NUCLEAR CRITICALITY SAFETY PROGRAM (NCSP)

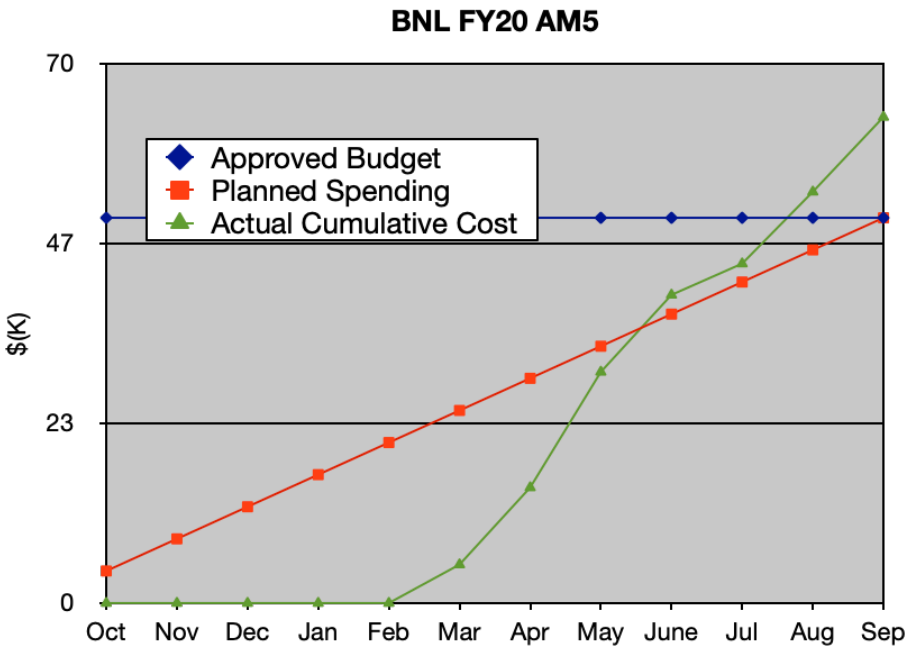
FY2020 4TH QUARTER REPORTS

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element and Subtask: Analytical Methods AM5
Task Title: FUDGE Generation of a Complete ENDF/B-VIII.0 Library for Testing in Production Codes
M&O Contractor Name: BNL
Point of Contact Name: David Brown
Point of Contact Phone: 631-344-2814

Reference: DP 0902000
Date of Report: Oct. 15, 2020

BUDGET

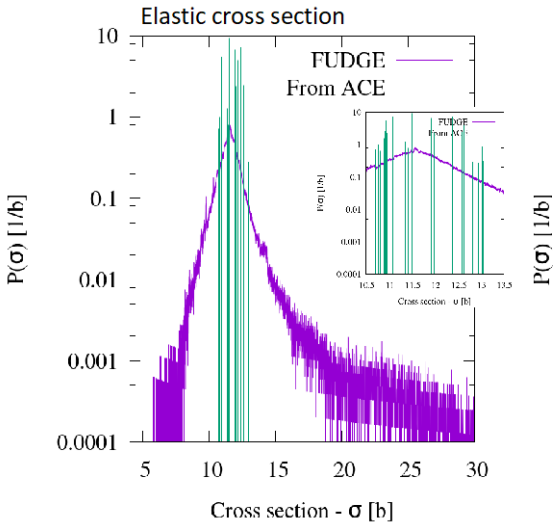


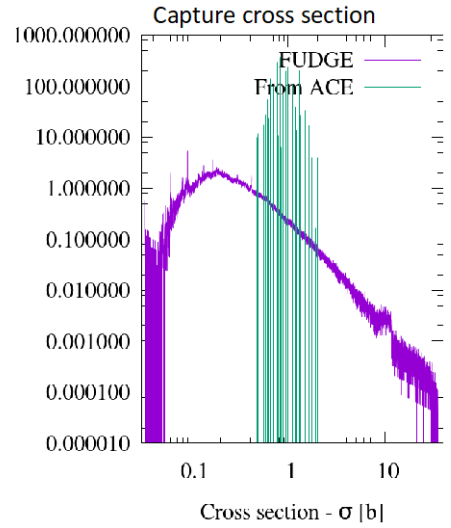
1. **Carryover into FY 2020** = $ 0
2. **Approved FY 2020 Budget** = $ 50,000
3. **Actual spending for 1st Quarter FY 2020** = $0
4. **Actual spending for 2nd Quarter FY 2020** = $5000
5. **Actual spending for 3rd Quarter FY 2020** = $35,000
6. **Actual spending for 4rd Quarter FY 2020** = $23,083
7. **Projected carryover into FY 2021** = -$13,083

ACCOMPLISHMENTS

FUDGE has support for the full GNDS-1.9 specification, including thermal neutron scattering (TNS) data and unresolved resonance (URR) probability tables. FUDGE has demonstrated the ability to process TNS and the processed data has been used in LLNL simulations along with results from a preliminary implementation of the URR probability tables.

Our preliminary URR implementation disagrees markedly with NJOY as shown below. We believe that the NJOY result, while similar to AMPX and FRENDY, reflects an incorrect interplay of Doppler broadening and Bayes' theorem. Nevertheless, a narrow capture probability distribution appears necessary for benchmarking. We will investigate in FY21.





NCSP Quarterly Progress Report (FY-2020 Q4)

BNL ND Milestones:

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

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	MILESTONE	STATUS	ISSUES/PATH FORWARD
Q1	Provide a status report on completing an ENDF/B-VII.0 library with FUDGE. (AM5)		
Q2	Provide a status report on completing an ENDF/B-VII.0 library with FUDGE. (AM5)		
Q3	Provide a status report on completing an ENDF/B-VII.0 library with FUDGE. (AM5)		A BNL Post-doc (Matteo Vorabbi) has developed a way to Doppler broaden the entire 0 degK cross section probability table. He is now testing the approach on 90Zr. A writeup should be available by the end of the FY.
Q4	Provide a status report on completing an ENDF/B-VII.0 library with FUDGE. (AM5)		Rescoping task given issue described above.

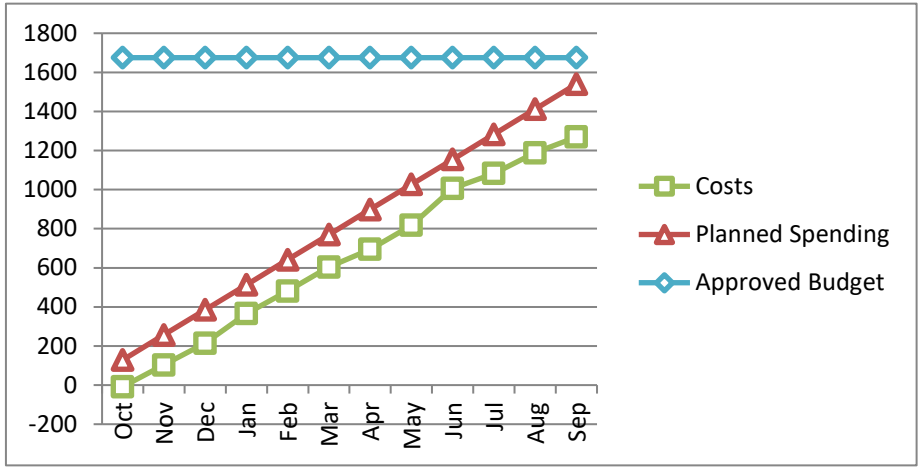
NCSP Quarterly Progress Report (FY-2020 Q4)

Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**	**no**	
Q2	**N/A**	**no**	
Q3	**N/A**	**no**	
Q4	**N/A**	**no**	

Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**	No	
Q2	**N/A**	**no**	
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element and Subtask: AM1, 2, 4, 5, 7 Task Title: see last page M&O Contractor Name: LANL Point of Contact Name: Joetta Goda / Bob Little Point of Contact Phone: 505-667-2812 / 505-665-3487	Reference: B&R DP0902000 Date of Report: October 14, 2020
BUDGET	**MAJOR ACCOMPLISHMENTS**



1. **Carryover into FY 2020 = $0**
2. **Approved FY 2020 Budget = $1,675,000 (includes carryover)**
3. **Actual spending for 1st Quarter FY 2020 = $216,459**
4. **Actual spending for 2nd Quarter FY 2020 = $386,988**
5. **Actual spending for 3rd Quarter FY 2020 = $403,321**
6. **Actual spending for 4rd Quarter FY 2020 = $262,279 (total = $1,269,047)**
7. **Projected carryover into FY 2021 = $135,000**

AM-1 (MCNP)

- MCNP Education and Training:
  - Our detailed MCNP class report is provided separately. We taught two on-line classes during the quarter: Introduction to MCNP and Intermediate MCNP6, with a total of 80 students.
  - Ongoing Monte Carlo course at UNM, 11 undergrad + 2 grad students.
  - Thesis advisor for UNM graduate student working in area of criticality calculations

- MCNP Support and Maintenance
  - Supported MCNP6 users through MCNP Forum, email, direct interactions, etc.
  - MCNP V&V report. Work completed, and report is under preparation for release. Will send later in October.
    - F.B. Brown, M.E. Rising, "Verification of MCNP6.3 Pre-release for Nuclear Criticality Safety Applications", in preparation, expected October 2020.
  - Code modernization effort – continuing.
  - Updating MCNP6 theory & user manual.

- MCNP R&D Work, continued to investigate and develop:
  - Region-dependent sensitivity-uncertainty data for NCS validation (with UNM)
  - Subcritical multiplication methods investigation and impact of correlated fission multiplicity models in criticality calculations (with UNM)
    - Timmons, Rising, Perfetti, "Subcritical Multiplication with a Fixed Source", LA-UR-20-25248 (submitted to ANS 2020 Winter Meeting and Nuclear Technology Expo).

- OECD-NEA-WPNCS-Subgroup-6 on statistical testing for automated criticality source convergence (F.B. Brown lead):
  - Meeting for July 20 in Paris cancelled.
  - Online international meeting with SG-6 members, July 8. Discussed report.
  - Prepared final draft of report. Under review by SG-6 members for OECD release in December.
- Further investigation and usage of partial c_k similarity metrics for experiment design and optimization

- Updated MCNP Thermal Scattering Library:
  - The updated library described last quarter was made available at https://nucleardata.lanl.gov in July.
  - Both ANS transactions submitted last quarter were accepted for the national meeting in November.

AM-2 (NJOY)

- NJOY21: RECONR
  - RECONR has been modernized and integrated into NJOY21.
  - We have processed all of ENDF/B-VIII.0 through ACER with modern RECONR and the remaining components from Legacy NJOY.
  - The implementation supports the following resonance formalisms
    - Resolved
      - Single- and Multi-level Breit Wigner (LRF=1 and 2)
      - Reich-Moore (LRF=3)
      - R-Matrix Limited (LRF=7)
    - Unresolved
      - Energy independent (Case A)
      - Energy dependent fission widths (Case B)
      - Energy dependent (Case C)
  - Documentation to be written at docs.njoy21.io
  - We are preparing a release of NJOY21 with modern RECONR
    - Much improved build system and version identification
    - Need to reduce compile time when using GCC
    - Need additional integration tests
  - Some additional details:
    - A functionality was added to translate traditional ENDF RM parameters (LRF=3) into the more general R-matrix

coding used for LRF=7. This provides an alternative to the previously developed classic RM coding (which only works for elastic, fission and capture).
        - A number of features related to the use of older evaluations were also implemented, such as the use of an energy dependent channel radius (used in older SLBW, MLBW, RM and unresolved evaluations).
    - NJOY21: LEAPR
        - Modernized LEAPR capabilities have been implemented in stand-alone code. Connecting that stand-alone code to NJOY21 will be completed in Q1 of FY21.

- Support NJOY users: Two NJOY2016 releases to fix a few minor issues pointed out by external users:
    - NJOY2016.58: This release fixes a processing issue for the IRDFF-II ENDF files in GROUPR. This release addresses issue #124.
    - NJOY2016.59: This release fixes a minor issue in ACER. Whenever an ACER check run changed the library suffix for thermal scattering libraries, it was ignored. Test 61 was added to the non-regression tests.
    - In addition to these two releases, an additional update to NJOY2016 related to the new IAEA photonuclear data library is good to go as well.

AM-4 (S/U Comparison Study)

- Completed report on comparison of results from LANL, ORNL, and IRSN. Detailed review, comparisons, and updates to the Sensitivity-Uncertainty Comparison Study.
    - J.L. Alwin, F.B. Brown, M.J. Lazaric, B.R. Murphy, K.D. Yancey Spencer, "Comparison Study of Upper Subcritical Limits Derived Using Sensitivity/Uncertainty Tools Case Studies of Benchmarks and Applications", LA-UR-20-28129.

AM-5 (Benchmark Comparison Study)

- Results were obtained from LANL, LLNL, ORNL, SNL, IRSN and used to investigate atypical cases. Documented in report sent previously LA-UR-20-23376.
- Further investigations of a few benchmarks are ongoing and some requests for information have been made of other laboratories.

	AM-7 (University of Michigan) ▪ This is a new start in FY20 "Incorporation of Benchmark Experiment Correlations into the Whisper Nuclear Criticality Safety Software." AM-7 is a University Project at the University of Michigan. The procurement took longer than anticipated, but is now in place as of September 2020. FY20 milestones will therefore become FY21 milestones.

NCSP Quarterly Progress Report (FY-2020 Q4)

LANL AM 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	Support MCNP6 users (AM1)		
	Support NJOY users (AM2)		
	Provide status reports on LANL participation in US and International analytical methods collaborations (AM1, AM2, AM4, AM5, and AM6)		
	Provide reports on summer intern work accomplished (AM1)		
	Provide MCNP6 Criticality training course (AM1)		
	Continue to distribute MCNP6 with automated acceleration and convergence testing to NCSP early-adopters and collect feedback (AM1)		
	Obtain (University of Michigan) Whisper and explore various approaches for the effective sample size (AM7)		As indicated above, due to delays in the procurement process, we will need to slip the University of Michigan AM-7 milestones into FY21.
Q2	Support MCNP6 users (AM1)		
	Support NJOY users (AM2)		
	Provide status reports on LANL participation in US and International analytical methods collaborations (AM1, AM2, AM4, AM5, and AM6)		

	Report on LANL XCP-3, LANL NCS, & IRSN collaboration on detailed differences found in ICSBEP Benchmark Comparison Study (AM5)		
	Provide status of all MCNP6 and Whisper progress at the NCSP Technical Program Review (AM1)		
	Implement the selected effective sample size method into Whisper (AM7)		As indicated above, due to delays in the procurement process, we will need to slip the University of Michigan AM-7 milestones into FY21.
Q3	Support MCNP6 users (AM1)		
	Support NJOY users (AM2)		
	Provide status reports on LANL participation in US and International analytical methods collaborations (AM1, AM2, AM4, AM5, and AM6)		
	Provide training module on the use of MCNP6 unstructured mesh for CAAS analysis (AM1)		
	Issue an MCNP V&V report, including MCNP6 automated acceleration and convergence (AM1)		Work is complete. Report is nearly finished and will be issued in October.
	Perform Whisper calculations demonstrating the impact of benchmark experiment correlations on results. (AM7)		As indicated above, due to delays in the procurement process, we will need to slip the University of Michigan AM-7 milestones into FY21.
Q4	Support MCNP6 users (AM1)		
	Support NJOY users (AM2)		
	Provide status reports on LANL participation in US and International analytical methods collaborations (AM1, AM2, AM4, AM5, and AM6)		
	Complete modernization of LEAPR capabilities (AM2)		

	Modernize and integrate RECONR capabilities in NJOY21 (AM2)		
	Issue report on detailed review, comparisons, and updates to the Sensitivity-Uncertainty Comparison Study (AM4)		
	Provide MCNP6 Criticality training course (AM1)		Scheduled class postponed. Converted to online class and re-scheduled in FY21 due to COVID.
	Document and release updated S(a,b) tables for MCNP based on ENDF/B-VIII.0 (AM1)		
	Deliver final modified version of Whisper to LANL with an ANS conference paper to disseminate the work (AM7)		As indicated above, due to delays in the procurement process, we will need to slip the University of Michigan AM-7 milestones into FY21.

