCSP manager on a 3-day TPR agenda for the first time and organized 68 technical presentations and task manager reports
    - Henley worked with LLNL on reorganizing the NCSP website TPR presentation download page for NCS community access

- TS7 - AM, ND Succession Planning

- Chris Chapman and Jordan McDonnell continued to work on nuclear data evaluations with Marco Pigni on Ce and V nuclear data evaluations. Chris is continuing work on thermal neutron scattering measurements at the ORNL SNS. Jesse Brown has been utilizing these funds to assist with SAMMY and AMPX modernization and to assist with the Monte Carlo Framework evaluation being performed at ORNL for the NCSP. Jesse Brown has been working to back up Doro Wiarda on SAMMY and AMPX code work.

- TS8 - NCSP Program Management Tools Development
  - Miller/Bowen continue to work to ensuing all IER team members and leads have access to the IER system. Issues are vetted and fixed working with ORNL and DOE HQ staff. Funds have been provided to subcontractors supporting G2 development at ORNL. A list of IER enhancements and fixes have been prioritized and funded and will be fixed in the various G2 update campaigns. This effort will be coordinated with the CEDT manual revision that is in progress.

- TS11 - NCSP C_EdT Manager Support
  - Miller lead and Bowen supported C_EDT tasks as needed (IER approvals, milestone tracking, and meeting execution support)
  - Supported monthly IE calls in Q2 and associated BCR approvals and IER milestone tracking
  - The C_EDT manager tracked IER products and Baseline Change Reviews and worked with the NCSP manager to approve tasks, as required.
  - Miller/Bowen working to find a new milestone tracking and progress scheme.

- TS13 - NDA Technical Support Group and NDA Technical Infrastructure Project
  - Efforts continue the TSG efforts to generate the new ANSI/ANS-8.28 standard for NDA administrative requirements in NCS programs. A second ANS-8 ballot has been completed and comments are being resolved. Bowen and Berg have not been able to coordinate the structure of the NDA program based on Larry's vision. The NCSP Mission and Vision is currently going through the ORNL publication process and will describe the various aspects of the NDA program based on NDA workshops at ORNL in FY19/20. Further telecons will help Berg in his planning efforts with his new program with assistance of the TSG chair, Dolin, and ORNL, Bowen.

PUBLICATIONS

Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

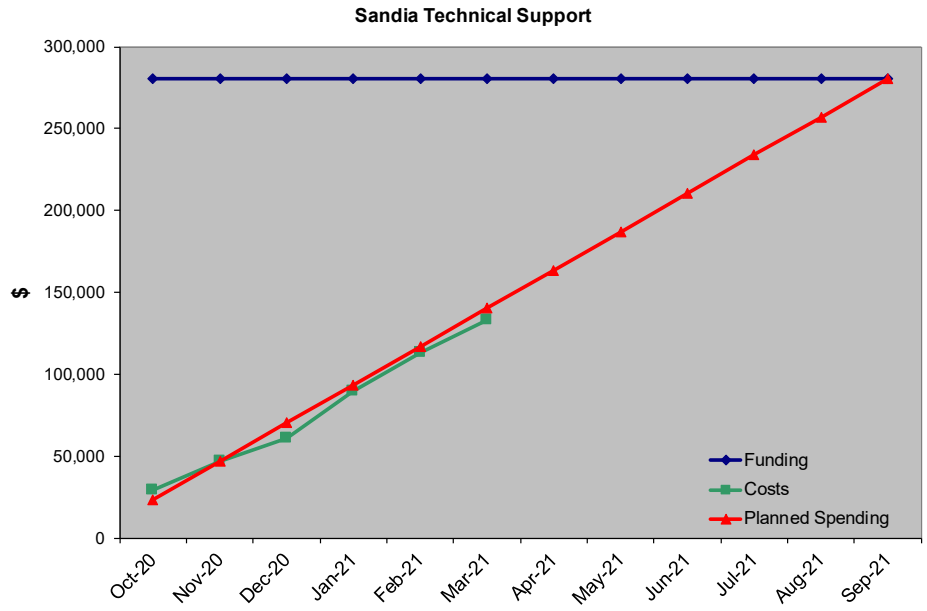
Quarter	Publication Reference example) J., "Excluding Benchmark Statistical Outliers in Nuclear Criticality Safety Validation: A Comparison Study of Upper Subcritical Limits for Plutonium Systems using Whisper-1.1", LA-UR-18-27731, October 1, 2019	Sent to NCSP? Yes/no	If no, status of submittal
Q1	N/A	N/A	
Q2	N/A		
Q3			

Q4			

NCSP Quarterly Progress Report (FY-2021 Q2)

NCSP Element and Subtask: TS3, 12 **M&O Contractor Name**: Sandia National Laboratories (SNL) **Point of Contact Name:** Gary A. Harms **Point of Contact Phone:** (505)845-3244	**Reference:** DP0909020 **Date of Report:** March, 2021

BUDGET



1. Carryover into FY 2021 = $32,488
2. Approved FY 2021 Budget = $280,488
3. Actual spending for 1st Quarter FY 2021 = $61,119
4. Actual spending for 2nd Quarter FY 2021 = $71,628
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	Provide NCSP Manager with report of succession planning efforts. (TS3)		
Q1	Provide the NCSP manager with a summary of NCSP CEdT support (TS12)		
Q2	Provide NCSP Manager with report of succession planning efforts. (TS3)		

Q2	Provide the NCSP manager with a summary of NCSP CEdT support (TS12)		
Q3	Provide NCSP Manager with report of succession planning efforts. (TS3)		
Q3	Provide the NCSP manager with a summary of NCSP CEdT support (TS12)		
Q4	Provide NCSP Manager with report of succession planning efforts. (TS3)		
Q4	Provide the NCSP manager with a summary of NCSP CEdT support (TS12)		

ACCOMPLISHMENTS

- TS3 – Support for Experimentalist Succession Planning
  - We have a matrixed employee who is performing as an experimenter.
  - The new experimenter is nearing completion of the IER-230 experiments and transitioning towards work on IER-441.
  - The new experimenter has been actively participating in the NCS community by attending conferences and publishing papers.
  - The student intern is in the final stages of the MS Thesis Degree, which is based on analysis techniques for evaluating critical experiments.
  - The student intern decided to continue education towards a PhD Degree and will also continue working with us as a year-round intern as a PhD student.
- TS12 - NCSP C_EdT Manager Support
  - Performed duties as the C_EdT Manager in support of the IE program element.
    - Interacted with the various C_EdT Leads, NCSP Management Team, and other NCSP members.
    - Facilitated IE update meetings and issued meeting agenda and minutes.
    - Assisted the DOE NCS Program Management Team on a broad scope of items.
    - Tracked progress and BCRs on IER milestones/action items.
    - Worked in the IER database and assisted others in gaining access to the database.

PUBLICATIONS

Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

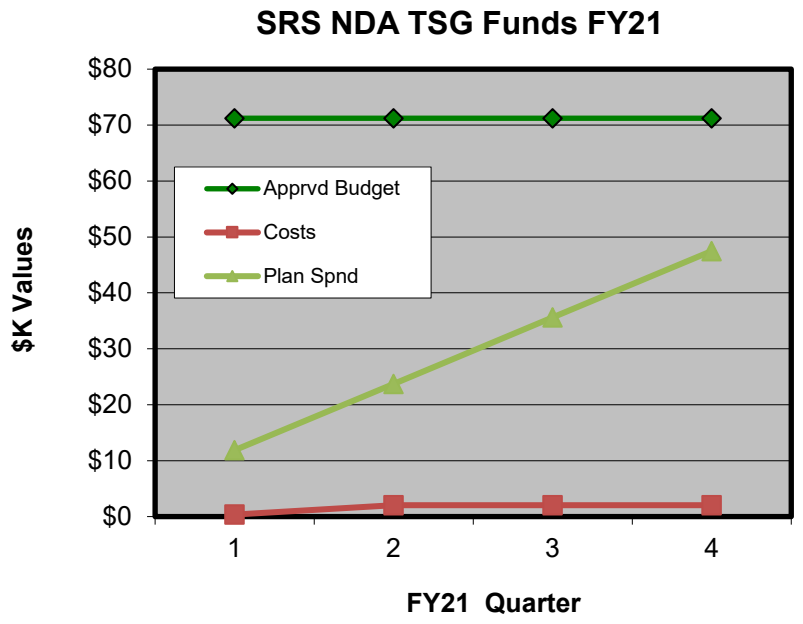
Quarter	Publication Reference example) J., "Excluding Benchmark Statistical Outliers in Nuclear Criticality Safety Validation: A Comparison Study of Upper Subcritical Limits for Plutonium Systems using Whisper-1.1", LA-UR-18-27731, October 1, 2019	Sent to NCSP? Yes/no	If no, status of submittal
Q1			

Q2			
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2021 Q2)

NCSP Element and Subtask: TS15 **M&O Contractor Name**: SRNS **Point of Contact Name:** David Erickson **Point of Contact Phone:** 803-557-9445	**Reference:** DP09090200 **Date of Report** April 15, 2021

BUDGET



1. Carryover into FY 2021 = $ 71,223
2. Approved FY 2021 Budget = $ 30,000*
3. Actual spending for 1st Quarter FY 2021 = $362
4. Actual spending for 2nd Quarter FY 2021 = $1,673
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $

* To be returned to NCSP

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	Provide the NCSP manager an update of NDA Technical Support Group and NDA Technical Infrastructure Project activities. (TS15)		
Q2	Provide the NCSP manager an update of NDA Technical Support Group and NDA Technical Infrastructure Project activities. (TS15)		

Q3	Provide the NCSP manager an update of NDA Technical Support Group and NDA Technical Infrastructure Project activities. (TS15)		
Q4	Provide the NCSP manager an update of NDA Technical Support Group and NDA Technical Infrastructure Project activities. (TS15)		