NCSP Quarterly Progress Report (FY-2020 Q4)

Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	OECD/NEA Paris, France May-20 AM2 Attend annual WPEC meeting and associated Sub-Group meetings (Conlin, Haeck) Contributor to multiple sub-groups-Conlin co-leads SG43; Haeck leads SG45.	No	Virtual meeting only
	Cambridge, England Apr-20 AM2 IE3 Attend PHYSOR 2020 meeting of the ANS. NCSP task that travel is performed under: LANL AM2 (Conlin, McKenzie, Hutchinson) Present NJOY updates and improvements Present research results.	No	Meeting cancelled
	Vienna, Austria TBD-date AM2 Consultancy meeting at IAEA (Conlin, Haeck) Participate in IAEA consultancy meeting on ACE processing	No	Meeting cancelled
Q4	OECD/NEA Paris, France Jul-20 AM1 OECD Expert Group Meetings for NCSP, collaboration with IRSN on NCS (Brown, Rising) Participation provides state-of-art information for improving MCNP®, Whisper, and other computational methods	No	Meeting cancelled; some virtual events were held
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**

Q1	Foreign trip report from the ICNC 2019 Conference & OECD-NEA-WPNCS Subgroup Meetings, held in Paris, France, 15-27 September 2019.	Yes	
Q1	D.H. Timmons, M.E. Rising, C.M. Perfetti, "The Use of MCNP 6.2 KCODE for High Fidelity, Near Critical Benchmarks" (M&C 2019)	Yes	
Q1	P. Grechanuk, M.E. Rising, T.S. Palmer, "Identifying Sources of Bias from Nuclear Data in MCNP6 Calculations Using Machine Learning Algorithms" (M&C 2019)	Yes	
Q1	P.A. Grechanuk, M.E. Rising, and T.S. Palmer, "Comparing the Whisper Validation Methodology with Machine Learning Methods" (ICNC)	Yes	
Q1	B. Merryman, F. Brown, J. Alwin, and C. Perfetti, "Investigating Region-Wise Sensitivities for Nuclear Criticality Safety Validation" (ICNC)	Yes	
Q2	J. Alwin, F. Brown, J. Clarity, I. Duhamel, L. Leal, R. Little, B. J. Marshall, M. Rising, E. Saylor, K. Spencer, "Sensitivity/Uncertainty Comparison Study with a Focus on Upper Subcriticality Limits" (AMWG)	Yes	
Q2	J. Alwin, K. Spencer, F. Brown, I. Duhamel, M. Rising, "LANL Critical Benchmark Comparison Study and Subsequent Revision," LA-UR-20-23376	Yes	Submitting with Q3 reports
Q2	Forrest Brown, "Automatic Acceleration & Convergence Testing for MC NCS Calculations," (AMWG)	Yes	AMWG presentations were collected during TPR
Q2	Forrest Brown, Mike Rising, Jen Alwin, Chris Perfetti, and Todd Palmer, "Analytical Methods Work (LANL AM-1) in FY2019 to Support NCSP," (TPR)	Yes	Already posted on NCSP / TPR Web Page
Q2	Jeremy L. Conlin, "NJOY Modernization and Support," (TPR)	Yes	Already posted on NCSP / TPR Web Page
Q2	Michael E. Rising, "MCNP Modernization Status," (TPR)	Yes	Already posted on NCSP / TPR Web Page
Q2	Bob Little, "Summary of MCNP Classes in FY 2019," (TPR)	Yes	Already posted on NCSP / TPR Web Page
Q3	D. Kent Parsons and Cecile Toccoli, "Re-release of the ENDFB-VIII.0 S(α, β) data processed by NJOY2016,"LA-UR-20-24456	Yes	
Q3	D. Kent Parsons and Cecile Toccoli, "Analytic Insights into the Neutronic Characteristics of Neutron Moderators from MCNP Calculations," LA-UR-20-24442	Yes	
Q3	D. Kent Parsons, Cecile Toccoli, and Jeremy L. Conlin, "Verification of the Re-Released ENDF/B VIII.0 Based Thermal Scattering Libraries," LA-UR-20-24679	Yes	
Q3	J. Alwin, F. Brown, J. Clarity, I. Duhamel, F. Fernex, L. Leal, R. Little, B. J. Marshall, M. Rising, E. Saylor, K. Spencer, "S/U Comparison Study with a Focus on USLs," LA-UR-20-24758	Yes	
Q4	Jennifer L. Alwin, Forrest B. Brown, Matthew J. Lazaric, Benjamin R. Murphy, and Kristina D. Spencer, "Comparison Study of Upper Subcritical	Yes	

	Limits Derived Using Sensitivity/Uncertainty Tools: Case Studies of Benchmarks and Applications," LA-UR-20-28129		
Q4	Timmons, Rising, Perfetti, "Subcritical Multiplication with a Fixed Source", LA-UR-20-25248 (submitted to ANS 2020 Winter Meeting and Nuclear Technology Expo).	Yes	
Q4	F.B. Brown, M.E. Rising, "Verification of MCNP6.3 Pre-release for Nuclear Criticality Safety Applications", in preparation.	No	Report being finalized for release. Will send later in October.

Task Title:

AM1 MCNP Maintenance and Support, Uncertainty Analysis Development, and Modernization

AM2 NJOY Development and Maintenance, Uncertainty Analysis Development, and Modernization

AM4 Sensitivity/Uncertainty Comparison Study with a Focus on Upper Subcritical Limits

AM5 Proposed Benchmark Intercomparison Study

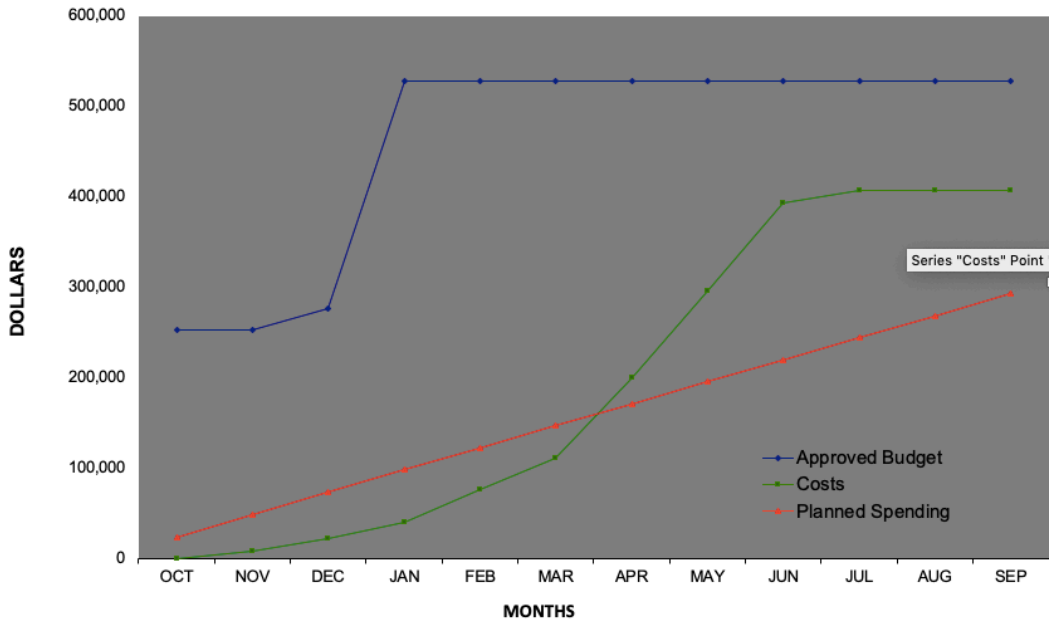
AM7 Incorporation of Benchmark Experiment Correlations into the Whisper Nuclear Criticality Safety Software

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element and Subtasks: AM2, 3, 5, 6, 7, 8
Task Titles: See last page
M&O Contractor Name: Lawrence Livermore National Laboratory
Point of Contact Name: David Heinrichs
Point of Contact Phone: (925) 424-5679

Reference: B&R DP0909010
Date of Report: October 16, 2020

BUDGET



1. **Carryover into FY 2020** = $209,244
2. **Approved FY 2020 Budget** = $528,244 (includes carryover)
3. **Actual spending for 1st Quarter FY 2020** = $21,786
4. **Actual spending for 2nd Quarter FY 2020** = $88,862
5. **Actual spending for 3rd Quarter FY 2020** = $282,901
6. **Actual spending for 4rd Quarter FY 2020** = $14,098
7. **Projected carryover into FY 2021 =** $120,597 (23%) of which $84,428 (16%) are obligated (liens) and $36,168 (7%) are unobligated (available).

MAJOR ACCOMPLISHMENTS

1. Site access request for multiphysics calculations deferred to next period due to delay in completing IER-268 (AM2).
2. Mathieu Duluc provided a draft paper with guidance on "Estimation of the total number of fissions" for review by LLNL and ORNL for incorporation into the Slide Rule (AM3).
3. A total of 2,915 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 Isabelle Duhamel (IRSN) for inclusion in the Benchmark Intercomparison Study (AM5) as follows:

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PU: 766     U233: 193     MIX: 204
HEU: 818    IEU:  188     LEU: 743
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4. Barry Ganapol submitted "Extension of Shmakov's Simple Back and Forth Neutron Transport Model to Multi-Regions" to the International Conference on Mathematics and Computational Methods Applied to Nuclear Science and Engineering (M&C 2021) at Raleigh, NC, April 11-15, 2021 (AM6).
5. The preprint "An Analytic Benchmark for Neutron Boltzman Transport with Downscattering" was provided by Vlad Sobes, Barry Ganapol, etc. LLNL completed data processing in Q2 and COG calculations in Q3 with excellent results. A summary paper was completed in Q4 and is in internal review (AM6).
6. Thermal scattering law (TSL) testing focused on discrepancies noted in the processed File 7 data due to differences in interpolation and extrapolation. To understand these discrepancies, the intercomparison was expanded to include FUDGE, FLASSH, NDEX, NJOY and COG with a special focus on hydrogen in water in advance of Nuclear Data Week in December 2020 (AM8).

NCSP Quarterly Progress Report (FY-2020 Q4)

LLNL AM 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 LLNL AM activities in NCSP Quarterly Progress Reports (AM2, AM3, AM5, AM6, AM7, and AM8).		IRSN to appoint a replacement for Matthieu Duluc to lead AM3
Q2	Provide status on LLNL AM activities in NCSP Quarterly Progress Reports (AM2, AM3, AM5, AM6, AM7, and AM8).		
Q3	Provide status on LLNL AM activities in NCSP Quarterly Progress Reports (AM2, AM3, AM5, AM6, AM7, and AM8).		IRSN to appoint a replacement for Isabelle Duhamel to lead AM5
Q4	Provide status on LLNL AM activities in NCSP Quarterly Progress Reports (AM2, AM3, AM5, AM6, AM7, and AM8).		

Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	Paris, France October 17, 2019 AM, IE, IP&D, ND, TS5 IRSN-LLNL Meeting (Percher, Heinrichs, Kim) Coordinate joint IRSN-LLNL work as described in Appendix E of the Five-Year Execution Plan.	**Yes** (LLNL-MI-796017)	
Q2	**N/A**	**N/A**	
Q3	**N/A**	**N/A**	
Q4	Chiba, Japan May-20 AM, IE Joint International Conference on Supercomputing in Nuclear Applications and Monte Carlo (Kim, Norris) Premier conference on analytical methods and computing.	**N/A**	The conference was cancelled on April 1, 2020 due to COVID-19 and will not be rescheduled.
	Aldermaston, United Kingdom TBD-date AM, IE, I&D, ND, T&E, TS5 JOWOG29/30 Meetings (Coleman, Zywiec) Coordinate joint AWE-LLNL work as described in Appendix F of the Five Year Execution Plan.		

Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	Dave Heinrichs, Soon Kim, Ed Lent, David Griesheimer, Mike Zerkle, "β_{eff} Benchmarks," LLNL-PRES-796197, November 4, 2019	**Yes**	
	Isabelle Duhamel et al., "International Criticality Benchmark Comparison for Nuclear Data Validation," Transactions of the American Nuclear Society: **121**, 873-876, November 2019.	**Yes**	
Q2	Dave Heinrichs, Soon Kim, Ed Lent, "LLNL Analytical Methods Update," LLNL-PRES-804127, February 10, 2020.	**Yes**	
	Tony Nelson, Ed Lent, Dave Heinrichs, "Importance of LLNL's Advanced Fission Physics Modeling (FREYA) in ISSA, A Time-Dependent Benchmark," LLNL-PRES-804222, February 12, 2020.	**Yes**	
Q3	**N/A**		
Q4	**N/A**		

NCSP Quarterly Progress Report (FY-2020 Q4)

Task Titles:

AM2 Multi-Physics Methods for Simulation of Criticality Excursions

AM3 Slide Rule Application

AM5 Proposed Benchmark Intercomparison Study

AM6 Proposed 1-D Multipoint Analytical Benchmark Comparison

AM7 Technical Data for the Pitzer Formulation of Solution Compositions to Include Uranium/Plutonium Solutions with Selected Admixed Absorbers

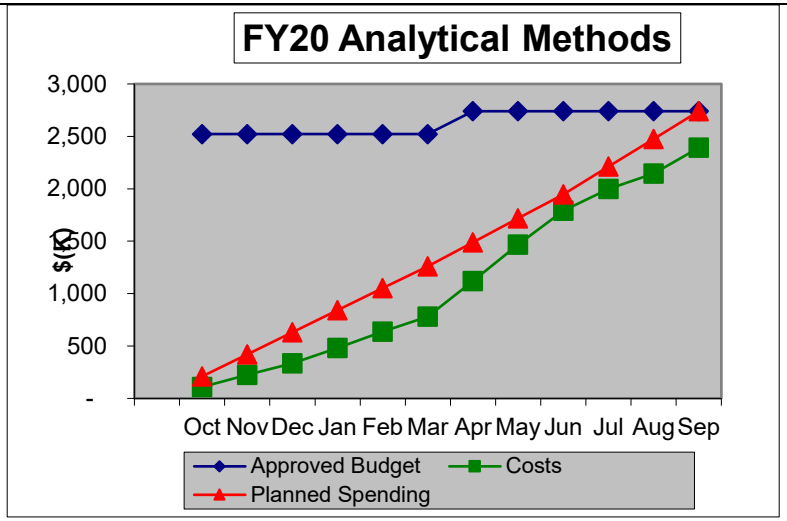
AM8 FUDGE Generation of a Complete ENDF/B-VIII.0 Library for Testing in Production Codes

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element and Subtask: ORNL – AM1, 2, 3, 6, 9, 10, 11, 15, 16, 20
Task Titles: See last page
M&O Contractor Name: ORNL
Point of Contact Name: Doug Bowen
Point of Contact Phone: (865) 576-0315

Reference: DP0909010/ORNL
Date of Report: Oct 2020

BUDGET



1. **Carryover into FY 2020** = $367K
2. **Approved FY 2020 Budget** = $2,522K (includes carryover). Budget increased by $218K to account for additional funds directed to RSICC AM1.
3. **Actual spending for 1st Quarter FY 2020** = $334K
4. **Actual spending for 2nd Quarter FY 2020** = $448K
5. **Actual spending for 3rd Quarter FY 2020** = $1009K
6. **Actual spending for 4rd Quarter FY 2020** = $600K
7. **Projected carryover into FY 2021 =** $349K

MAJOR ACCOMPLISHMENTS

AM1 – Distribution of available and newly packaged software for FY2020 (RSICC) (Valentine)

- Distributed 2897 software packages and updated 2 software packages.
- 572 SCALE, 1185 MCNP®, and 2 COG packages distributed.
- Q4 147 SCALE and 289 MCNP packages distributed
- RSICC quarterly report issued.

AM2 - SCALE/KENO/TSUNAMI Maintenance and Support/Cross-Section Generation/Modernization/etc. (Wieselquist)

- Completion of the following activities
  - Finished CSAS Primers (KENO-V.a and KENO-VI) with paper discussing and revised to be presented at Winter ANS meeting.
  - SCALE 2020 Users' Group with over 150 participants from various organizations including labs, universities, institutes, companies (https://www.ornl.gov/content/2020-scale-users-group-workshop).
  - Finalization of the FY19 annual report.
  - SCALE website updates including references page with links to OSTI documents (https://www.ornl.gov/scale/references).
  - Additions to the criticality validation database (VALID) including the following.
    - HMI-006 (part of ZEUS experiments)
    - LCT-079 and submitted for review (SNL rhodium foil experiments)
    - LMT-001, -002, -015, and HCT-017 were submitted for review. These are all models involving deuterium at the same reactor facility.
    - HSI-001 and HST-004 completed technical review and are ready for finalization. These are simple uranium solution experiments moderated with deuterium.
    - HST-020 and HMF-063 completed technical review and are ready for finalization. These are experiments containing deuterium.
    - Initial models were completed for LCT-093. These are deuterium moderated lattices.
    - Initial models were completed for LMT-003 and IMF-022. LCT-003 is the ZED reactor (Canada) and IMF-022 is an FR0 reactor (Sweden) model.
    - Initial models were completed for HCT-018 and UCT-004. HCT-018 is deuterium-moderated UO2/ThO2 lattices and UCT-004 is deuterium moderated 233U lattices.
- Activities continuing into FY21 Q1 for 6.3.0 release

- WPNCS SG-8 Benchmark rating system efforts piloted by a small group from ORNL, IRSN, and LLNL.
- Deployment of CSAS Primers
- Develop the FY20 annual report
- Finish in-progress and begin additional validation benchmarks to VALID based on FY21 re-prioritization

- SCALE 6.3 beta13 releases with the following updates (level of support from NCSP dependent on task)
  - Infrastructure/Maintenance
    - Implemented more robust, standardized routines across SCALE for random sampling of probability distributions for the Sampler uncertainty propagation code and cumulative distribution functions for the VADER trend analysis program
  - Code/Data Enhancements
    - Improved various cross section shielding methods to handle multi-group physics of systems with hundreds of thousands of TRISO particles with graphite reflection
      - Temperature homogenization scheme was improved (fuel kernels and matrix will be different temperatures)
      - Thermal scattering matrix reconstruction now uses linear interpolation
      - Dancoff factors for fuel grains may be provided for improved accuracy
    - Improved handling of opacity in 3D visualization
    - Improved output echoing of defaults for Shift sequences
    - Improved performance of AMPX data visualization of cross sections when data has many groups (e.g. >1000)
    - Improved VADER trending analysis from internal user feedback including input echo with defaults as well as adding CR6698 and parametric methods
    - Improved TSUNAMI-IP similarity assessment runtime by 50% with new binary (HDF5) formatted sensitivity coefficient data file (SDF)
  - Code/Data Fixes
    - Fixed Sampler's logic to check whether runs completed (and re-run)
    - Refined input checking for the standard composition database (some sync issues resolved with new ENDF/B-VIII compositions)
    - Fixed Fulcrum "save as" for already opened text file

AM3 - AMPX Maintenance and Modernization (Wiarda)

- The conversion of the C++ class that converts GNDS JSON files to python is finished and awaits final reviews and related updates.
- Since we got permission to release AMPX as open-source, we want to release parts of AMPX and SCALE that can be open-sourced. Work continues in identifying and

separating the parts that are necessary for AMPX and are not export controlled. Work is tied to modernization efforts of the build system in SCALE.

- Work was started on improving the thermal scattering processing code Y12 to better handle cold moderator materials and materials with large values of α and *β* found in some S(α, *β*) files. Several causes of differences between AMPX and NJOY were identified, and will be investigated further.
- R-external features were completed (pending ENDF approval of format) and implemented in the new C++ resonance reconstruction code

AM6 – Slide Rule Application (Dupont, Celik)

- IRSN published its findings on the "Fission Yield Estimation in the Critical Solution Systems" in FY20. Mathieu Dupont has been also added to the ORNL team and got familiarized with the objectives and status of the project in FY20. ORNL will either expect more collaboration with the IRSN on the Slide Rule Updates or develop its own milestones in the FY21.
- IRSN sent a document named "Estimation of the total number of fissions" to ORNL for review during Q4. Comments have been made internally in ORNL and calls with David Heinrichs and then IRSN have to be organized.

AM9 - Sensitivity / Uncertainty Comparison Study with a Focus on Upper Subcritical Limits (Saylor, Marshall)

- Nothing to report

AM10 - Proposed Benchmark Intercomparison Study (Saylor, Marshall)

- Nothing to report.

AM11 - Proposed 1D Multipoint Analytical Benchmark Intercomparison (Hart)

- ORNL support has not been needed so funding has been redirected to other tasks. No further updates will be provided for this task in the future.

AM15 - The Effects of Temperature on the Propagation of Nuclear Data Uncertainty in Nuclear Criticality Safety Calculations (MIT, Isaac Meyer, PhD Student)

- Added capability in AMPX that generates tabulated derivatives of the cross section with respect to resonance parameters at 0 K. This data will be needed for generating derivatives at higher temperatures
- Implemented a test case for multigroup cross section covariance generation that uses a single resonance and calls the PUFF-IV routine in AMPX with a temperature argument

AM20 - Nuclear Data and Cross Section Testing using ENDF/B-VIII.0 (Greene)

- All calculations have been completed and an ORNL report has been written; it is currently being reviewed by B. J. for any analysis problems.