ACCOMPLISHMENTS

- TS15 - NDA Technical Support Group and NDA Technical Infrastructure Project

PUBLICATIONS

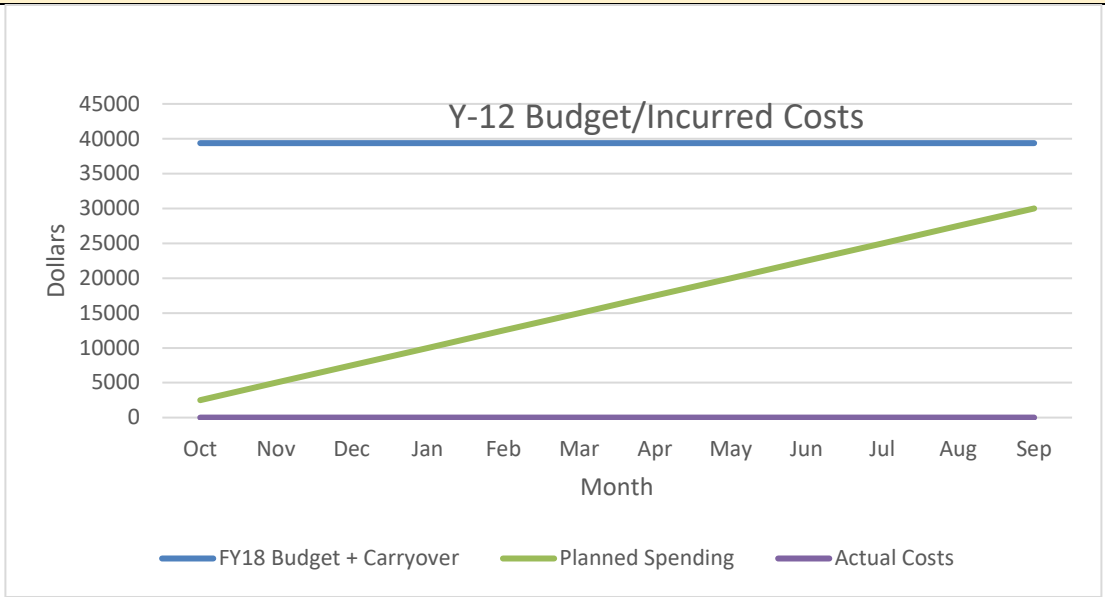
Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

Quarter	Publication Reference example) J., "Excluding Benchmark Statistical Outliers in Nuclear Criticality Safety Validation: A Comparison Study of Upper Subcritical Limits for Plutonium Systems using Whisper-1.1", LA-UR-18-27731, October 1, 2019	Sent to NCSP? Yes/no	If no, status of submittal
Q1			
Q2			
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2021 Q2)

NCSP Element and Subtask: TS14 **M&O Contractor Name**: Y12 **Point of Contact Name:** Kevin Reynolds **Point of Contact Phone:** (865) 241-9067	**Reference:** DP0909020 **Date of Report:** April, 2021

BUDGET



1. Carryover into FY 2021 = $ 9,371.48
2. Approved FY 2021 Budget = $ 30,000
3. Actual spending for 1st Quarter FY 2021 = $0 (there is a $14,886.80 commit for CSSG support carried over that has not yet posted)
4. Actual spending for 2nd Quarter FY 2021 = $0.00 (there is a $14,886.80 commit for CSSG support carried over that has not yet posted)
5. Actual spending for 3rd Quarter FY 2021 = $
6. Actual spending for 4th Quarter FY 2021 = $
7. Projected carryover into FY 2022 = $

MILESTONES

STATUS (copy color code and paste below in 'STATUS' field)

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	Provide the NCSP manager an update of NDA Technical Support Group and NDA Technical Infrastructure Project activities. (TS14)		No activity this quarter.
Q2	Provide the NCSP manager an update of NDA Technical Support Group and NDA Technical Infrastructure Project activities. (TS14)		No activity this quarter.

Q3	Provide the NCSP manager an update of NDA Technical Support Group and NDA Technical Infrastructure Project activities. (TS14)		
Q4	Provide the NCSP manager an update of NDA Technical Support Group and NDA Technical Infrastructure Project activities. (TS14)		

ACCOMPLISHMENTS

- TS14 - NDA Technical Support Group and NDA Technical Infrastructure Project

PUBLICATIONS

Any publications created during the quarter should be submitted to Marsha Henley, henleym@ornl.gov.

Quarter	Publication Reference example)	Sent to NCSP? Yes/no	If no, status of submittal
Q1			
Q2			
Q3			
Q4			

2021-04-11

Summary of MCNP Classes in FY 2021 – Q2

F.B. Brown[1], M.E. Rising[1], J.L. Alwin[2]
[1] Monte Carlo Codes (XCP-3), [2] Radiation Transport Applications (XCP-7), LANL

FY2021 – Q2 classes are highlighted in red.

Total Students

- **FY2021 – Q1: 89 students (UNM, Intro, Intermediate, VR, UM)**
- **FY2021 – Q2: 106 students (Intro, Intermediate, Advanced)**
- **FY2021 – Q3: -- students (Intro, Intermediate, Criticality, SU)**
- **FY2021 – Q4: -- students (UNM, Intro, NJOY)**
- **FY2021 – TOTAL: -- students**

Due to COVID-19 & travel restrictions, in-person classes & site visits were cancelled. All classes are currently being conducted online. Importantly, offering online classes has significantly increased class enrollment.

Classes sponsored by DOE-NNSA-NCSP

- **Criticality Calculations with MCNP6 (LANL-AM1)**
  - **June 7-9, 2021 online**

  MCNP criticality class for NCS & reactor physics practitioners, with focus on best practices. Includes 1 day on NCS validation using MCNP6-Whisper. NCS participants at DOE sites do not pay registration fees.

- **Sensitivity-Uncertainty Tools & Practices for NCS Validation (LANL-TE4)**
  - **April 27 & 28, 2021 online**

  Joint LANL & ORNL effort, covering background material and specific usage of MCNP6-Whisper and SCALE-KENO-TSUNAMI-TSURFER. D. Bowen coordinates scheduling at DOE sites.