	• The report will then be sent to RES for a complete review and subsequent publication as an ORNL report. • The next step is to generate an ANS summer conference paper (2021) and possible journal article in Nuclear Science and Engineering (if applicable).

ORNL AM 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)		
	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, AM3)		
	Provide status on ORNL AM activities in NCSP Quarterly Progress Reports. (AM1, AM2, AM3, AM6, AM9, AM10, AM15, AM16, AM20)		
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)		
	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, AM3)		
	Provide status on ORNL AM activities in NCSP Quarterly Progress Reports. (AM1, AM2, AM3, AM6, AM9, AM10, AM11, AM15, AM16, AM20)		
	Issue an annual SCALE maintenance report to the NCSP Manager. (AM2)		This is behind schedule and will be completed in Q4. The FY19Q4 newsletter and SCALE annual report will be

			delayed due to the focus on completing SCALE 6.2.4 first. Both are in progress.
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)		
	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, AM3)		
	Provide status on ORNL AM activities in NCSP Quarterly Progress Reports. (AM1, AM2, AM3, AM6, AM9, AM10, AM11, AM15, AM16, AM20)		
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)		
	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, AM3)		
	Provide status on ORNL AM activities in NCSP Quarterly Progress Reports. (AM1, AM2, AM3, AM6, AM9, AM10, AM11, AM15, AM16, AM20)		
	Publish annual newsletter to users to communicate software updates, user notices, generic technical advice, and training course announcements. (AM2)		
	Document AMPX modernization and technical support for SCALE CE, multigroup, and covariance libraries and report status annually to the NCSP Manager. (AM3)		ORNL/TM-2020/1755 – NCSP Analytical Methods Subtask 3, AMPX Development and Maintenance, and NCSP Nuclear Data Subtask 6, SAMMY Modernization published in Q4

NCSP Quarterly Progress Report (FY-2020 Q4)

Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	OECD/NEA Paris, France Oct-19 TS1, IE, AM2 ICSBEP and IRPhE Technical Review Meetings (Bowen, Marshall) Provide oversight of NCSP IE tasks as ICSBEP tasks are the end product of the NCSP IE process.	**Yes**	
Q2	Cambridge, England Apr-20 AM2 Attend PHYSOR 2020 meeting of the ANS. (Bowen, Greene) Present papers for ANS subcritical limits and progress on GA Tech NCSP tasks.	**NO**	**TRIP CANCELLED**
Q3	Paris, France TBD – date AM, IE, IP&D, ND1, TS7 IRSN Meetings (Wiarda, Holcomb) Coordinate joint IRSN-ORNL work per 5YP such as the Pu SlideRule; Collaborate with IRSN on the resonance evaluation of the isotopes of lead for the NCSP.	**NO**	**TRIP CANCELLED**
	Geel, Belgium April 2020 ND1 ND Measurements with Zr 90 @ GELINA	**NO**	**TRIP CANCELLED**
Q4	OECD/NEA Paris, France TBD – date TS1, IE, AM2 WPNCS Meetings (Marshall, Bowen, Clarity, Wieselquist) AM collaboration; provide relationship between IAEA and ISO with respect to NCS standards.	**NO**	**Meeting was attended virtually (July 6-10, 2020).**

Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	• Dorothea Wiarda, Andrew Holcomb, Friederike Bostelmann, "Current Status of PX", November 2019	**Yes**	

	• William Wieselquist, Brad Rearden, "Recent Developments in SCALE", November 2019 • B.J. Marshall, "Energy-dependent Bias between ENDF/B-VII.1 and ENDF/B-VIII.0 for LCT Benchmarks, CSEWG, November 2019 • B.J. Marshall, "Energy-dependent Bias between ENDF/B-VII.1 and ENDF/B-VIII.0 for LCT Benchmarks, ANS, November 2019 • W.J. Marshall, "Bias between ENDF/B-VIII.0 and ENDF/B=VII.1 for LEU Pin Array System"		
Q2	None		
Q3	• M. N. Dupont and E. M. Saylor, "Evaluation of Oak Ridge National Laboratory Health Physics Research Reactor Operation Data for Criticality Accident Alarm System Benchmark Creation," June 2020. • SCALE Newletter, https://www.ornl.gov/file/spring-2020-scale-newsletter/display		
Q4			

Task Titles:

AM1 Radiation Safety Information Computational Center (RSICC)

AM2 SCALE/KENO/TSUNAMI Maintenance and Support/Cross-Section and Generation/Modernization

AM3 AMPX Maintenance and Modernization

AM6 Slide Rule Application

AM9 Sensitivity/Uncertainty Comparison Study with a Focus on Upper Subcritical Limits

AM10 Proposed Benchmark Intercomparison Study

AM11 Proposed 1-D Multipoint Analytical Benchmark Intercomparison

AM15 The Effects of Temperature on the Propagation of Nuclear Data Uncertainty in Nuclear Criticality Safety Calculations

AM16 Technical Data for the Pitzer Formulation of Solution Compositions to Include Uranium/Plutonium Solutions with Selected Admixed Absorbers

AM20 Nuclear Data and Cross Section Testing Using ENDF/B-VIII.0

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element and Subtasks: IPD1, 2, 4, 5, 6

Task Titles:

IPD1-Conduct ICSBEP for Benchmarks listed in Appendix C of the 5-Year Plan and publish annual revision to the Handbook
IPD2-Maintain the NCSP Website and Systems
IPD4-Benchmark Evaluation of Hot Box, LLNL Historical Critical Configurations at High Temperature
IPD5-IT Support at NNSS
IPD6-Benchmark Evaluation of LLNL 'Pulsed Spheres'

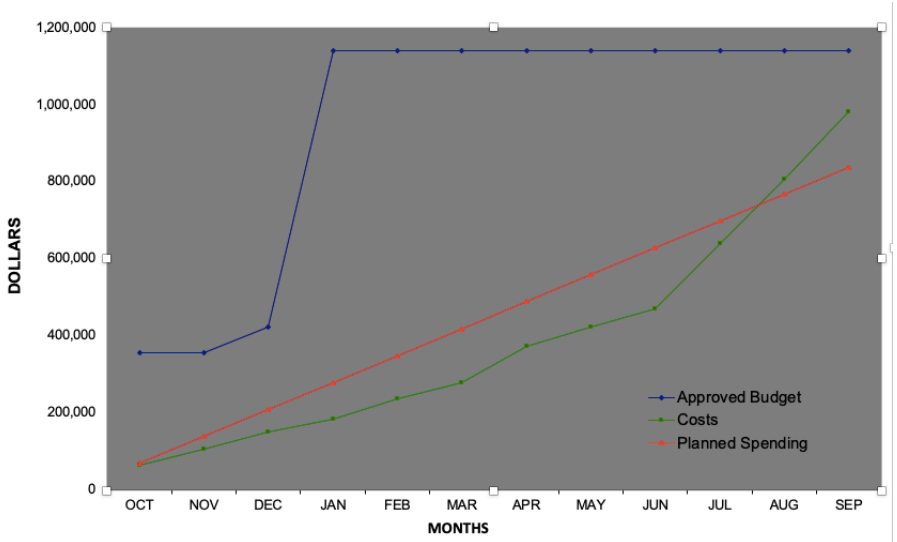
M&O Contractor Name: Lawrence Livermore National Laboratory

Point of Contact Name: David Heinrichs

Point of Contact Phone: (925) 424-5679

Reference: B&R DP0909010
Date of Report: October 16, 2020

BUDGET



1. **Carryover into FY 2020** = $230,063
2. **Approved FY 2020 Budget** = $1,141,063 (includes carryover)
3. **Actual spending for 1st Quarter FY 2020** = $147,416
4. **Actual spending for 2nd Quarter FY 2020** = $131,454
5. **Actual spending for 3rd Quarter FY 2020** = $184,122
6. **Actual spending for 4rd Quarter FY 2020** = $518,129
7. **Projected carryover into FY 2021 =** $159,942 (14%) of which $26,365 (2%) are obligated (liens) and $133,577 (12%) are unobligated (available).

MAJOR ACCOMPLISHMENTS

1. ICSBEP (IPD1)
- NCSP evaluations in preparation for the October 19-23, 2020 meeting include:
  (a) **IER-230**, LCT102, 7uPCX with pitch variations, Ames (SNL)
  (b) **IER-299**, HMF101, KRUSTY cold/warm criticals, Hutchinson (LANL)
  (c) **IER-192**, HMT004, Class foils with Lucite (LANL/JSI)
  (d) **IER-528**, PMM003, TEX-Pu-Ta, Percher (LLNL)
- Non-NCSP evaluations in preparation include:
  (d) MIRTE-2 , LCT106 (IRSN)
  (e) JUPITER, HEU/Pb, PMF047'and LEU/Pb, MMF016 (JAEA, LANL)
  (f) LR(0)-VVER-CRIT-005, VVER-1000 LEU Assemblies in Water with Void, SiO2 or Center Modules (Košt'ál, Czech Rep.)
- The 2019 edition of the Handbook should be available in November 2020.

2. Website and Systems (IPD2)

Provided NCSP website updates as requested by NCSP Management including:
- Maintained the site, updating documents and the calendar
- Updated training course information
- CSSG tasking and responses
- Added and updated foreign trip reports

3. IT Support at NNSS (IPD5)

Maintained NTS-SLAN and performed essential maintenance, software updates, and continuous monitoring and authenticated scans of NCERC network devices. Supporting NCERC Controls Upgrade Project as IT and Networking SME. Resolved network issues allowing NCERC detectors to operate on LANL Yellow enabling unattended operations from High Bays to Control Room. Received approval for iSRD testing in DAF. Replacement/new laptops for NCERC staff.

4. Benchmark Evaluation of LLNL 'Pulsed Spheres' (IPD6)

This quarter was focused on benchmark selection and commencing to write the evaluation focusing on the NE-213 scintillator (with 0.8 MeV bias), the "blank run", and one of the corresponding spheres (i.e., CH_2 1.8, LiD 3.0, Be 0.8, Cu 1.0, Sn 1.0, Ta 3.0, or Th 1.0 mfp).

NCSP Quarterly Progress Report (FY-2020 Q4)

LLNL IP&D 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 ensure the finalizing and publishing ICSBEP evaluations per IE schedule. (IPD1)		
	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)		
	Maintain, operate and modernize he NCSP website, databases, and provide user assistance as required. (IPD2).		
	Provide a status report for the evaluation of the LLNL "Hot Box" for inclusion in the ICSBEP Handbook. (IPD4)		
	Provide status report on progress on IT support at NNSS, and the benchmark evaluation of LLNL 'Pulsed Spheres.' (IPD5, IPD6).		
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)		
	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)		WPEC SG47 on SINBAD will occur on Tuesday, May 12, 2020, via WebEx only.
	Maintain, operate and modernize he NCSP website, databases, and provide user assistance as required. (IPD2)		

	Provide a status report for the evaluation of the LLNL "Hot Box" for inclusion in the ICSBEP Handbook. (IPD4)		
	Provide status report on progress on IT support at NNSS and the benchmark evaluation of LLNL 'Pulsed Spheres.' (IPD5, IPD6).		NTS-SLAN shut down on March 26, 2020, in response to cessation of programmatic work due to COVID-19 concerns.
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)		IER-184 (TEX Pu Baselines) and IER-209 (7uPCX with variable water height) completed CED-4b and will appear in the 2020 edition of ICSBEP Handbook.
	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)		Four NCSP evaluations in preparation for the October 19-23, 2020 ICSBEP meeting. The ICSBEP meeting will likely be convened on-line in October. The IRPhE and SINBAD meetings may be delayed until 2021.
	Maintain, operate and modernize he NCSP website, databases, and provide user assistance as required. (IPD2)		
	Provide a status report for the evaluation of the LLNL "Hot Box" for inclusion in the ICSBEP Handbook. (IPD4)		
	Provide status report on progress on IT support at NNSS, and the benchmark evaluation of LLNL 'Pulsed Spheres.' (IPD5, IPD6).		
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)		2019 edition of the ICSBEP Handbook (DVD) available for distribution in November 2020 per OECD NEA.
	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)		ICSBEP TRG (virtual) meeting scheduled for October 19-23, 2020.
	Maintain, operate and modernize he NCSP website, databases, and provide user assistance as required. (IPD2)		
	Provide a status report for the evaluation of the LLNL "Hot Box" for inclusion in the ICSBEP Handbook. (IPD4)		On hold until after 2020 ICSBEP TRG Meeting.
	Provide status report on progress on IT support at NNSS, and the benchmark evaluation of LLNL 'Pulsed Spheres.' (IPD5, IPD6).		

NCSP Quarterly Progress Report (FY-2020 Q4)

Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	Paris, France October 21-25, 2019 AM, IE, IP&D, ND, TS5 ICSBEP, IRPhE, and SINBAD Technical Review Meetings (Heinrichs, Kim, Percher) Conduct ICSBEP for benchmarks listed in Appendix C of the Five-Year Execution Plan.	**Yes** (LLNL-MI-796017)	
Q2	**N/A**		
Q3	**N/A**		
Q4	OECD/NEA Paris, France Jun-20 IPD1 TS5 WPNCS Meeting (Percher, Scorby) Participate in activities of the Working Party on Nuclear Criticality Safety and expert group meetings on MC methods and excursion analyses.		

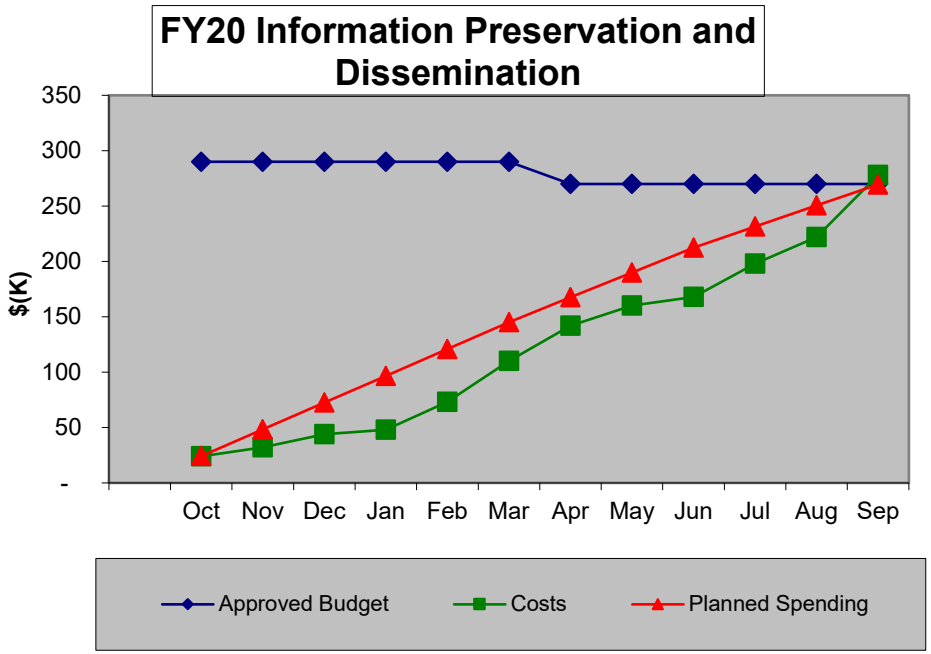
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	Catherine Percher, Jesse Norris, "PU-MET-MIX-002: TEX Plutonium Baseline Assemblies: Plutonium/ Aluminum Metal Alloy Plates with Varying Thicknesses of Polyethylene Modera-tor and a Thin Polyethylene Reflector", LLNL-TR-785164-DRAFT, October 19, 2019	**No**	Final report to be uploaded into IER-184 C_EdT webpage.
Q2	**N/A**		
Q3	**N/A**		
Q4	**N/A**		

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element and Subtask: ORNL – IPD5, 7
Task Titles:
IPD5-Oak Ridge Health Physics Research Reactor CAAS Benchmark Evaluation
IPD7- Preserving the "Howard Dyer" Library at ORNL
M&O Contractor Name: ORNL
Point of Contact Name: Doug Bowen
Point of Contact Phone: (865) 576-0315

Reference: DP0909010/ORNL
Date of Report: Oct 2020

BUDGET



1. **Carryover into FY 2020** = $15K
2. **Approved FY 2020 Budget** = $290K (includes carryover) (Budget decreased by $20K in Q2 to account for funds transferred to RSICC)
3. **Actual spending for 1st Quarter FY 2020** = $44K
4. **Actual spending for 2nd Quarter FY 2020** = $66K
5. **Actual spending for 3rd Quarter FY 2020** = $58K
6. **Actual spending for 4th Quarter FY 2020** = $110K
7. **Projected carryover into FY 2021** = **–$16K**

MAJOR ACCOMPLISHMENTS

IPD 5 – Oak Ridge Health Physics Research Reactor CAAS Benchmark Evaluation (Dupont)

- The HPRR benchmark report has been completed and is currently under internal review. It will be on time for publication to NCSP mid-October. Benchmark model and uncertainties are thoroughly described in the report.

IPD 7 - Preserving the "Howard Dyer" Library at ORNL (Saylor)

- Library has been scanned
- In progress of checking library against index for any missing documents

NCSP Quarterly Progress Report (FY-2020 Q4)

ORNL IPD Milestones:

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

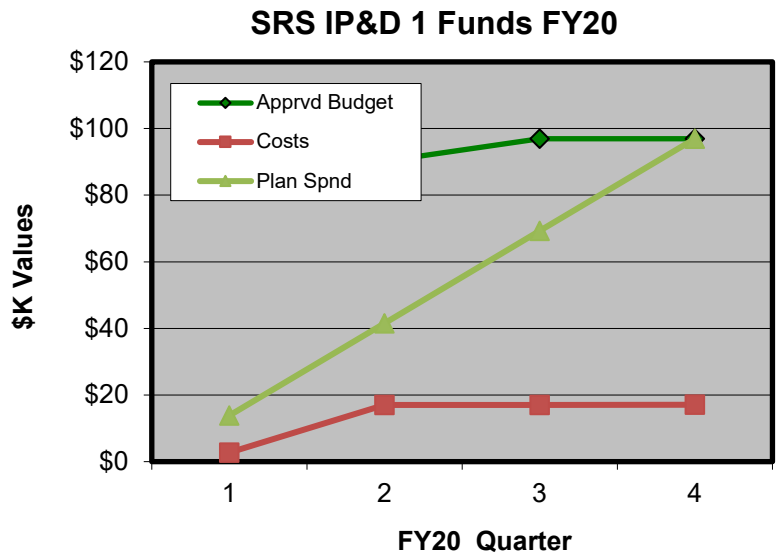
Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	Provide a status report on progress made on IPD tasks. (IPD5, IPD7)		
Q2	Provide a status report on progress made on IPD tasks. (IPD5, IPD7)		
Q3	Provide a status report on progress made on IPD tasks. (IPD5, IPD7)		
Q4	Provide a status report on progress made on IPD tasks. (IPD5, IPD7)		

NCSP Quarterly Progress Report (FY-2020 Q4)

Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4	**N/A**		
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	• M. N. Dupont and E. M. Saylor, "Evaluation of Oak Ridge National Laboratory Health Physics Research Reactor Operation Data for Criticality Accident Alarm System Benchmark Creation," June 2020.	**YES**	
Q4	**N/A**		

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element and Subtask: SRS IPD1 **Task Title:** ARH-600 Reissue **M&O Contractor Name(s):** SRNS **Point of Contact Name:** David Erickson **Point of Contact Phone:** 803-557-9445	**Reference: B&R DP 0909010** **Date of Report: October 15, 2020**
BUDGET	**MAJOR ACCOMPLISHMENTS**
 1. **Carryover into FY 2020** = $48.9K 2. **Approved FY 2020 Budget** = $96.9K (includes carryover) 3. **Actual spending for 1st Quarter FY 2020** = $2.7K 4. **Actual spending for 2nd Quarter FY 2020** = $14.3K 5. **Actual spending for 3rd Quarter FY 2020** = $0.0K 6. **Actual spending for 4rd Quarter FY 2020** = $0.0K 7. **Projected carryover into FY 2021** = $79.8K	Updated CritView package was released to NCSP for inclusion on Website. Awaiting user feedback. Will be developing scope and milestones for FY21. Will provide to NCSP Manager for approval.

NCSP Quarterly Progress Report (FY-2020 Q4)

SRS IP&D 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)		
Q2	Provide status reports on SRS progress with CritView. (IPD1)		
	Develop QA documents for current version to meet current SRS/DOE requirements. (IPD1)		
Q3	Provide status reports on SRS progress with CritView. (IPD1)		
Q4	Provide status reports on SRS progress with CritView. (IPD1)		
	Issue Preliminary (updated) CritView version for internal testing. (IPD1)		
	Issue Preliminary User Guide to support internal testing. (IPD1		

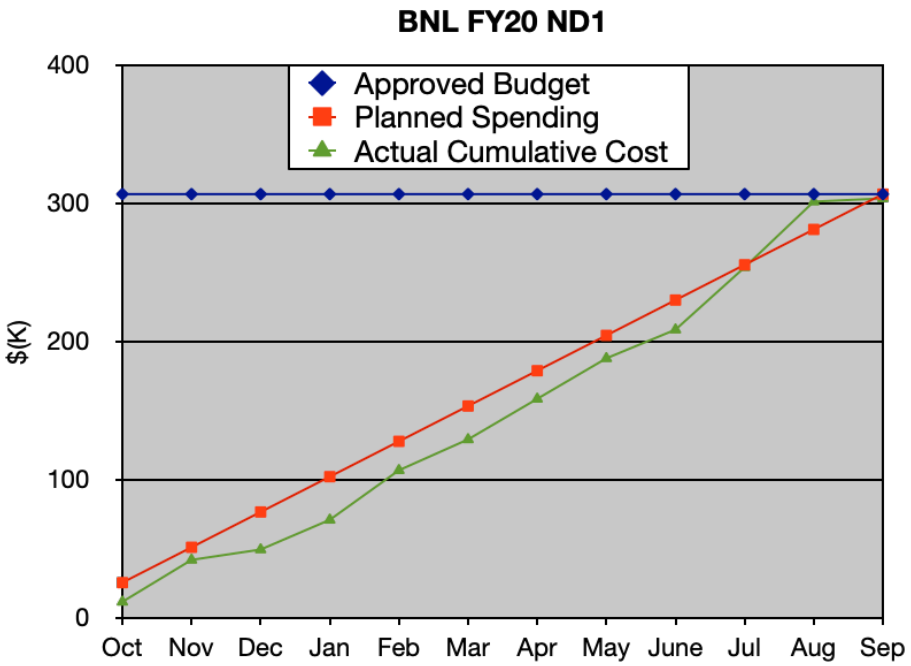
NCSP Quarterly Progress Report (FY-2020 Q4)

Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4	**N/A**		
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element and Subtask: Nuclear Data ND1 Task Title: National Nuclear Data Center (NNDC) Support to the NCSP M&O Contractor Name: BNL Point of Contact Name: David Brown Point of Contact Phone: 631-344-2814	Reference: DP 0902000 Date of Report: Oct. 15, 2020

BUDGET



1. **Carryover into FY 2020** = $35,688
2. **Approved FY 2020 Budget** = $306,688
3. **Actual spending for 1st Quarter FY 2020** = $49,500
4. **Actual spending for 2nd Quarter FY 2020** = $79,698
5. **Actual spending for 3rd Quarter FY 2020** = $79,413
6. **Actual spending for 4rd Quarter FY 2020** = $94,973
7. **Projected carryover into FY 2021 =** $3,104

MAJOR ACCOMPLISHMENTS

In Q3, we reported that all ENDF projects (source code, trackers, etc.) have been moved to git.nndc.bnl.gov. ADVANCE and git.nndc.bnl.gov are communicating and GitLab is triggering builds on ADVANCE which are being posted on the NNDC website. We have begun adding CSEWG member user accounts and there are now 21 CSEWG members with activate accounts that belong to the ENDF projects.

In Q3 we also reported that we are actively adding new and revised evaluations and are clearing the backlog of evaluation. NCSP Dy evaluations have been checked and formatting errors corrected. NCSU & NNL thermal scattering law data submitted since the ENDF/B-VIII.0 release has been checked. RPI thermal scattering data is still queued for addition.

This situation is unchanged in Q4.

NCSP Quarterly Progress Report (FY-2020 Q4)

BNL ND Milestones:

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

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	MILESTONE	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)		With the new ADVANCE/GitLab system, we are revising how we will review new evaluation. More information will become available as we figure out the proper review criteria for new/revised evaluations.
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)		
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)		We are piloting a peer review system for checking evaluations before they are merged into the Phase 2 branch for validation by the CSEWG Validation Committee using decay data and charged particle data. Neutron data, being more complex, will follow.
	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)		Work stalled temporarily while we adjust to major changes in FUDGE's distribution and installation.

NCSP Quarterly Progress Report (FY-2020 Q4)

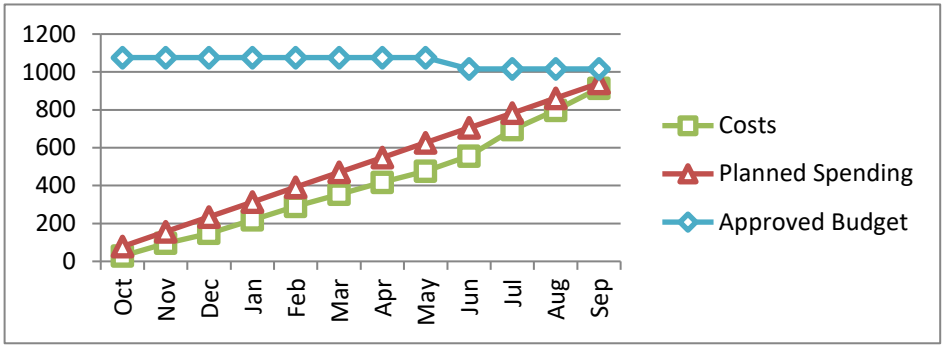
Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**	**no**	
Q2	**N/A**	**no**	
Q3	**N/A**	**no**	
Q4	**N/A**	**no**	
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**	No	
Q2		**no**	
Q3		**no**	
Q4			

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element and Subtask: ND1, 2, 3
Task Title:
ND1: Nuclear Data Evaluation and Testing
ND2: Prompt Fission Neutron Spectra (PFNS) Measurement of Plutonium-240
ND3: Unresolved and Fast Measurements of Uraunium-233 (n,gamma)
M&O Contractor Name: LANL
Point of Contact Name: Joetta Goda / Bob Little
Point of Contact Phone: 505-667-2812 / 505-665-3487

Reference: DP0902000
Date of Report: October 14, 2020

BUDGET



1. **Carryover into FY 2020 = $0**
2. **Approved FY 2020 Budget = $1,076,000 (includes carryover); $60,000 transferred to Livermore in June**
3. **Actual spending for 1st Quarter FY 2020 = $147,361**
4. **Actual spending for 2nd Quarter FY 2020 = $206,073**
5. **Actual spending for 3rd Quarter FY 2020 = $202,295**
6. **Actual spending for 4rd Quarter FY 2020 = $358,141 (total = $913,870)**
7. **Projected carryover into FY 2021 = $76,000**

MAJOR ACCOMPLISHMENTS

ND-1 Nuclear Data Evaluation and Testing

- Progress on Be-9 evaluation:
  - Culled data for the (n,n), (n,n'), (n,a), (n,2n), and (n,t) reactions on ^{9}Be from EXFOR/CSIRS and converted them to EDA format using the Perl5 LANL-EDA5 conversion code ('c5toeda')
  - Performed a new R-matrix analysis of reactions in the ^{10}Be system using the data collected above, plus lower-energy data already existing in the analysis. This new analysis accounts well for all the integrated cross sections at energies below 14 MeV, as well as for the angular distributions at energies up to at least 5 MeV (see figures below). Several level assignments in the MeV region changed as a result of the analysis.
  - Used the R-matrix analysis above to produce a new evaluation for neutrons on ^{9}Be. This evaluation gives, for the first time, elastic scattering angular distributions in File-6 that are unitarily consistent with the integrated cross sections in File-3. We are testing the new evaluation against integral data both locally and at RPI before submitting the evaluation to the NNDC.

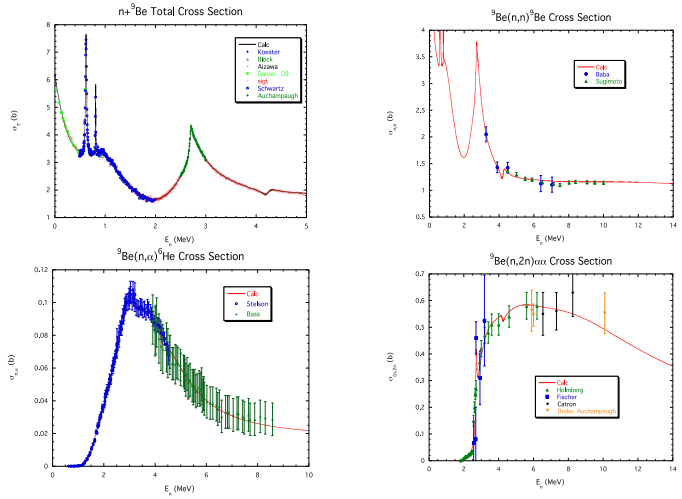


Figure 2:Integrated cross sections for the n+9Be reactions from the new 10Be R-matrix analysis: upper left, total cross section; upper right, elastic cross section; lower left (n,a), cross section; lower right, (n,2n) cross section) cross section;

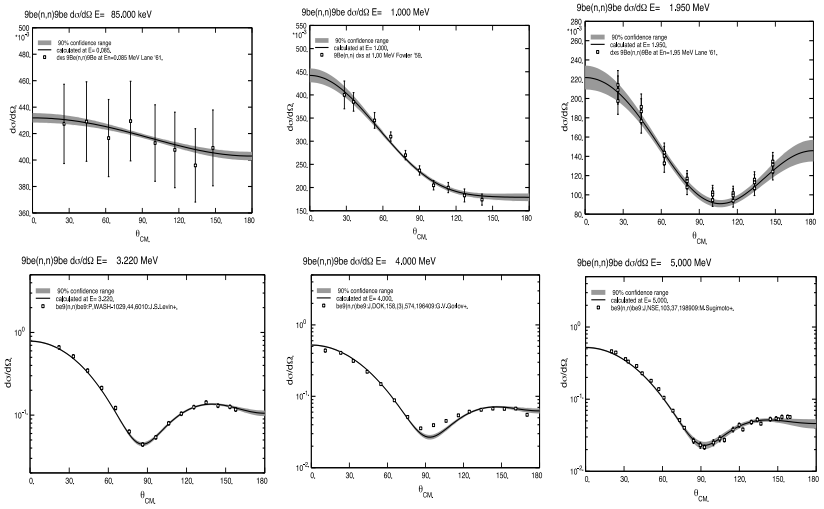


Figure 1: Differential n+9Be elastic scattering cross sections at energies up to 5 MeV.

- Evaluations of U234 and U236:
  - 236U: While the charge was to evaluate only the capture channel based on the DANCE data, we have additionally extended the evaluation to include modeling all the other channels using CoH. We have kept the fission cross section as in ENDF/B-VIII.0, and readjusted CoH parameters so that we exactly reproduce the ENDF/B-VIII.0 evaluation. For all the other channels, we have used CoH calculations, which are in particular good agreement with DANCE capture data. The covariance for capture has been updated based on a Bayesian analysis to reflect the DANCE uncertainties. We have also updated the covariances and uncertainties in all relevant channels, including fission, where we have scaled the uncertainties following WNR data by Tovesson. Finally, until we improve the PFNS model in CoH, we have imported the PFNS and its covariance from JENDL-4, which replaces the unrealistic ENDF/B-VIII.0 MF=5/MT=18 section. The new file has been submitted to NNDC for further scrutiny and a summary of the evaluation will be presented at the CSEWG meeting in November-December.
  - 234U: As in the case of 236U, we have not only re-evaluated the capture channel, but also all other open channels. In particular, we have re-evaluated the fission cross section to include measurements by Tovesson at WNR. Like for 236U, we have adjusted parameters in CoH to the newly evaluated cross sections, and have evaluated all the other channels based on CoH calculations in the fast region. The goal was to update the fission cross section based on input from DANCE data. However, the final analysis of the experimental data has not been completed, so that we have at the moment only a relatively good agreement of our evaluation with the preliminary data. This is not necessarily surprising, as the CoH parameters have been already been calibrated using 236U(n,g) and 238U(n,g) data taken by DANCE. We should point out that the DANCE data points to some required changes in the resonance region, but a final resonance parameter analysis has not been yet performed. In Fig. 3, we show a comparison between the capture cross section, the new evaluation, and the data by DANCE (M. Jandel). We have excellent agreement with the early results of the analysis from DANCE, but the latest data are systematically lower. Because we were told to expect a 30% uncertainty on the latest results, we have evaluated the capture data based on the initial DANCE results (June 2020). The early uncertainties have been used to evaluate the capture uncertainties based on a Bayesian analysis. As in the case of 236U, until we improve the PFNS model in CoH, we have imported the PFNS and its covariance from JENDL-4, which

replaces the unrealistic ENDF/B-VIII.0 MF=5/MT=18 section. Finally, we have updated the covariances and uncertainties in all relevant channels, including fission, where we have scaled the uncertainties following WNR data by Tovesson. The new file has been submitted to NNDC for further scrutiny and a summary of the evaluation will be presented at the CSEWG meeting in November-December.

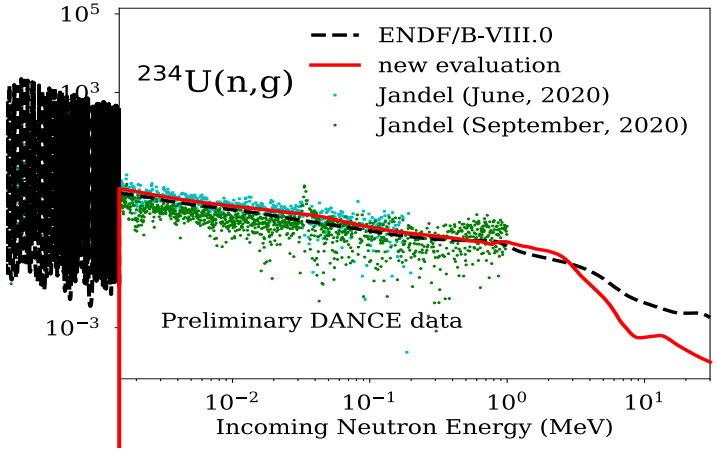


Figure 3: Comparison of ENDF/B-VIII.0 and the new evaluated cross section compared with the preliminary DANCE data.

- A final report ("End-report of the "Nuclear Data Machine Learning" Team to the ASC-ATDM-ML Funding Source," by Denise Neudecker et al.) was prepared for a 2-year LANL project focused on using machine learning to improve nuclear data. The team showed that ML techniques can be used to significantly improve our capability to evaluate and validate nuclear data compared to traditional techniques used in the field. This work was the result of a multi-program effort, which was initiated in FY18 with NCSP funding. The final 400+ page report includes a summary plus 12 publications / reports that resulted from the work Highlights of recent work on this project funded by NCSP are:
  - Newly developed FAUST system was used to analyze Pu benchmarks in terms of their sensitivities to nuclear data. The goal of this analysis was to (i) identify materials and reactions that play major role and could be responsible for difference between benchmarks and calculated results, (ii) point to possible compensation of errors, (iii) find out leeway for eventual modification of nuclear data that have potential to improve overall performance, (iv) identify problematic benchmarks.

- Three methods were employed: (i) analysis of integrated sensitivities, (ii) impact of changes in the specific reaction cross sections to the full set of benchmarks (including non-plutonium ones), and (iii) analysis of dis-similarities for similar experiments. Main results are:
  - Most sensitive non-actinides: H1, O16, H-H2O, Be9, Fe56 others: N14, Cu63, Cu65, Ni58, Gd157 (sensitivity analysis).
  - Neutron sources U235, Pu239 seem to be just fine (impact analysis).
  - Pu239 elastic could be reduced by 7-9% (sensitivity and impact analysis)
  - Pu239 inelastic may benefit from reduction up to 10% leading to 200 pcm improvement in overall bias (impact analysis).
  - Pu240 fission (neutron source) reduction by 8% reduces overall bias and standard deviation (impact analysis).
  - Be9 indication by sensitivity profiles for Pu benchmarks to increase elastic by ~1% (or (n,2n) by several percent). This, however, is not confirmed by the impact analysis on all benchmarks.
- This has been the first systematic attempt to analyze the LANL set of ~1000 benchmarks using capabilities of FAUST. The shortcomings of the present analysis (no angular distributions, no spectra, disregarding benchmark uncertainties and nuclear data covariances, …) will be gradually eliminated in further studies. Also, potentially very powerful, dis-similarity analysis will have to be developed. For the time being, it seems that calculated differences between very similar benchmarks can be predicted using sensitivity profiles without resorting to lengthy transport calculations.