- **Monte Carlo Techniques for Nuclear Systems (LANL-AM1)**
  - **Aug 21 – Dec 4, 2020 UNM+online 13 students**
  - **Aug 27 – Dec 10, 2021 UNM+online**

  This is a 1-semester class for senior undergrads & graduate students at the University of New Mexico. Includes Monte Carlo theory & practical use of MCNP6. Partially supported by NCSP, ASC, and other programs.

- **Advanced Monte Carlo Methods (LANL-AM1)**
  - **TBD UNM+online**

  This is a 1-semester UNM graduate class covering details of transport theory, Monte Carlo, advanced computing, & codes. This course is also used to teach LANL staff members. Partially supported by NCSP, ASC, and other programs.

Other Classes - supported by student registration fees.

- **Introduction to MCNP6** (includes 1/2 day on criticality calculations, without NCS validation & Whisper)
  - **Nov 30 - Dec 4, 2020 online 35 students**
  - **Jan 25-29, 2021 online, OECD-NEA 28 students**
  - **May 24-28, 2021 online**
  - **Aug 16-20, 2021**
- **Intermediate MCNP6**
  - **Feb 1-5, 2021 online, OECD-NEA 39 students**
  - **Apr 5-9, 2021 online**
- **Advanced MCNP6 Features & Utilities**
  - **Feb 8-12, 2021 online, OECD-NEA 39 students**
- **Unstructured Mesh with Attila4MC**
  - **Nov 2-6, 2020 online 18 students**
- **Variance Reduction**
  - **Dec 14-16, 2020 online 23 students**
- **NJOY**
  - **Aug 30 – Sept 1, 2021 online**

2021 Q2 – SCALE Training Courses Report for the Nuclear Criticality Safety Program

Class Name	SCALE/Polaris Lattice Physics, Depletion, and Uncertainty Analysis
Class Dates	Feb 22 - 25, 2021
Location	Oak Ridge National Lab, Virtual
Number of Attendees	13
Short Description	Polaris is a new 2-dimensional (2-D) lattice physics capability in the SCALE code system for LWR analysis. Polaris provides an easy-to-use input for defining lattice geometries, material compositions, and reactor state conditions. Other features of Polaris include a new resonance self-shielding implementation based on the novel embedded self-shielding method (ESSM), a new 2-D method of characteristics (MOC) neutron transport solver, and the integration of the ORIGEN depletion and decay solver for depleting material compositions. For the first three days of this five days course, attendees will learn how to model typical PWR and BWR assemblies (VVER currently not supported): develop geometry models, perform depletion simulations, setup branch and history calculations to generate few-group cross sections for full-core nodal diffusion analysis (.t16 file), and perform reflector calculations. Sampler is a new uncertainty analysis capability in SCALE that propagates uncertainties in nuclear data and input parameters to estimate the resulting uncertainty in calculated responses for most codes and sequences within the SCALE code system. Using stochastic sampling to generate perturbed calculation models, Sampler can automate multiple runs (i.e. samples) of a calculation model and then post-process the outputs to quantify the uncertainty in user-selected quantities of interest. In the final two days of this course, attendees will learn how to use Sampler with Polaris to quantity the uncertainty in lattice physics quantities of interest (reactivity, nodal cross sections, isotopic inventories) from a broad range of input uncertainty sources (nuclear data, geometry, composition, and reactor condition). No prior knowledge of SCALE is required.

Class Name	SCALE/ORIGEN Standalone Fuel Depletion, Activation, and Source Term Analysis Course
Class Dates	March 1 – 4, 2021
Location	Oak Ridge National Lab, Virtual
Number of Attendees	20
Short Description	This is a hands-on class that covers the use of ORIGEN for isotopic depletion, decay, decay heat, and radiation source-terms calculations. The course features the use of the Fulcrum consolidated SCALE graphical interface and its' plotting capabilities for displaying nuclear data and results. Participants will learn about ORIGEN's capabilities and nuclear data, how to generate ORIGEN libraries, and how to use ORIGEN for activation, spent fuel, and nuclear safeguards applications. This class introduces the ORIGAMI tool for convenient characterization of spent nuclear fuel with radially and axially varying burnup. Advanced applications including simulation of chemical processing, continuous feed and removal are also covered. No prior knowledge of SCALE is required.

Class Name	SCALE Criticality Safety and Radiation Shielding Course
Class Dates	March 8 - 11, 2021
Location	Oak Ridge National Lab, Virtual
Number of Attendees	19
Short Description	This course provides instruction on the use of the KENO-VI Monte Carlo code for criticality safety calculations and the MAVRIC (Monaco with Automated Variance Reduction using Importance Calculations) shielding sequence with 3-D automated variance reduction for deep-penetration problems. KENO-VI is a 3D eigenvalue Monte Carlo code for criticality safety and Monaco is a 3D fixed-source Monte Carlo code for shielding analysis. Both codes use the SCALE Standard Composition Library and the SCALE Generalized Geometry Package (SGGP), which allows for versatile modeling of complex geometries and provides convenient, efficient methods for modeling repeated and nested geometry configurations such as lattices. The MAVRIC sequence is based on the CADIS (Consistent Adjoint Driven Importance Sampling) methodology. For a given tally in a Monte Carlo calculation that the user wants to optimize, the CADIS method uses the result of an adjoint calculation from the Denovo 3D deterministic code to create both an importance map for weight windows and a biased source distribution. MAVRIC is completely automated in that from a single user input, it creates the cross sections (forward and adjoint), computes the adjoint fluxes, creates the importance map and biased source, and then executes Monaco. An extension to the CADIS method using both forward and adjoint discrete ordinates calculations (FW-CADIS) is included in MAVRIC so that multiple point tallies or mesh tallies over large areas can be optimized (calculated with roughly the same relative uncertainty). Both KENO and Monaco use ENDF/B-VII.0 or ENDF/B-VII.1 cross-section data distributed with SCALE to perform continuous energy (CE) or multigroup (MG) calculations. Both codes can also be used with the Fulcrum consolidated SCALE user interface and KENO3D for interactive model setup, computation, output review, and 3-D visualization. Instruction is also provided on the SCALE material input and resonance self-shielding capabilities and the data visualization capabilities within Fulcrum for visualizing fluxes, reaction rates, and cross-section data as well as mesh tallies. KENO-VI and MAVRIC can be applied together to perform an integrated criticality accident alarm system (CAAS) analysis. No prior knowledge of SCALE is required.