- We completed a Q4 Appendix B milestone titled "Finalize a report assessing our methodology to evaluate PFNS and multiplicity consistently, including angular information about prompt neutrons." A report was issued: A.E. Lovell, D. Neudecker, P. Talou, I. Stetcu, M.J. Grosskopf, T. Kawano, "Consistent Evaluation of the Prompt-Fission Neutron Spectrum and Multiplicity for $n+^{235;238}U$ and $n+^{239}Pu$," LA-UR-20-26932. This comprehensive report includes the following:
  - Sensitivity studies with CGMF, focusing on the average neutron energy and nubar
  - Overview of available experimental data for nubar, average neutron energy, and PFNS

- Comparison between data, ENDF/B-VIII.0, and CGMF for nubar, average neutron energy, and PFNS

ND-2 Prompt fission neutron spectra (PFNS) measurement of Pu-240

- We have the Pu-240 PFNS measurements on the LANSCE 2021 schedule.
- At LLNL, the 240Pu has been delivered from the National Isotope Development Center at ORNL, the fission chamber (PPAC) assembly has been procured and vacuum tested. The electroplating apparatus needed for the preparation of the 240Pu foils has also been procured and assembled, and electroplating is expected to begin soon.

ND-3 Unresolved and fast measurements of U-233(n,g)

- A new measurement of the ^{233}U(n,g) cross section using the DANCE detector combined with NEUANCE has been scheduled for beamtime from 11/19/2020 to 12/21/2020. DANCE is used to detect the gammas coming from capture reactions while NEUANCE will be used to detect neutrons coming from fission in order to determine by coincidence the gammas coming from fission and subtract them from the analysis. In FY20 Q4, the purchase order was issued to the National Isotope Development Center for the ^{233}U for the fabrication of a sample for measurement. Target fabrication by stippling will be done by Evelyn Bond in C-NR in Q1 FY21. This thick ^{233}U target will be used in order to achieve high statistics. In Q4, test operation of the NEUANCE detector was begun to ensure reliable operation, including testing all the channels and setting the HV. This work has been somewhat more time consuming than normal due to COVID procedures and work restrictions, but is still in a position to be complete in time for November measurements. The schedule is tight to accomplish first measurements during Q1 but assuming no unanticipated delays, it is possible.

NCSP Quarterly Progress Report (FY-2020 Q4)

LANL ND Milestones:

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

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	MILESTONE	STATUS	COMMENTS
Q1	Provide status reports on LANL participation in US and International Nuclear Data collaborations. (ND1)		
	Conduct CSEWG Data Evaluation Committee session. (ND1)		
	Report data testing results with ENDF/B-VIII.0 and additional beta release cross sections. (ND1)		
Q2	Provide status reports on LANL participation in US and International Nuclear Data collaborations. (ND1)		
Q3	Provide status reports on LANL participation in US and International Nuclear Data collaborations. (ND1)		
	Complete review of previous "thin" target U233 measurements and finalize specifications for new "thick" U233 target. (ND3)		
Q4	Provide status reports on LANL participation in US and International Nuclear Data collaborations. (ND1)		
	Acquire Pu240 PPAC target (ND2)		**In progress at LLNL. No delay in experiment anticipated.**
	Deliver nuclear data evaluations as indicated in Appendix B of this document. (ND1)		

NCSP Quarterly Progress Report (FY-2020 Q4)

Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	OECD/NEA Paris, France TBD-date ND1 The NEA/WPEC Subgroup 38 is developing a modern nuclear database (XML) structure. (Paris) Contributor to multiple sub-groups-Paris co-leads SG38.	No	Virtual Meeting Only
	OECD/NEA Paris, France TBD-date ND1 The NEA/WPEC Subgroup 45 is "Validation of Nuclear Data Libraries (VaNDaL) Project." (Herman) Contributor to multiple sub-groups-Herman co-leads SG45.	No	Virtual Meeting Only
	OECD/NEA Paris, France TBD-date ND1 The NEA/WPEC Subgroup 46 is "Efficient and Effective Use of Integral Experiments for Nuclear Data Validation." (Herman) Contributor to multiple sub-groups-Herman co-leads SG46.	No	Virtual Meeting Only
Q4	**N/A**		

Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	Bob Little, "LANL ND-1," (TPR)	Yes	Already posted on NCSP / TPR Web Page
Q2	Denise Neudecker et al., "Identifying Questionable ICSBEP Benchmark Data and Underestimated Uncertainties Using Machine Learning Methods," (TPR)	Yes	Already posted on NCSP / TPR Web Page
Q2	Mark Paris and Gerry Hale, "R-matrix code capabilities and modernization," (TPR)	Yes	Already posted on NCSP / TPR Web Page
Q2	Paul Koehler, "DICER (Device for Indirect Capture Experiments on Radionuclides) Instrument," (NDWG)	Yes	NDWG presentations were collected during TPR
Q2	Mark Paris, "R-matrix evaluation of ^{10}Be (n+^{9}Be) system," (NDWG)	Yes	NDWG presentations were collected during TPR
Q2	Denise Neudecker, "Nuclear Data Validation Using ICSBEP Benchmarks and Machine Learning," (NDWG)	Yes	NDWG presentations were collected during TPR

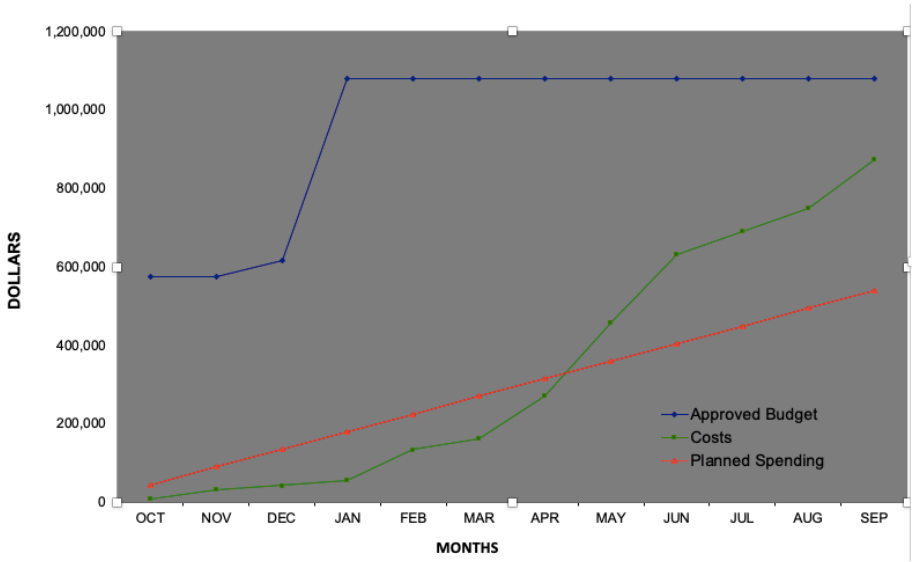
Q2	Michael Rising, "Update on subcritical benchmarks, validation, and simulations," (NDWG)	Yes	NDWG presentations were collected during TPR
Q2	Wim Haeck, "FAUST Benchmark and Validation Framework," (NDWG)	Yes	NDWG presentations were collected during TPR
Q3	E. Leal Cidoncha and A. Couture, "Report to NCSP on 2008 DANCE Measurements of ^{233}U(n,g)"	Yes	Waiting for LA-UR. Will submit early in Q4. Submitted.
Q4	D. Neudecker, M.J. Grosskopf, A. Clark, P. Grechanuk, W. Haeck, M.W. Herman, M.E. Rising, S.A.Vander Wiel, and B.Whewell, "End-report of the 'Nuclear Data Machine Learning' Team to the ASC-ATDM-ML Funding Source"	Yes	
Q4	A.E. Lovell, D. Neudecker, P. Talou, I. Stetcu, M.J. Grosskopf, T. Kawano, "Consistent Evaluation of the Prompt-Fission Neutron Spectrum and Multiplicity for n+$^{235;238}$U and n+^{239}Pu," LA-UR-20-26932	Yes	

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element and Subtask: ND1, 2, 3, 5, 6, 7
Task Titles: See last page
M&O Contractor Name: Lawrence Livermore National Laboratory
Point of Contact Name: David Heinrichs
Point of Contact Phone: (925) 424-5679

Reference: B&R DP0909010
Date of Report: October 16, 2020

BUDGET



1. **Carryover into FY 2020** = $494,744
2. **Approved FY 2020 Budget** = $1,080,744 (includes carryover)
3. **Actual spending for 1st Quarter FY 2020** = $42,353
4. **Actual spending for 2nd Quarter FY 2020** = $120,734
5. **Actual spending for 3rd Quarter FY 2020** = $468,943
6. **Actual spending for 4rd Quarter FY 2020** = $240,457
7. **Projected carryover into FY 2021 =** $208,257 (19%) of which $195,747 (18%) is obligated (liens) and $12,510 (1%) is unobligated (available).

MAJOR ACCOMPLISHMENTS

1. NCSU continued the evaluation and quality assurance of thermal neutron scattering law (TSL) data libraries. This includes work on hydrofluoric acid (HF), where TSL libraries were produced at temperatures in the range of 343-383 K. This temperature range was covered by the experiments reported in HEU-SOL-THERM-039, (2001). In addition, expanded libraries were generated for polyethylene that cover cryogenic temperatures as low as 15K. To enable this extension to cryogenic temperatures, numerical modifications were made and implemented in the NCSU *FLASSH* code. The generated TSL libraries are currently in the process of being transferred to NNDC. (ND2)
2. NCSU continued the development of the *FLASSH* code with improved capabilities. Upgrades have focused on providing accurate cross section data. Beginning with the evaluation of the TSL, the numerical methods implemented in the evaluation were improved allowing for calculations with finer precision and a larger range of energy space. This allowed the calculations to extend to cryogenic temperatures while still capturing the full energy exchange space accurately. In addition, the work was completed on reformatting the TSL and improving TSL integration to cross sections to support the implementation of ACE output from *FLASSH* for use in various neutronic codes. (ND3)
3. NCSU continued work on the TSL formulation for implementation in Doppler broadening. Using generalized treatment for the Debye-Waller matrix and lattice symmetry, a self TSL formulation was tested for the impact of non-cubic symmetry on the inelastic component of the cross section. Currently, *FLASSH* modules are implemented to provide the combined non-cubic parameters. Different components are under testing where the Debye-Waller term is implemented through the inelastic range. The impact of up-scattering is significant to the generalized treatment as it drives the cross section at the lowest energies. As free atom behavior is approached, the impact of structure drops which contributes to the shape of the down-scattering cross section. (ND5)
4. LLNL initiated procurements and the chamber, target frames and thin metal foils have arrived. Mounting the metal foils to the target frames has been completed and are ready for electroplating. The chamber was successfully tested for vacuum integrity. Conversions of IWSs to WCDs also completed.

NCSP Quarterly Progress Report (FY-2020 Q4)

LLNL ND 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 LLNL/NCSU nuclear data activities to NCSP Manager (ND1 {subtask 1 and 2}, ND2, ND3, ND5, ND6, ND7)		Costs include actual (LLNL) and estimated (NCSU) expenditures as LLNL has yet to receive invoices for Q1 from NCSU.
Q2	Provide status on LLNL/NCSU nuclear data activities to NCSP Manager (ND1 {subtask 1 and 2}, ND2, ND3, ND5, ND6, ND7)		Costs include actual (LLNL) and estimated (NCSU) expenditures as LLNL has yet to receive invoices for Q1-Q2 from NCSU.
Q3	Provide status on LLNL/NCSU nuclear data activities to NCSP Manager (ND1 {subtask 1 and 2}, ND2, ND3, ND5, ND6, ND7)		Costs include actual (LLNL) and estimated (NCSU) expenditures. NCSU invoices received at end of Q3 and will cost (as actuals) in Q4.
Q4	Provide status on LLNL/NCSU nuclear data activities to NCSP Manager (ND1 {subtask 1 and 2}, ND2, ND3, ND5, ND6, ND7)		Costs represent actual Q4 costs to date.
	Deliver thermal neutron scattering data evaluations as indicated in Appendix B of the 5-Year Plan. (ND2)		Ahead of schedule.

NCSP Quarterly Progress Report (FY-2020 Q4)

Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4	**N/A**		
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	C. A. Manring, A. I. Hawari, "Development of Neural Thermal Scattering (NeTS) Modules for Reactor Physics Applications," Transactions of the American Nuclear Society: **121**, 1351-1353, November 2019	**Yes**	
Q2	A. Hawari et al., "Thermal Scattering Law S(α,β): Measurement, Evaluation and Application," International Evaluation Co-operation Volume 42, Organization for Economic Co-operation and Development, Nuclear Energy Agency, NEA No. 7511, © OECD 2020.	**Yes**	
	D. Heinrichs et al., "Nuclear Data ND1 (LLNL)", LLNL-PRES-804223, February 11, 2020.	**Yes**	Available at ncsp.llnl.gov/TPRAgendas/2020/
Q3	**N/A**		
Q4	**N/A**		

NCSP Quarterly Progress Report (FY-2020 Q4)

Task Titles:

ND1 Subtasks 1 – Delayed Fission Gamma Multiplicity and Spectra – Data testing
ND1 Subtask 2 – Delayed Fission Gamma Multiplicity and Spectra – Document the technical basis of the method and data testing results

ND2 Generation and Benchmarking of Thermal Neutron Scattering Cross Sections in Support of Advanced Nuclear Reactor Concepts

ND3 Development and Implementation of an Advanced and Rigorous Computational Platform for Thermal Neutron Scattering Analysis

ND5 Development and Implementation of a Modern Doppler Broadening Approach Including Atomic Binding Effects

ND6 Evaluate Neutron Radiative Capture Gamma Production in Cadmium

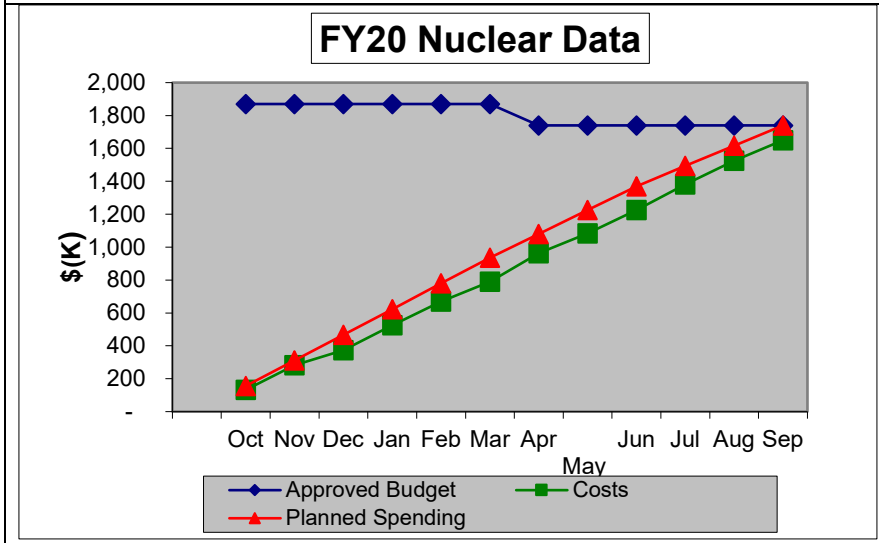
ND7 'Alpha-N' Benchmark Measurements

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element and Subtask: ORNL – ND1, 3, 4, 6, 7, 10
Task Title: see last page
M&O Contractor Name: ORNL
Point of Contact Name: Doug Bowen
Point of Contact Phone: (865) 576-0315

Reference: DP0909010/ORNL
Date of Report: Oct 2020

BUDGET



1. **Carryover into FY 2020** = $95K
2. **Approved FY 2020 Budget** = $1870K (includes carryover) (In Q2, the ND budget was decreased by $130K to account for funds moved to RSICC, AM1)
3. **Actual spending for 1st Quarter FY 2020** = $374K
4. **Actual spending for 2nd Quarter FY 2020** = $415K
5. **Actual spending for 3rd Quarter FY 2020** = $437K
6. **Actual spending for 4th Quarter FY 2020** = $424K
7. **Projected carryover into FY 2021 = $90K**

MAJOR ACCOMPLISHMENTS

ND1 –Nuclear Data Measurement and Evaluation (Guber, Pigni, Brown, Chapman)

- Work and mentor data analysis for nat-Ce and Ce-142. Motivated direct capture calculations for major Ce isotopes to help the evaluation. These data will possibly be included in the evaluation.
- Discussed various data sets (Cr53, Cu63, Ce) with ND staff members.
- Discussion with BNL personnel about Cr data analysis and experiments.
- Mentor new staff member for the NCSP.
- ND1: [140,142Cerium Evaluation]:
  - Detector efficiencies were applied to 142Ce capture inputs to normalize oxygen abundancies with other input files. Preliminary RRR evaluation of 140,142Ce up to 200 keV was completed using simultaneous evaluation of all data sets measured by Klaus Guber. Statistical checks of new parameters & calculation of auxiliary information (thermal cross sections, Maxwellian averages, etc.) was initiated.
- ND1: [63,65Cu Evaluation]
  - The fit of resonance parameters for 63Cu isotope have been refined, especially for incident neutron energies below 100 keV. In the energy range between100--300 keV, feedback from integral benchmark experiments suggested an improved benchmark performance by increasing the radiative capture cross section. As first attempt to generate benchmark performance similar to ENDF/B-VIII.0 evaluation, the resolved resonance region was extended to 300 keV by generating resonance parameters for each spin group distributed to enforce an average level spacing consistent with the average level spacing found below 100 keV. Then, these resonance parameters were fitted to experimental capture data with increased normalization. This scheme performs in the benchmark calculations similarly to the ENDF/B-VIII.0 evaluation. To explore the high energy region above 300 keV, a different strategy was employed by defining an unresolved resonance region from 100 keV up to 650 keV (according to the energy threshold of the first inelastic state). The unresolved resonance region parameters were fitted to both transmission data and to recent resolution capture cross section data although their resolution was lower than the data sets below 100 keV. This strategy yielded an even larger capture cross section in the region above 100 keV together with a modest improvement in integral benchmark performance over ENDF/B-VIII.0. The examination and adjustment of the angular