Class Name	SCALE Sensitivity/Uncertainty Analysis and Uncertainty Quantification for Criticality Safety Validation
Class Dates	March 15 – 18, 2021
Location	Oak Ridge National Lab, Virtual for Framatome
Number of Attendees	14
Short Description	The Framatome training class was based on the standard TSUNAMI/Sampler class, but was modified to shift the focus from a burnup credit application to an LEU+/HALEU application. The modifications focused on the workshop problems for TSUNAMI-IP and USLSTATS. ORNL developed a new non-proprietary model to be used for this demonstration of TSUNAMI-based experiment selection and validation. The TSUNAMI-IP workshop used SDFs available through either the ICSBEP Handbook or from prior SCALE training. The instruction on Sampler was not modified.

STATUS REPORT
on the
International Collaboration with the Atomic Weapons Establishment (AWE)

Reference			AWE Contributions and POCs			
AWE Reference	**Task Description**	**NCSP Reference**	**FY2018 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	ORNL
AWE effort currently on hold due to lack of resource.						
INTEGRAL EXPERIMENTS						
AWE-IE1	Inaugural international inter-comparison of nuclear accident dosimetry using Flattop	LLNL-IE1 IRSN-IE15	Co-author final report (CED-4b)	P. ANGUS	D. STONE	LLNL
Report completed and issued by C. Wilson before his departure in 2019. Next inter-comparison exercise anticipated to be 2021.						
AWE-IE2	Development of Passive Neutron Spectrometer (PNS)		Fully commission TLD version of the PNS; Perform validation irradiations at NPL; develop unfolding tools for directionality	P. ANGUS	D. STONE	LLNL
3x PNS developed and built. Irradiations at NPL, planned for March 2020 (with potential involvement from US community), impacted by COVID-19 pandemic.						
AWE-IE3 **IER 406**	Cf-252 CAAS benchmark	LLNL-IE1 IRSN-IE28	Perform/support PNS(TLD) measurements with a shadow cone	P. ANGUS	D. HEINRICHS	LLNL
Dependent on completion of IE2.						
AWE-IE4 **IER 175**	Godiva-IV CAAS benchmark	ORNL-IE4 IRSN-IE27	Review of experiment design. Provide measurement capability as required	T. BIRKETT	J. SCORBY	ORNL
AWE involvement complete. Any further work dependent on future ORNL programme.						
AWE-IE5	Correction factor for dosimetry linked to orientation of the victim	LLNL-IE1 IRSN-IE29	Participate in experiment design; use PNS data to determine directional components of neutron fields (Godiva, Flattop, LLNL RCL)	P. ANGUS	D. HEINRICHS	LLNL
Dependent on completion of IE2 (unfolding tools for directionality). Linked with IE11 (2021 International inter-comparison)						
AWE-IE6	ICSBEP shielding benchmark for shipping containers	LLNL-IE13 IRSN-IE36	Participate in experiment design; PNS(TLD) could be deployed as primary measurement device AWE to do some preliminary design	P. ANGUS	S. KIM	LLNL

Reference			AWE Contributions and POCs			
AWE Reference	**Task Description**	**NCSP Reference**	**FY2018 AWE Contribution**	**AWE Technical POC**	**Collaborator POC**	**DOE Lab**
Not started due to long lead time (2023) and dependence on PNS availability (see IE2). Scope definition required.						
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
Awaiting LANL to advise on the extent of AWE involvement.						
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
An internal AWE report has been issued summarizing the outcome of the fast neutron liquid scintillation trials conducted at the DAF in 2019. This will inform future measurement aspirations but the schedule for measurement campaigns is on hold during the COVID-19 pandemic.						
AWE-IE9	(Neutron multiplicity experiments) AWE/LLNL NCT 5 year measurement campaign	LLNL-PROPOSAL 18	Participate in experiment design, measurements and reporting	N. KELSALL	D. HEINRICHS	LLNL
AWE has issued an internal report summarizing the results from analysis of bulk material measurements. Modified version of this report has been shared with the NCSP. In addition to the ongoing travel limitations imposed by COVID, funding for AWE staff to attend the DAF during the forthcoming UK Financial Year (April 2021 to March 2022) has yet to be approved by MOD, but AWE is actively seeking to secure this funding.						
AWE-IE10	Enhanced methods of criticality accident dosimetry.	LLNL-IE1 IRSN-30 IRSN-33 Naval Dosimetry Center	Develop prototypes, participate in design, execution and reporting of dosimetry experiments	P. ANGUS	F. TROMPIER	LLNL
No progress to date. Potentially use IE11 as an opportunity to compare & test any new instrumentation.						
AWE-IE11	International inter-comparison of nuclear accident dosimetry AWE to assist in preliminary design FY19 and FY20	LLNL-IE18 SNL-IE4	Produce experiment design; participate in exercise; produce final report. Repeat 2 - 3 years	P. ANGUS	D. STONE	LLNL
Next international inter-comparison is scheduled for 2021.						
AWE-IE12	CIDAAS testing	Proposal 20	Deploy AWE CIDAAS for test irradiation. Repeat 2 - 3 years	T. BIRKETT	J. SCORBY	LLNL
AWE successfully tested CIDAAS in May 2018 and provided support to CED-4. Technical report detailing the results has been issued. New design of visual alarm procured, which will be evaluated during the next available Testing Visit.						