NCSP Element and Subtask: ORNL – ND1, 3, 4, 6, 7, 10 **Task Title:** see last page **M&O Contractor Name:** ORNL **Point of Contact Name:** Doug Bowen **Point of Contact Phone:** (865) 576-0315	**Reference:** DP0909010/ORNL **Date of Report:** Oct 2020
BUDGET	**MAJOR ACCOMPLISHMENTS**
	distributions is on progress. A presentation on the preliminary results was given at the R-matrix workshop in June 2020 • ND1: [140,142Ce Evaluation] ○ Detector efficiencies were applied to 142Ce capture inputs to normalize oxygen abundancies with other input files. Preliminary RRR evaluation of 140,142Ce up to 200 keV was completed by fitting simultaneously all data sets measured by Guber. Statistical checks of newly fitted resonance parameters as well as calculation of auxiliary information such as thermal and Maxwellian-averaged cross sections was initiated. Problems in the fit of the transmission data due to the background subtraction were discussed and partially resolved. Preliminary results on Evaluation for natCe samples was presented at CSEWG2019 • ND1: [181Ta Evaluation] ○ A first release of the 181Ta resonance parameter evaluation in the resolved and unresolved region including covariance information was generated in the spring 2020. This included the fit of the available measured data (transmission, capture) focusing also on obtaining consistent values in the thermal energy region such as scattering lengths and thermal constants ○ Updates to the first release in the resolved resonance region included a statistical analysis of the resonance parameters to guarantee a linear behavior in the level spacing for both spin populations and an improved distribution of the neutron resonance widths ○ Updates to the first release in the unresolved resonance region included calculations of the R-infinity and pole strength parameters to account for higher partial waves (p and d) than s-wave to calculate the average cross sections up to the second inelastic state. These additional parameters were obtained by a methodology that uses S-matrix elements calculated from the coupled-channel calculations. In this case coupled-channel calculations were performed by using an optical model parametrization from a spherical potential coupled to available deformation parameters ○ A second release of the tantalum evaluation (ENDF file) with the feature described above was released in the summer 2020 ○ Biweekly meetings were attended among the RPI and ORNL collaborators to discuss updates to the RRR and URR evaluation and related problems ○ The preliminary results were presented at the R-matrix workshop in June 2020

NCSP Element and Subtask: ORNL – ND1, 3, 4, 6, 7, 10 **Task Title:** see last page **M&O Contractor Name:** ORNL **Point of Contact Name:** Doug Bowen **Point of Contact Phone:** (865) 576-0315	**Reference:** DP0909010/ORNL **Date of Report:** Oct 2020
BUDGET	**MAJOR ACCOMPLISHMENTS**
	○ Evaluation of Ta URR average resonance pars. (based on preliminary RRR eval) is stable and consistent with RRR ○ URR covariance has been produced (based on preliminary RRR eval) ○ First steps taken for automated evaluation in repository in order to accelerate evaluation process. This allows for a quick response to changes in the preliminary RRR evaluation • ND1: [233u] Evaluation] ○ The Resolved Resonance Region (RRR) evaluation up to 600 eV was updated with the latest Prompt fission Neutron Spectrum (PFNS) and the recommended thermal values for capture, fission, and elastic reaction channels. Another major update was the increase of the fission data following ORELA data and recent nTOF data showing a different trend with the respect the ENDF/B-VIII.0 evaluation ○ These updates were tested with the current benchmarks. In the validation process, something important that partly clarify the poor performance of 233U was found in the trend of particular benchmarks, the Falstaff thermal solutions with beryllium (Be) and polyethylene (PE) reflectors. Based on the experience of 235U and being 233U coupled with a softer PFNS, benchmarks with solutions of uranyl nitrate were analyzed to check for trends in reactivity. This was part of the above-mentioned Falstaff program carried out in 1950's with Be and PE reflected solutions in spherical vessels of different sizes. The analysis of these benchmarks was reported in the main document describing the ENDF/B-VIII.0 library (Nuclear Data Sheets 148 (2018) 1–142, Fig.165) and a strong negative gradient as a function of above-thermal fission fraction (ATFF) is observed. However, when the same data are plotted as a function of beryllium reflector thickness, a different picture appears ▪ Benchmarks with only PE reflector do not show any significant gradient ▪ Only the cases with thin beryllium reflectors seem to strongly under-predict reactivity ▪ Thin beryllium reflectors with additional polyethylene layers on the outside also do not show a strong trend ○ From this, the systematic under-prediction of reactivity seems to be partly related to beryllium, in particular its neutron the transmission properties. The discrepancy diminishes when an extra PE layer is placed on the outside, which

NCSP Element and Subtask: ORNL – ND1, 3, 4, 6, 7, 10 Task Title: see last page M&O Contractor Name: ORNL Point of Contact Name: Doug Bowen Point of Contact Phone: (865) 576-0315	Reference: DP0909010/ORNL Date of Report: Oct 2020
BUDGET	**MAJOR ACCOMPLISHMENTS**
	makes the flux in beryllium less anisotropic. However, there remains the overall negative gradient in reactivity with increasing spectrum hardness expressed by the above-thermal fission fraction FEPIT, which is observed even when the strong outliers are eliminated ○ Currently, there have been released several evaluation tests to improve the negative trend and I am working towards an optimal solution for this set of benchmarks. The plan is to report this work in a journal paper submitted in a special issue of Annals Nuclear Energy honoring Massimo Salvatores. In addition, work on the Unresolved resonance region could be initiated depending on the performance of the evaluation. Also, there are other set of benchmarks that require validation analysis. • ND1: [54,56,57Fe Evaluation] ○ Minor work on the most abundant iron isotopes was performed by sorting available measured experimental data and testing their agreement with the reaction cross sections reconstructed from the current ENDF files (ENDF/B-VIII.0 and CIELO). Particular emphasis was given to the inelastic cross section ○ The evaluation work for the iron isotopes is part of the NCSP APPENDIX B and is currently scheduled to be completed by 2024 **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**). However, with the discussed path forward experiments are schedule to start in fall, if the COVID-19 situation permits to run the JRC accelerator. During last quarter JRC-Geel was intermittently operational. GELINA was started up after summer break but is not running fulltime. • 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. **Y12 ND1 – GELINA depleted Uranium target cost estimate and construction (Guber)** • MSC Inc. discovered concerns in the target design and initiated discussion with JRC-Geel. Also an improved production method of some parts were proposed. (**green**). **ND3 – Isotopic Sample Lease to Support ND1 ND Measurements (Guber, Brown)**

NCSP Element and Subtask: ORNL – ND1, 3, 4, 6, 7, 10 **Task Title:** see last page **M&O Contractor Name:** ORNL **Point of Contact Name:** Doug Bowen **Point of Contact Phone:** (865) 576-0315	**Reference:** DP0909010/ORNL **Date of Report:** Oct 2020
BUDGET	**MAJOR ACCOMPLISHMENTS**
	• Zr-90 sample was produced and shipped to JRC-Geel in September **ND4 – Thermal Neutron Total Cross Section Measurements for Improvement of Criticality Calculations and Propagation of Scattering Kernel Uncertainties (Chapman)** • Joint task with RPI (RPI-ND2) • RPI has not yet provided ORNL with data to analyze due to their beamline upgrades • RPI task has not progressed to the point where ORNL ND4 funding can be used **ND6 – SAMMY Nuclear Data Evaluation Code Modernization (Wiarda, Holcomb, Arbanas, Brown)** • After consolidating the energy grids in SAMMY, it was possible to remove all uses of container arrays from the main SAMMY program. This is an accomplishment of a major milestone in the SAMMY modernization effort. This will make it much easier to add new capabilities and to use code profiling tools like Valgrind to find errors and uninitialized variables in SAMMY. Final review of this update is ongoing. • Corrected an overstepped bound in SAMMY if using two different resolution functions. • Corrected an overstepped bound that could lead to the calculation of wrong angular distributions in the LAB if there were more channels with a non-zero threshold than isotopes. • Fixed values for the derivatives that were not re-initialized to zero if fitting all gamma width of a given spin group together. • Prepared the annual report. **ND7 - Nuclear Data Evaluation and Testing for Nuclear Criticality Safety Applications (Holcomb, Bowen, Shaw)** • Received review of intermediate ZEUS continuous-energy VALID inputs and data, with minor adjustments corrected for. • Received peer review from Nuclear Science and Engineering journal article on O-16, Fe-56, Cu-63, Cu-65 ENDF/B-VIII.0 performance, with revisions submitted and accepted for publication. • End of task and contract reached. **ND10 - Monte Carlo Evaluation of Differential and Integral Data (Arbanas, Brown, Holcomb)**

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element and Subtask: ORNL – ND1, 3, 4, 6, 7, 10 **Task Title:** see last page **M&O Contractor Name:** ORNL **Point of Contact Name:** Doug Bowen **Point of Contact Phone:** (865) 576-0315	**Reference:** DP0909010/ORNL **Date of Report:** Oct 2020
BUDGET	**MAJOR ACCOMPLISHMENTS**
	• In continuation of successful testing of our Metropolis-Hastings implementation on analytically-solvable *linear* models reported in Q3, we have successfully tested our code on a non-linear model. For testing of non-linear models we have used the Single-Level Breit-Wigner (SLBW) resonance model that is an important milestone towards deployment on nuclear data evaluations using the Reich-Moore R-matrix formalism implemented in the SAMMY code. o Our preliminary results show that the SLBW covariance matrix computed using the Metropolis-Hastings methods is significantly larger than the corresponding covariance matrix computed using a conventional generalized least square method. This finding could potentially lead to consideration of our evaluation framework as an alternative nuclear data evaluation method. • Our implementation of Metropolis-Hastings algorithm has been ported to C++ to enable seamless integration with the SAMMY, AMPX, or the SCALE code system, for increased ROI. o The C++ Metropolis-Hastings implementation of linear model fitting has been completed and is pending a formal code review for software QA. • Synergies between NCSP Task ND-10 and the SAMMY Modernization Task (ND-6) have been outlined in the SAMMY Modernization Annual Report.

NCSP Quarterly Progress Report (FY-2020 Q4)

ORNL ND 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, ND3, ND4, ND6, ND7m ND10).		
	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).		
	Complete cross-section measurement and evaluation deliverables per the nuclear data schedule in Appendix B (ND1).		
Q2	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (ND1, ND3, ND4, ND6, ND10).		Due to COVID-19, our ND measurement work will likely be behind schedule.
	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).		
	Complete cross-section measurement and evaluation deliverables per the nuclear data schedule in Appendix B (ND1).		
Q3	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (ND1, ND3, ND4, ND6, ND10).		
	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).		

	Complete cross-section measurement and evaluation deliverables per the nuclear data schedule in Appendix B (ND1).		ND measurement work at Geel, Belgium, was not possible in Q3 due to COVID-19. Facility is open for Q4 and samples are being prepared for measurements.
Q4	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (ND1, ND3, ND4, ND6, ND10).		
	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).		
	Complete cross-section measurement and evaluation deliverables per the nuclear data schedule in Appendix B (ND1).		
	Document SAMMY modernization progress and report status annually to the NCSP Manager (ND6).		ORNL/TM-2020/1755 – NCSP Analytical Methods Subtask 3, AMPX Development and Maintenance, and NCSP Nuclear Data Subtask 6, SAMMY Modernization published in Q4

Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	IRMM Geel, Belgium Nov 2019 ND1, TS7 Perform resonance region nuclear data measurements using GELINA facility at IRNN in accordance with Appendix B of the Five-Year Plan Participate in WPEC and attend IAEA International Nuclear Data Evaluation Network (INDEN) meeting WPEC and INDEN Paris, France, Vienna, Austria Nov, 2019 Participate in WPEC annual meeting, coordinate international nuclear data collaborations for the NCSP, and present NCSP/ORNL nuclear data evaluation work. Attend IAEA International Nuclear Data Evaluation Network (INDEN) meeting ND1 INDEN Vienna, Austria	**Yes**	

	Oct, 2019 ND1 Attend IAEA International Nuclear Data Evaluation Network (INDEN) meeting		
Q2	**N/A**		
Q3	OECD/NEA Paris, France Jun-20 ND1, TS Participate in WPEC annual meeting, coordinate international nuclear data collaborations for the NCSP, and present NCSP/ORNL nuclear data evaluation work (Sobes, Pigni, Wiarda) Technical meeting of international experts on nuclear data including SG38 (GND), EG-GNDS, SG42 (thermal scatter), SG44 (covariance), SG45 (validation), SG46 (IE for ND evaluation)	**No**	**CANCELLED**
	Vienna, Austria TBD – date ND1 Participate in IAEA working group meeting to improve nuclear data evaluations to support new evaluations of interest to the NCSP (Sobes, Pigni) IAEA International Nuclear Data Evaluation Network (INDEN), Vienna, 1 week. International nuclear data evaluation collaboration. Represent NCSP and ORNL interests in international nuclear data evaluation.	**No**	**CANCELLED**
Q4	Tokyo, Japan Sep-20 ND10 Participate in the 5th International Workshop on Nuclear Data Covariances 2020, (CW2020) (Pigni). Present NCSP-funded project Bayesian Monte Carlo Evaluation of Differential and Integral Data (ND10, Arbanas). Present the progress on fission modeling and generation of covariance matrices for fission product yields with physical constraints.		
	IRMM Mol, Belgium Jan-19 Apr-19 Jun-19 Sep-19 ND, TS7 Perform resonance region nuclear data measurements using GELINA facility at IRMM in accordance with Appendix B of the Five-Year Plan (Guber)		

	Continues cross-section measurements to support the production of new cross-section evaluations per the schedule in Appendix B of the Five-Year Plan.		
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	• Dorothea Wiarda, "Issues in ENDF/B-VIII.0 GNDS Covariances", November, 2019 • Dorothea Wiarda, Goran Arbanas, Andrew Holcomb, Marco Pigni, "Current Status of SAMMY", November 2019 • Marco Pigni, "Updates to R-matrix Evaluations for Fissile Actinides: 233,235U, 239Pu", November 2019 • Marco Pigni, "Status of the n+35Cl cross sections", November 2019Updates to R-matrix Evaluations of Fissile Actinides: 233,235U, 239Pu" • Klaus Guber, ORNL, C. Paradela, S. Kopecky, J. Heyse, P. Schillebeeckx, EC-JRC, "ORNL neutron cross section measurements for the US Nuclear Criticality Safety Program", November 2019 • Jesse Brown, Y. Danon RPI, D. Barry, B. Epping, M. Rapp, Naval Nuclear Laboratory, "Differential Transmission Benchmark Method to Validate Resolved and Unresolved Resonance Parameter Evaluations", November 2019 • Jesse Brown, Dorothea Wiarda, "Format proposal: R-external function", November 2019		
Q2	None		
Q3	• Arbanas et al, "Bayesian Monte-Carlo Evaluation Framework for Cross Sections Nuclear Data and Integral Benchmark Experiments" • M. Pigni, "Complex Radius in the R-Matrix algorithm for inclusion of direct capture measurement," Presentation, R-matrix Workshop, Ohio University, June 2020. • D. Barry, J. Brown, M. Pigni, "Progress on the R-matrix Analysis for the n+181Ta Evaluation, R-matrix workshop, Ohio University, June 2020. • G. Arbanas, J. Brown, A. Holcomb, D. Wiarda, "Bayesian Monte Carlo Evaluation Framework for Cross Sections Nuclear Data and Integral Benchmark Experiments," 2020 Winter ANS Meeting.		
Q4			

NCSP Quarterly Progress Report (FY-2020 Q4)

Task Titles:

ND1 Nuclear Data Measurement and Evaluation

ND3 Isotopic Sample Leases to Support ND1 ND Measurements

ND4 Thermal Neutron Total Cross Section Measurements for Improvement of Criticality Calculations and Propagation of Scattering Kernel Uncertainties

ND6 SAMMY Nuclear Data Evaluation Code Modernization

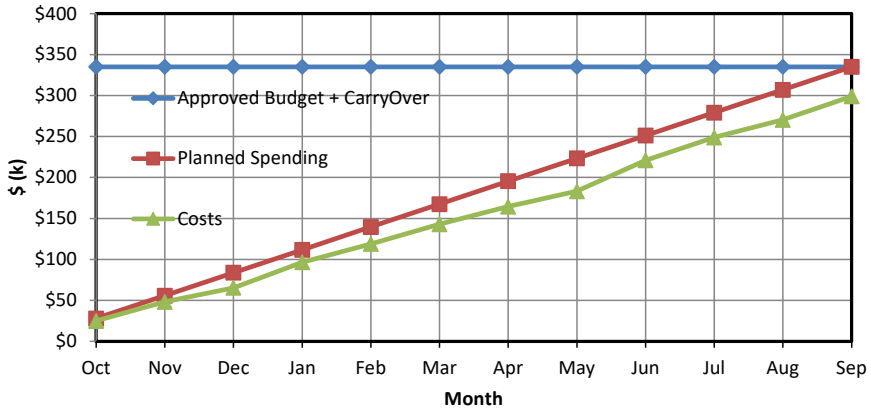
ND10 Monte Carlo Evaluation of Differential and Integral Data

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element and Subtask: ND1
Task Title: Resonance Region Nuclear Data Measurement Capability at RPI
M&O Contractor Name: RPI
Point of Contact Name: Yaron Danon
Point of Contact Phone: 518-276-4008

Reference: BNR Code 0909010
Date of Report: 10 5, 2020

BUDGET



1. **Carryover into FY 2020** = $ -8913
2. **Approved FY 2020 Budget** = $ 335,087 (includes carryover)
3. **Actual spending for 1st Quarter FY 2020** = $ 65,388
4. **Actual spending for 2nd Quarter FY 2020** = $ 77,593
5. **Actual spending for 3rd Quarter FY 2020** = $ 77,949
6. **Actual spending for 4rd Quarter FY 2020** = $ 78,154
7. **Projected carryover into FY 2021 =** $ 36,003

MAJOR ACCOMPLISHMENTS

- Cu scattering publication was submitted to Annals of Nuclear Energy
- Complete C_6D_6 detector array upgrade
- Completed preliminary scoping radiative capture measurement on Cr-53.
- Fe-54 sample is on order from the ORNL isotope center (no delivery time yet)

NCSP Quarterly Progress Report (FY-2020 Q4)

RPI ND1 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)		
	Provide status reports on RPI participation in US and International Nuclear Data collaborations, and for foreign travel, provide a brief trip summary report to NCSP Manager on items of NCSP interest (ND1)		
	Complete analysis of measurement from FY-18 (ND1)		
Q2	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (ND1)		
	Provide status reports on RPI participation in US and International Nuclear Data collaborations, and for foreign travel, provide a brief trip summary report to NCSP Manager on items of NCSP interest (ND1)		No travel to report
Q3	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (ND1)		
	Provide status reports on RPI participation in US and International Nuclear Data collaborations, and for foreign travel, provide a brief trip summary report to NCSP Manager on items of NCSP interest (ND1)		Participated in WPEC remotely
	Complete transmission measurement per the nuclear data schedule in Appendix B (ND1)		Only capture measurements were needed for Cr-53 and Fe-54 (transmission measurements were not performed)