Reference			AWE Contributions and POCs			
AWE Reference	**Task Description**	**NCSP Reference**	**FY2018 AWE Contribution**	**AWE Technical POC**	**Collaborator POC**	**DOE Lab**
AWE-IE13	Characterization of AFRRI TRIGA reactor radiation field AWE will provide onsite measurement	LLNL-IE18 SNL-IE4	Provide support to experiment design	P. ANGUS	A. ROMANYUKHA	LLNL
AWE was fully prepared for July 2019 trial, prior to the regulatory shut-down of TRIGA. If trial is re-scheduled for 2021 AWE will be able to support it, provided sufficient notice is given.						
INFORMATION PRESERVATION AND DISSEMINATION						
AWE-IPD1	Conduct benchmark evaluations of legacy IEU integral experiments Requires no NCSP funding	LLNL-IPD1	Assess feasibility of sponsoring PhD; determine availability of data	R. JONES	D. HEINRICHS	LLNL
Considered unlikely to make any material progress.						
TRAINING AND EDUCATION						
AWE-TE1	Hands-on criticality safety training	ORNL-TE1 LANL-TE1 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. EVO (IRSN)	ORNL
No AWE personnel attended courses during the reporting period. Currently no AWE personnel are expected to attend courses in the next quarter.						

STATUS REPORT of international collaboration with the Institut de Radioprotection et de Sûreté Nucléaire (IRSN) for FY2021

	REFERENCE		IRSN Contribution / POC			
IRSN Reference	**Task Title**	**DOE Reference**	**FY 2021 IRSN Contribution**	**IRSN Technical POC**	**DOE Technical POC**	**DOE LAB**
Analytical Methods						
IRSN-AM1	Validation and qualification methods	ORNL-AM2 ORNL-IPD4	Determination of the experimental correlations of Valduc experiments. To be discussed with ORNL.	N. LECLAIRE	B.J. MARSHAL	ORNL
Q1 status No progress **Q2 status** No progress						
IRSN-AM5	Update of the slide rules	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
Q1 status The document about the specifications for delayed gamma calculations for plutonium systems was sent on 27th November to all collaborators (ORNL, LLNL, NNL, AWE). It was discussed during a meeting on 8th January and partners decided to make first calculations for April 2021. The next meeting is planned on 13th April. **Q2 status** During the 13th April meeting, first results were discussed. Additional calculations are necessary to understand discrepancies between participants' results. The section about the estimation of the number of fissions was also discussed. The next meeting is planned on 26th May.						
IRSN-AM8	Analytical Methods Working Group	NCSP-TS2	IRSN participation to NCSP analytical methods Working Group, NDAG meeting, and -TPR meeting	S. PIGNET	F. BROWN D. BOWEN D. HEINRICHS	NCSP
Q1 status IRSN will participate in the NDAG meeting. Luiz LEAL will make a presentation on ND needs. Presentations are scheduled to be delivered in next TPR meeting. **Q2 status** IRSN has participated to the AM WG, NDAG and TPR meetings on February 22-23. IRSN work activities were presented by Nicolas LECLAIRE Luiz LEAL and Sophie PIGNET.						
IRSN-AM9	Cross sections processing validation	ORNL-AM3	AMPX training - Development of an interface between GAIA and AMPX and test interface capabilities.	R. ICHOU	D. WIARDA D. BOWEN	ORNL
Q1 status Nicolas LECLAIRE and Frederic FERNEX participated in AMPX training on October 2020. Due to the COVID-19 situation other planned activities were delayed. **Q2 status** A comparison was made between the PUFF module of AMPX and the ERRORR module of NJOY, with the use of several weighting fluxes, on U235 and Gd155 and Gd157, in the frame of a five months intern ship. Moreover PUFF was used to generate covariances from the JEFF 3.3 library for internal use at IRSN.						

	REFERENCE		IRSN Contribution / POC			
IRSN Reference	**Task Title**	**DOE Reference**	**FY 2021 IRSN Contribution**	**IRSN Technical POC**	**DOE Technical POC**	**DOE LAB**
IRSN-AM13	Benchmark intercomparison study	LLNL-AM5 ORNL-AM10 LANL-AM5	Definition of common set of developed benchmark models Calculations for Pu and HEU systems. LEU, MIX, U233 and SPEC systems will be included in FY 2021.	N. LECLAIRE	D. HEINRICHS D. BOWEN F. BROWN	LLNL ORNL LANL
Q1 status Analysis of inconsistencies on LEU systems, MIX and U233 calculations. Conclusions transmitted to LANL (Jennifer ALWYN). Next action: Proposal of additional cases to be modelled with the MORET code in 2021 for U233 systems. A status of results will be presented at the next TPR meeting. **Q2 status** Additional experiments for U233 and MIX were identified and are being modelled this year. The analysis of the results will follow.						
IRSN-AM14	Sensitivity/Uncertainty comparison study with a focus on Upper Subcritical Limits	ORNL-AM9 LANL-AM4	Definition of test cases Calculations and intercomparison Technical report	A. BARDELAY	F. BROWN D. BOWEN	LANL ORNL
Q1 status No progress **Q2 status** No progress						
IRSN-AM15	MCNP Maintenance and Support / Uncertainty Analysis Development / Modernization / etc.	LANL-AM1	Interest for uncertainty analysis, source convergence development and modernization strategy	W. MONANGE	F. BROWN	LANL
Q1 status No progress. **Q2 status** No progress						
Integral Experiments						
IRSN-IE6 **IER 306**	Rh experiment	SNL-IE1	CED-2 report	N. LECLAIRE	G. HARMS	SNL
Q1 status The CED-2 report is in progress. It takes into account the last results of a subcontract for the design optimization. The report should be submitted to the NCSP review team mid-2021. **Q2 status** The CED-2 report is almost finished. It takes into account the last results of a subcontract for the design optimization. The report should be submitted to the NCSP review by end of June. A preliminary study for rhodium supply was initiated. The cost of rhodium seems to have hugely increased and could constitute a limitation for the pursuit of the IER.						
IRSN-IE7 **IER 305**	Mo experiment	SNL-IE1	Leading the CED-3a report; Supplying the Mo rods for the experiment. Participation to the experiments	N. LECLAIRE	G. HARMS	SNL

	REFERENCE		IRSN Contribution / POC			
IRSN Reference	**Task Title**	**DOE Reference**	**FY 2021 IRSN Contribution**	**IRSN Technical POC**	**DOE Technical POC**	**DOE LAB**
Q1 status The technical specifications report was written and submitted along with other documents to various companies through a public tender. Tender process in progress. The manufacturing of sleeves, measurement campaign (chemical and dimensions) and analysis of the results should be done beginning of May 2021. The CED-3a will need to be written when an estimate of the sleeves manufacturing is available. **Q2 status** The technical specifications report was written and submitted along with other documents to various companies for public bids. The PLANSEE company had the best offer. The order has been done after discussing the specification values with Gary Harms and David Ames and adjusting some dimensions to ease the experimental realization. The manufacturing of sleeves, measurement campaign (chemical and dimensions) and analysis of the results should be achieved beginning of July 2021. The CED-3a will be written shortly since the cost for Mo sleeves is now available.						
IRSN-IE11 **IER 297**	TEX - Hf baseline experiments (HEU)	LLNL-IE4	Contribution to ICSBEP evaluation of the baselines experiments	M. BROVCHENKO	C. PERCHER	LLNL
Q1 status Activity is on hold. The ICSBEP evaluation is under preparation by LLNL. **Q2 status** Activity is on hold. The ICSBEP evaluation is under preparation by LLNL.						
IRSN-IE11 **IER 532**	TEX-Hf experiments	LLNL-IE4	Participation to experiments and analysis of results	M. BROVCHENKO	C. PERCHER	LLNL
Q1 status Activity is on hold. Experiments foreseen to be performed summer 2021. **Q2 status** Activity is on hold. Experiments foreseen to be performed summer 2021.						
IRSN-IE27 **IER 498**	GODIVA CAAS benchmark	ORNL-IE4	Participation in the design (CED2 FY2021) Provide IRSN materials for irradiation	F. TROMPIER	D. BOWEN	ORNL
Q1 status Discussion in progress on the design. **Q2 status** Discussion in progress on the design.						
IRSN-IE28 **IER 406**	Cf-252 CAAS benchmark	LLNL-IE1	Participation to the experiments. Provide IRSN materials for irradiation	F. TROMPIER	D. HEINRICHS	LLNL
Q1 status Stand by - waiting for experiments to be planned						

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Q2 status Stand by - waiting for experiments to be planned						
IRSN-IE30	Full dosimetry exercise around GODIVA	LLNL-IE1	Participation in the design. Provide IRSN materials for irradiation, analysis of results	F. TROMPIER	D. HEINRICHS	LLNL AWE
Q1 status No progress **Q2 status** No progress (discussion HEINRICHS and TROMPIER)						
IRSN-IE34 **IER 488**	MUSIC (HEU) critical and Subcritical measurements.	LANL-IE23	Participation to the experiments, analysis of results	W. MONANGE	J. HUTCHINSON	LANL
Q1 status The experiment should be carried out the second week of February. Team discussions for preparation of the experiment. Decision made early January due to the COVID-19 situation: IRSN team is not allowed to travel. **Q2 status** The experiments have been carried out mid-february. IRSN is waiting for the results.						
IRSN-IE36 **IER 514**	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
Q1 status Activity is on hold waiting for LLNL input **Q2 status** Activity is on hold waiting for LLNL input						
IRSN-IE41 **IER 499**	Thermal/Epithermal Experiments (TEX) with Chlorine and Lithium	LLNL-IE23	Participation in experiments design and CED reports.	M. BROVCHENKO	D. HEINRICHS	LLNL
Q1 status Technical exchanges between LLNL and IRSN. **Q2 status** Technical exchanges between LLNL and IRSN.						
IRSN-IE42 **IER 121**	Neptunium Subcritical Observations (NeSO) experiment	LANL-IE3	Independent review of the ICSBEP evaluation.	W. MONANGE	J. HUTCHINSON	LANL
Q1 status Activity is on hold; Evaluation is under preparation by LANL **Q2 status** Activity is on hold waiting for LANL input						