	Complete capture measurement per the nuclear data schedule in Appendix B (ND1)		Preliminary run was completed for Cr-53 feasibility of full measurement is being evaluated
Q4	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (ND1)		
	Provide status reports on RPI participation in US and International Nuclear Data collaborations, and for foreign travel, provide a brief trip summary report to NCSP Manager on items of NCSP interest (ND1)		
	Complete data analysis for transmission and capture measurements and provide the data to ORNL as needed to support the evaluation effort per the nuclear data schedule in Appendix B (ND1)		Preliminary Cr-53 was completed, final run pending evaluation delayed to Q1 FY21

NCSP Quarterly Progress Report (FY-2020 Q4)

Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**	No	Did not travel
Q2	**N/A**	No	Did not travel
Q3	OECD/NEA Paris, France May-20 ND1 ND2 Participate in WPEC, and WPEC (Danon, Lui) As US Measurements Chair, participate in WPEC and SG-40 annual meeting to present NCSP/RPI nuclear data measurement work. Participate in SG (thermal scattering meeting) to present NCSP/RPI thermal scattering measurements and analysis.	No	Due to COVID meeting was hosted remotely and travel did not occur.
Q4	**N/A**		

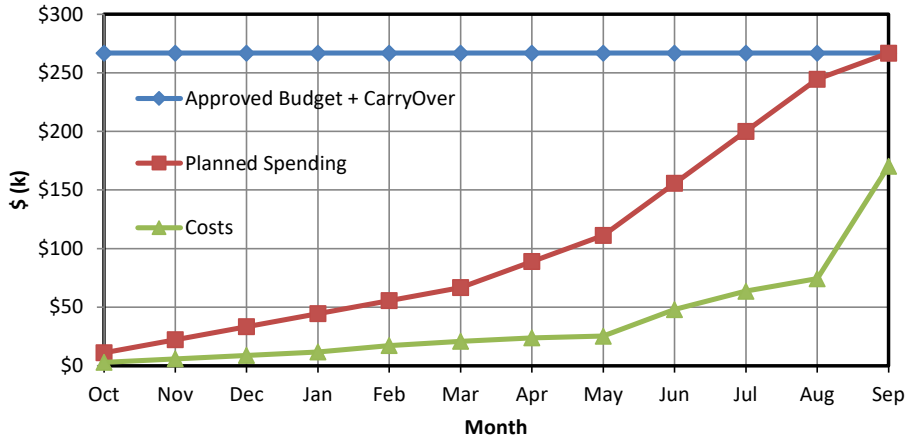
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1		No	
Q2		No	
Q3		No	
Q4	Experimental Low-Energy Research at RPI		Low Energy Community Meeting, 10-12 August 2020
Q4	NCSP/NR technical review – multiple talks		NCSP/NR technical review

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element and Subtask: ND2
Task Title: Thermal Neutron Scattering Measurement for Improvement of Criticality Calculations and Propagation of Scattering Kernel Uncertainties
M&O Contractor Name: RPI
Point of Contact Name: Yaron Danon
Point of Contact Phone: 518-276-4008

Reference: BNR Code 0909010
Date of Report: 10 15, 2020

BUDGET



1. **Carryover into FY 2020** = $ 116,888
2. **Approved FY 2020 Budget** = $ 266,888 (includes carryover)
3. **Actual spending for 1st Quarter FY 2020** = $ 8,827
4. **Actual spending for 2nd Quarter FY 2020** = $11,998
5. **Actual spending for 3rd Quarter FY 2020** = $27,126
6. **Actual spending for 4rd Quarter FY 2020** = $122,396
7. **Projected carryover into FY 2021 =** $96,542

MAJOR ACCOMPLISHMENTS

- Cryogenic system was delivered to RPI.
- Successfully tested the cryogenic system at RPI, reaching 17 K base temperature at cold moderator location.
- Successful application of the Short Collision Time approximation to resolve numerical difficulties in the NJOY LEAPR module and calculate Bragg edges observed in transmission experiments
- Paper scheduled for publication in ANS Winter 2020.

NCSP Quarterly Progress Report (FY-2020 Q4)

RPI ND2 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 (ND2)		
	Provide status reports on RPI participation in US and International Nuclear Data collaborations, and for foreign travel, provide a brief trip summary report to NCSP Manager on items of NCSP interest (ND2)		
	Submit cryostat order to vendor (ND2)		
Q2	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (ND2)		
	Provide status reports on RPI participation in US and International Nuclear Data collaborations, and for foreign travel, provide a brief trip summary report to NCSP Manager on items of NCSP interest (ND2)		No travel to report
	Complete design and order of auxiliary support for cold moderator. (ND2)		
Q3	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (ND2)		
	Provide status reports on RPI participation in US and International Nuclear Data collaborations, and for foreign travel, provide a brief trip summary report to NCSP Manager on items of NCSP interest (ND2)		No travel to report, participated in WPEC meeting remotely

	Complete cryostat test. (ND2)		
Q4	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (ND2)		
	Provide status reports on RPI participation in US and International Nuclear Data collaborations, and for foreign travel, provide a brief trip summary report to NCSP Manager on items of NCSP interest (ND2)		
	Complete cold moderator test. (ND2)		Operation of cold moderator test in neutron beam delayed due to refurbishment activity to Q1 FY21.

NCSP Quarterly Progress Report (FY-2020 Q4)

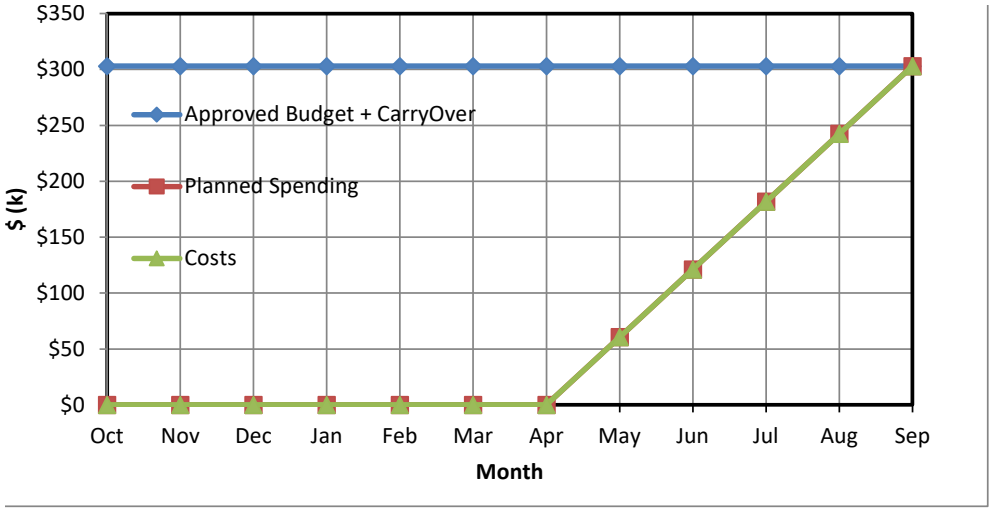
Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**	No	Did not travel
Q2	**N/A**	No	Did not travel
Q3	OECD/NEA Paris, France May-20 ND1 ND2 Participate in WPEC, and WPEC (Danon, Lui) As US Measurements Chair, participate in WPEC and SG-40 annual meeting to present NCSP/RPI nuclear data measurement work. Participate in SG (thermal scattering meeting) to present NCSP/RPI thermal scattering measurements and analysis.		No travel to report, participated in WPEC meeting remotely
Q4	**N/A**		
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1		No	
Q2		No	
Q3		No	
Q4	D. Fritz, Y. Danon, A Cold Moderator For Sub-Thermal Neutron Flux Enhancement At The RPI-LINAC, submitted to ANS 2020 Winter Meeting and Nuclear Technology Expo, 2020.		Accepted to ANS 2020 Winter meeting

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element and Subtask: ND3
Task Title: RPI/ORNL: LINAC 2020 Nuclear Data Capabilities Maintenance Plan
M&O Contractor Name: RPI
Point of Contact Name: Yaron Danon
Point of Contact Phone: 518-276-4008

Reference: BNR Code 0909010
Date of Report: 10 16, 2020

BUDGET



1. **Carryover into FY 2020** = $ 0
2. **Approved FY 2020 Budget** = $ 303K (includes carryover)
3. **Actual spending for 1st Quarter FY 2020** = $ 0
4. **Actual spending for 2nd Quarter FY 2020** = $ 0
5. **Actual spending for 3rd Quarter FY 2020** = $ 121,200
6. **Actual spending for 4rd Quarter FY 2020** = $ 181,800
7. **Projected carryover into FY 2021 =** $ 0

MAJOR ACCOMPLISHMENTS

- Received modulator M1263-4 from ScandiNova to replace Modulator 1 which needs some minor modification and thus cannot be tested on site (at RPI).
- Modulator M1263-1 was successfully put into offsite storage until modulator building is completed.
- Received delivery of two klystrons from Thales; 4th and 5th units fabricated.
- Received the delivery of the TPV & SOL#1 sections
- Installed Modulator 4 and one klystron as preparation for modulator acceptance test.
- Installed RF guides as preparation for the first speed of light accelerating structure.

NCSP Quarterly Progress Report (FY-2020 Q4)

RPI ND3 Milestones:

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

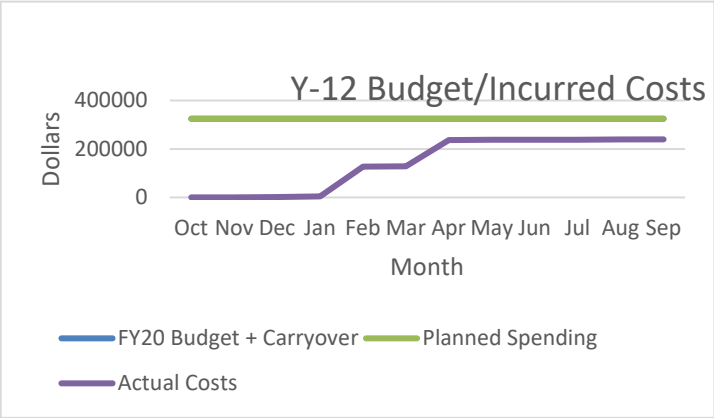
Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	TASK	STATUS	ISSUES/PATH FORWARD
Q1	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (ND3)		
	Factory acceptance test of RF Modulators 4 (ND3)		
Q2	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (ND3)		
	Factory acceptance test of Tapered Phase Velocity accelerating structure. (ND3)		
Q3	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (ND3)		
	Factory Acceptance test for Tapered Phase Velocity and Speed of Light #1 Accelerator Sections (ND3)		
	Factory Acceptance test of first Speed of Light accelerating structure and Delivery and of TPV and SOL1 Accelerator Sections. (ND3)		Delivery is behind schedule due to COVID19 (can receive large items once we return to work)
	Factory Acceptance test of Modulator 5 (remotely viewed). (ND3)		
Q4	Provide status reports on all nuclear data support activities in NCSP Quarterly Progress Reports (ND3)		
	Site acceptance testing of Modulator 1. (ND3)		Was delayed to FY21 Q1 for modulator number 4 (No. 1 is in storage for a later test)
	Site acceptance testing and conditioning of first speed of light accelerating structure. (ND3)		Now scheduled for FY21 Q2

NCSP Quarterly Progress Report (FY-2020 Q4)

Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	N/A	No	Did not travel
Q2	N/A	No	Did not travel
Q3	N/A	No	Did not travel
Q4	**N/A**		
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1		No	
Q2		No	
Q3		No	
Q4			

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element and Subtasks: ND1 **Task Title:** Fabrication of New Uranium Target for IRMM/GELINA for Cross-section Measurements **M&O Contractor Name:** Y12 **Point of Contact Name:** Kevin Reynolds **Point of Contact Phone:** (865) 241-9067	**Reference: B&R DP0909010** **Date of Report: October 22, 2020**
BUDGET	**MAJOR ACCOMPLISHMENTS**
 1. **Carryover into FY 2020** = $324,722.59 2. **Approved FY 2020 Budget** = $0.00 + $324,722.59 = $324,722.59 (includes carryover) 3. **Actual spending for 1st Quarter FY 2020** = $2,168.14 4. **Actual spending for 2nd Quarter FY 2020** = $126,087.30 5. **Actual spending for 3rd Quarter FY 2020** = $109,534.50 6. **Actual spending for 4rd Quarter FY 2020** = $1,739.61 7. **Projected carryover into FY 2021 =** $85,193.05	Q1: Fabrication of new target has begun. Completion estimated in summer (Q3) with delivery in Q4 Alight overage in cost of target manufacture to be covered by carryover in accounts from previous year. Q2: No report from manufacturer as none is expected until Q3 for completion of fabrication. Q3: MSC anticipating September completion of target assembly subject to COVID impacts. Du-Mo disk completed, now waiting on stainless steel components for final assembly. Q4: DU Manufacturing Complete. Awaiting delivery of SS parts for final assembly. Anticipate shipment in Q2 2021.

NCSP Quarterly Progress Report (FY-2020 Q4)

Y12 ND Milestones:

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

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	MILESTONE	STATUS	COMMENTS
Q1	Provide a status report of the fabrication of a depleted uranium/molybdenum target per IRMM/GELINA specifications to the NCSP Manager. (ND1)		
Q2	Provide a status report of the fabrication of a depleted uranium/molybdenum target per IRMM/GELINA specifications to the NCSP Manager. (ND1)		
Q3	Provide a status report of the fabrication of a depleted uranium/molybdenum target per IRMM/GELINA specifications to the NCSP Manager. (ND1)		Completion this FY at risk due to COVID impacts.
Q4	Provide a status report of the fabrication of a depleted uranium/molybdenum target per IRMM/GELINA specifications to the NCSP Manager. (ND1)		

NCSP Quarterly Progress Report (FY-2020 Q4)

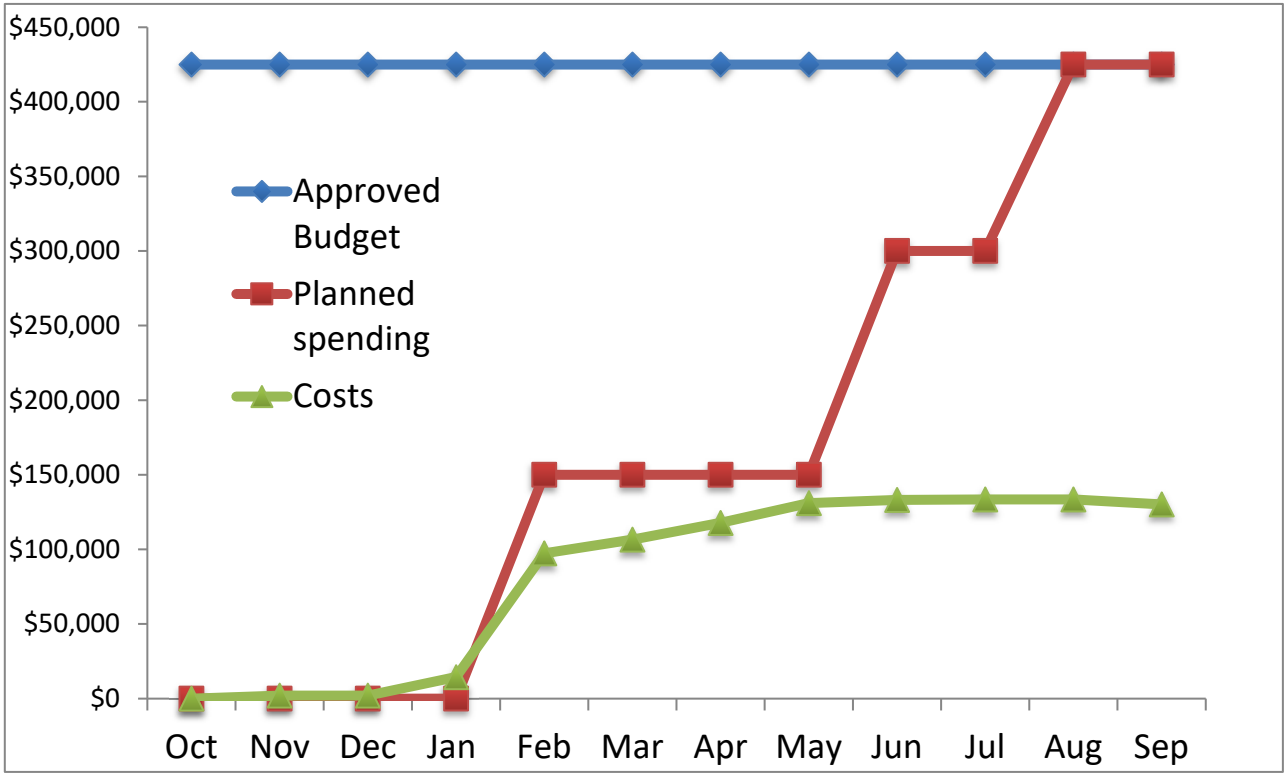
Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4	**N/A**		
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4	**N/A**		

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element: LANL TE3
Task Title: Conduct Hands-On Criticality Safety Training Course at NCERC
M&O Contractor Name: Los Alamos National Laboratory (LANL)
Point of Contact Name: Joetta Goda
Point of Contact Phone: (505) 667-2812

Reference: DP0909010
Date of Report: October 12, 2020

BUDGET



1. **Carryover into FY 2020 = $0K**
2. **Approved FY 2020 Budget = $425K**
3. **Actual spending for 1st Quarter FY 2020 = $2K**
4. **Actual spending for 2nd Quarter FY 2020 = $105K**
5. **Actual spending for 3rd Quarter FY 2020 = $27K**
6. **Actual spending for 4rd Quarter FY 2020 = -$3K**
7. **Projected carryover into FY 2022 = $290K**

MAJOR ACCOMPLISHMENTS

- NCSP Class in August cancelled.
- End of year institutional rebates make Q4 spending negative.