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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.	N. LECLAIRE W. MONANGE	N. THOMPSON	LANL
Q1 status No progress. **Q2 status** The proposal was submitted. Both critical and sub-critical experiments are scheduled. Discussion between IRSN and LANL on IER design.						
IRSN-IE46 **IER 518**	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
Q1 status No progress. **Q2 status** No progress.						
IRSN-IE47	Copper Critical Experiment	LANL-IE3	Participation in experiments design and CED reports. IRSN interest to understand results of various experiments (ZEUS experiments results and IRSN-IE48)	J-B. CLAVEL	J. HUTCHINSON	LANL
Q1 status No progress **Q2 status** No progress						
IRSN-IE49	Iron/Steel/Chromium Critical Experiment Series	LANL-IE3	Participation in experiments design and CED reports. High interest for IRSN.	J-B. CLAVEL	J. HUTCHINSON	LANL
Q1 status No progress **Q2 status** No progress.						
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
Q1 status MIRTE 2 experiments evaluation approved. Few modifications in progress. To be published in 2021 handbook.						

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Q2 status Last comments on MIRTE 2 experiments evaluation received and included in the benchmark. Evaluation to be published in 2021 handbook.						
Nuclear Data						
IRSN-ND1	Contribution to new evaluations	ORNL-ND1 NNL-ND1 RPI	Contribution to new evaluations and validation in accordance with the milestone schedule in Appendix B	L. LEAL	D. BOWEN T. TRUMBULL	ORNL NNL RPI
Q1 status Work on the evaluation of Mo and Pb isotopes are in progress; Evaluation of F19, Fe54, Fe56, Pu239 in progress; Rh103 evaluation completed and available for testing; **Q2 status** IRSN/NNL completed the Rh103 RR and URR evaluations. The library will be sent to NNDC. Work on the Mo and Pb isotope evaluation is under way. Fruitful exchanges with NNL/RPI. ANS paper on the Hf data assessment (shared with ORNL) accepted for presentation. Discussion on the RR Hf evaluation coordination (IRSN/ORNL/NNL) has been initiated. Fe56 evaluation shared with LLNL for testing.						
IRSN-ND2	Nuclear data Evaluation and Testing	LANL-ND1 LANL-ND2	Contribution to new evaluations and validation in accordance with the milestone schedule in Appendix B Contribution to Prompt Fission Neutron Spectra (PFNS) Measurement of Plutonium-240	L. LEAL	B. BLUHM	LANL
Q1 status No progress **Q2 status** No progress						
IRSN-ND3	Nuclear data Evaluation and Testing	LLNL-ND8 ORNL-ND1	Resonance evaluation of ^{233}U	L. LEAL	D. HEINRICHS D. BOWEN	LLNL ORNL
Q1 status Work underway. Resolved resonance evaluation nearly completion; focus on the unresolved resonance evaluation: **Q2 status** Resolved resonance parameters from low to 2 keV and unresolved resonance parameter from 2 keV to 40 keV revised according to benchmark results.						
IRSN-ND4	Delayed fission gamma multiplicity and spectra	LLNL-ND1 (a and b)	Data testing as new experimental data becomes available from foil activation measurements and dosimetry testing using GODIVA, FLATTOP, and other assemblies	M. BROVCHENKO	D. HEINRICHS	LLNL
Q1 status Activity is on hold waiting for LLNL input **Q2 status**						

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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
Q1 status Activity delayed due to COVID. IRSN would like to send 2 participants to August 2021 session (if possible to travel) **Q2 status** Activity delayed due to COVID. IRSN would like to send 2 participants to August 2021 session (if possible to travel)						

Additional information:

- **Q1 :**
  - **IER 513** Blind NAD Intercomparison with Godiva: exchanges (F. TROMPIER) with LLNL in November 2020 about the next dose blind intercomparison exercise plan at NCERC using the Godiva reactor. IRSN plans to participate to the exercise in 2021.
  - **IER 520** TEX-Pu240 on the Planet machine: exchanges between LLNL and IRSN on the possible designs
  - **IER 479** TEX low temperature: exchanges between LLNL and IRSN on the possible designs.
  - **IER 519** TEX with absorbers Fe and Mn : technical exchanges between LLNL and IRSN on the nuclear data validation needs.
- **Q2 :**
  - **IER 520** TEX-Pu240 on the Planet machine: exchanges between LLNL and IRSN on the possible designs
  - **IER 479** TEX low temperature: exchanges between LLNL and IRSN on the possibility to had materials of interest for transport (steel, Al, resin, …). Discussion on IRSN CH_2 Sab evaluations at different temperatures.
  - **IER 519** TEX with absorbers Fe and Mn : technical exchanges between LLNL and IRSN.

- **IER 296**: comments from NCSP team on TEX MOX CED 1 received by IRSN.
- **IER 184**: TEX Ta – contribution to TEX Ta review (PMM003)