NCSP Quarterly Progress Report (FY-2020 Q4)

LANL TE3 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)		
Q2	Provide status reports on all training activities to the NCSP Manager. (TE3)		
Q3	Provide status reports on all training activities to the NCSP Manager. (TE3)		
Q4	Provide status reports on all training activities to the NCSP Manager. (TE3)		

NCSP Quarterly Progress Report (FY-2020 Q4)

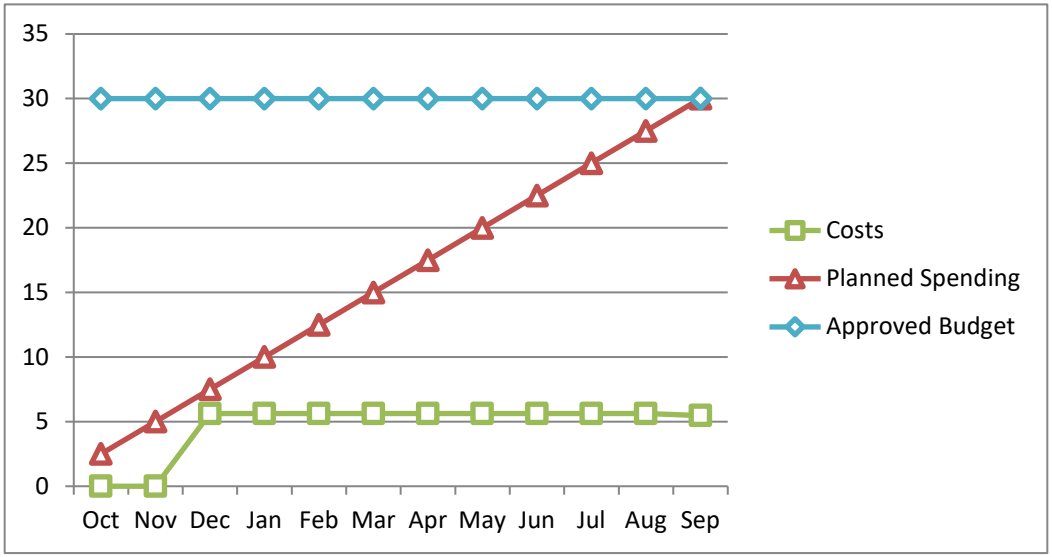
Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4	**N/A**		
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4			

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element: LANL TE4
Task Title: On-Site Introductory Training for the NCS Practitioner on Modern Approaches to Validation using Sensitivity and Uncertainty Analysis Tools
M&O Contractor Name: Los Alamos National Laboratory (LANL)
Point of Contact Name: Joetta Goda / Bob Little
Point of Contact Phone: (505) 667-2812 / (505) 665-3487

Reference: B&R DP090200
Date of Report: October 14, 2020

BUDGET



1. **Carryover into FY 2020 = $0**
2. **Approved FY 2020 Budget = $30,000 (includes carryover)**
3. **Actual spending for 1st Quarter FY 2020 = $5,628**
4. **Actual spending for 2nd Quarter FY 2020 = $0**
5. **Actual spending for 3rd Quarter FY 2020 = $0**
6. **Actual spending for 4rd Quarter FY 2020 = $-156 (total = $5,472)**
7. **Projected carryover into FY 2021 = $0**

MAJOR ACCOMPLISHMENTS

- Joint ORNL / LANL S/U training did not happen in FY20 due to COVID-19 travel restrictions. We expect to be able to re-schedule during FY21.

NCSP Quarterly Progress Report (FY-2020 Q4)

LANL TE4 Milestones:

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

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	MILESTONE	STATUS	ISSUES/PATH FORWARD
Q1	Provide status reports on all training activities to the NCSP Manager. (TE4)		
Q2	Provide status reports on all training activities to the NCSP Manager. (TE4)		
Q3	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 FY20. (TE4)		**On-site training could not be provided in FY20 due to COVID-19 travel restrictions. We expect to be able to re-schedule during FY21 and use Carry-Over funds to execute the training.**

NCSP Quarterly Progress Report (FY-2020 Q4)

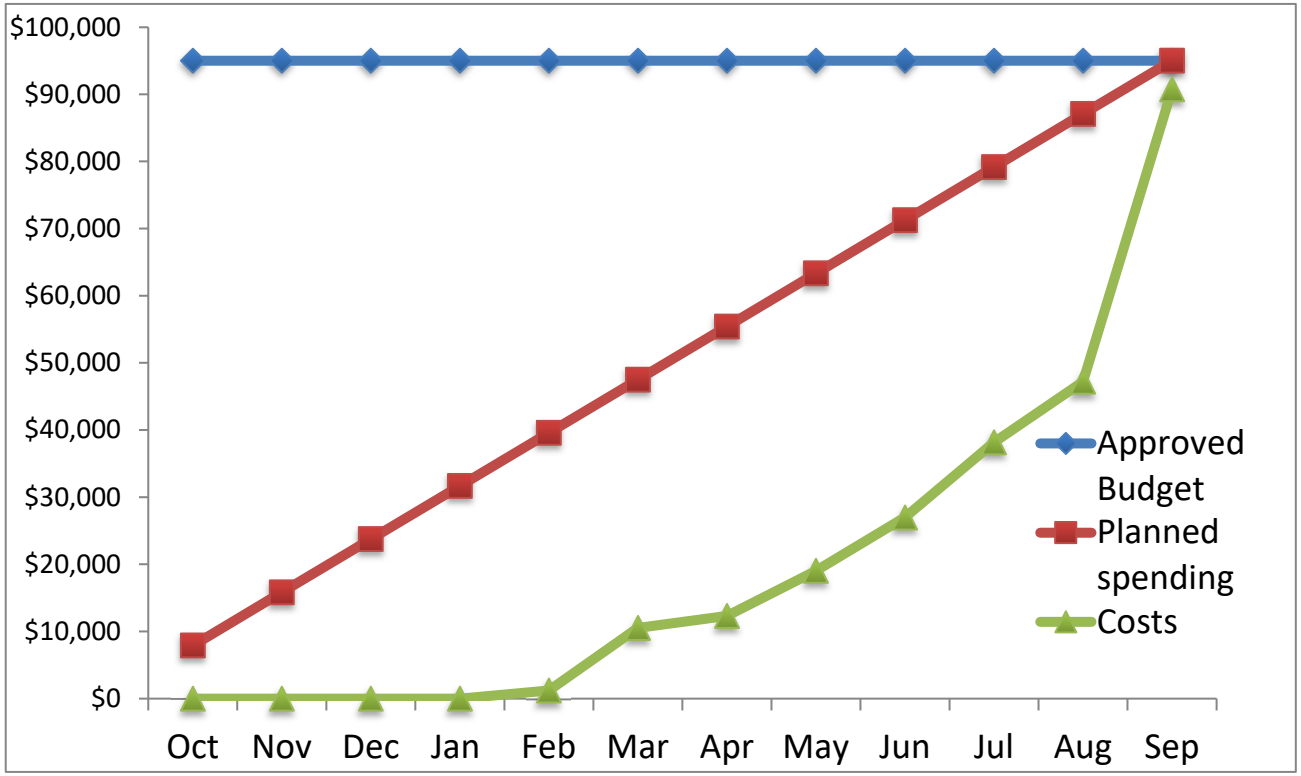
Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4	**N/A**		
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4	**N/A**		

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element: LANL TE6
Task Title: Development of University Pipeline for Criticality Safety Professionals
M&O Contractor Name: Los Alamos National Laboratory (LANL)
Point of Contact Name: Joetta Goda
Point of Contact Phone: (505) 667-2812

Reference: B&R DP0909010
Date of Report: October 12, 2020

BUDGET



1. **Carryover into FY 2020 = $0K**
2. **Approved FY 2020 Budget = $50K**
3. **Actual spending for 1st Quarter FY 2020 = $0K**
4. **Actual spending for 2nd Quarter FY 2020 = $10K**
5. **Actual spending for 3rd Quarter FY 2020 = $16K**
6. **Actual spending for 4rd Quarter FY 2020 = $64K**
7. **Projected carryover into FY 2021 = $0K**

MAJOR ACCOMPLISHMENTS

- NCS developed course materials for University Pipelines

NCSP Quarterly Progress Report (FY-2020 Q4)

LANL TE6 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. (TE6)		
Q2	Provide status reports on all training activities to the NCSP Manager. (TE6)		
Q3	Provide status reports on all training activities to the NCSP Manager. (TE6)		
Q4	Provide status reports on all training activities to the NCSP Manager. (TE6)		

NCSP Quarterly Progress Report (FY-2020 Q4)

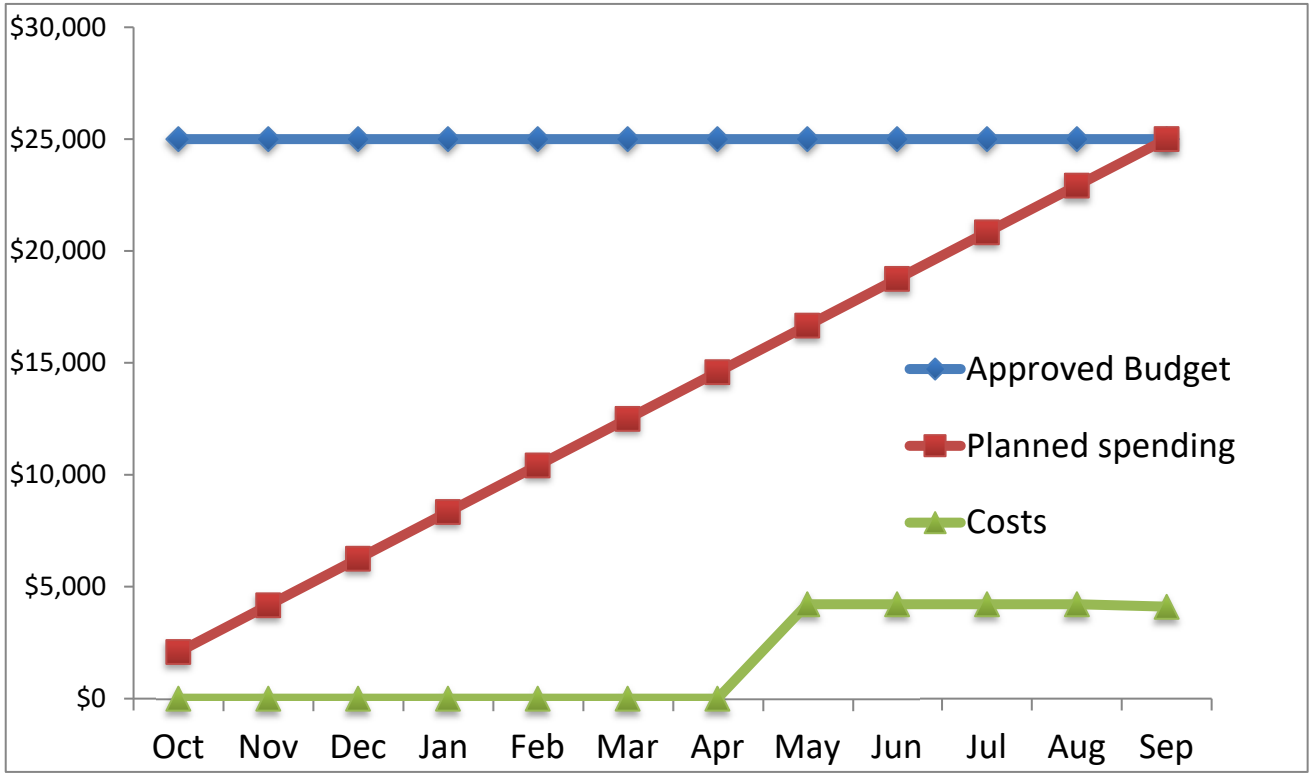
Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4	**N/A**		
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4			

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element: LANL TE7
Task Title: Design and Develop a New NCSP T&E Course Criticality Safety Officers at DOE/NNSA Nuclear Facilities
M&O Contractor Name: Los Alamos National Laboratory (LANL)
Point of Contact Name: Joetta Goda
Point of Contact Phone: (505) 667-2812

Reference: B&R DP0909010
Date of Report: October 12, 2020

BUDGET



1. **Carryover into FY 2019 = $ 0K**
2. **Approved FY 2020 Budget = $25K**
3. **Actual spending for 1st Quarter FY 2019 = $0K**
4. **Actual spending for 2nd Quarter FY 2019 = $0K**
5. **Actual spending for 3rd Quarter FY 2019 = $4K**
6. **Actual spending for 4rd Quarter FY 2019 = $21K**
7. **Projected carryover into FY 2020 = $20K**

MAJOR ACCOMPLISHMENTS

- Charges were incorrectly put to a different code and were shifted to the correct code in May.

NCSP Quarterly Progress Report (FY-2020 Q4)

LANL TE7 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. (TE7)		
Q2	Provide status reports on all training activities to the NCSP Manager. (TE7)		
Q3	Provide status reports on all training activities to the NCSP Manager. (TE7)		
Q4	Provide status reports on all training activities to the NCSP Manager. (TE7)		

NCSP Quarterly Progress Report (FY-2020 Q4)

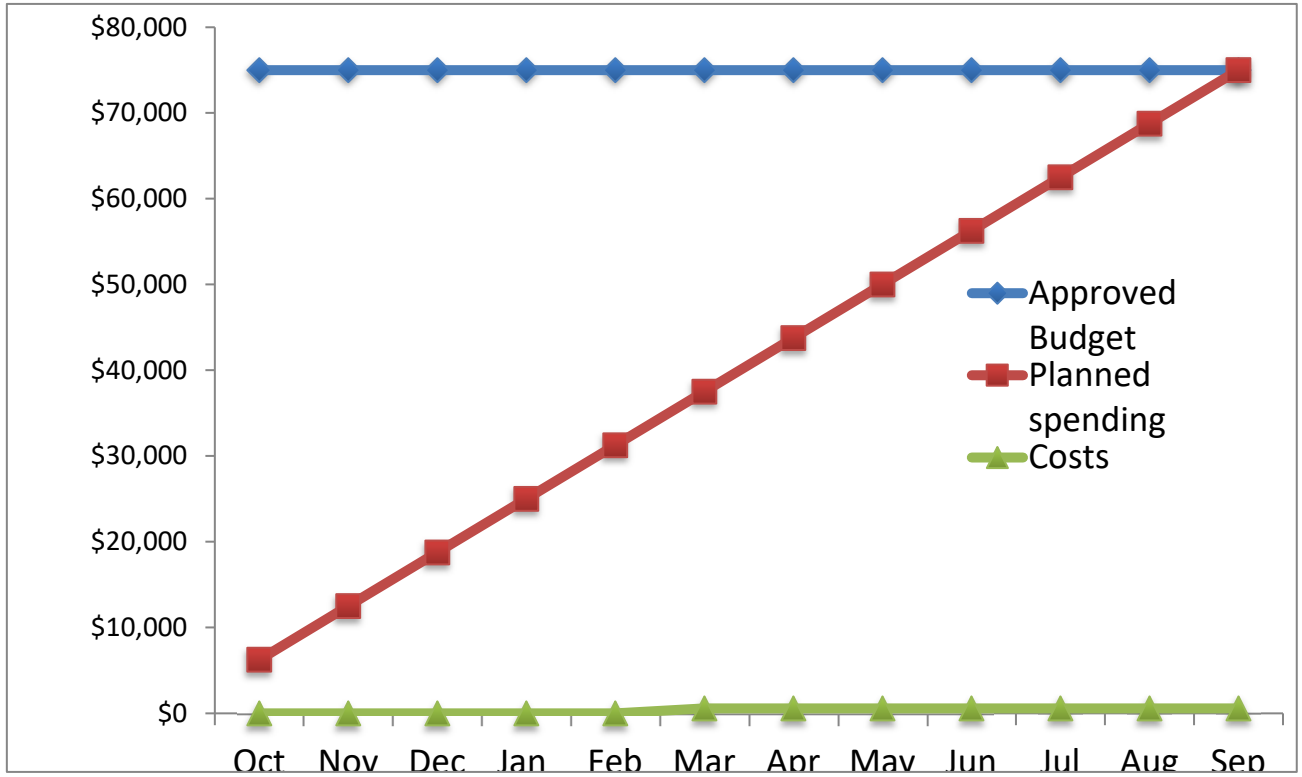
Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4	**N/A**		
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4			

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element: LANL TE8
Task Title: Reactivity Simulation Aids
M&O Contractor Name: Los Alamos National Laboratory (LANL)
Point of Contact Name: Joetta Goda
Point of Contact Phone: (505) 667-2812

Reference: B&R DP0909010
Date of Report: October 12, 2020

BUDGET



1. **Carryover into FY 2020 = $0K**
2. **Approved FY 2020 Budget = $75K**
3. **Actual spending for 1st Quarter FY 2020 = $0K**
4. **Actual spending for 2nd Quarter FY 2020 = $1K**
5. **Actual spending for 3rd Quarter FY 2020 = $0K**
6. **Actual spending for 4rd Quarter FY 2020 = $0K**
7. **Projected carryover into FY 2021 = $74K**

MAJOR ACCOMPLISHMENTS

- No activity.

NCSP Quarterly Progress Report (FY-2020 Q4)

LANL TE8 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. (TE8)		
Q2	Provide status reports on all training activities to the NCSP Manager. (TE8)		
Q3	Provide status reports on all training activities to the NCSP Manager. (TE8)		
Q4	Provide status reports on all training activities to the NCSP Manager. (TE8)		

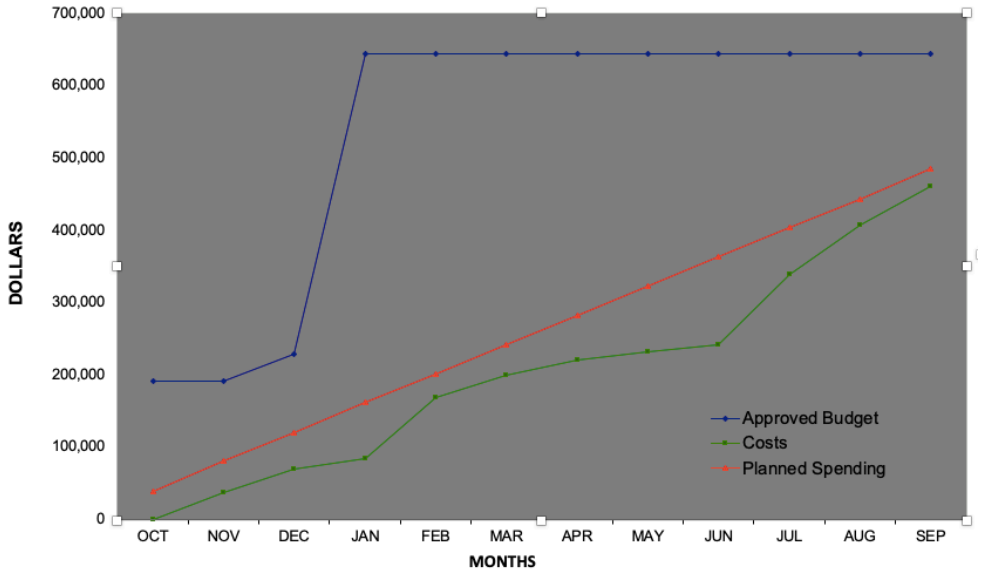
NCSP Quarterly Progress Report (FY-2020 Q4)

Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4	**N/A**		
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4			

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element and Subtasks: TE1, 3, 6, 7, 9 **Task Titles:** See last page **M&O Contractor Name:** Lawrence Livermore National Laboratory **Point of Contact Name:** David Heinrichs **Point of Contact Phone:** (925) 424-5679	Reference: B&R DP0909010 Date of Report: October 16, 2020

BUDGET



1. **Carryover into FY 2020** = $118,004
2. **Approved FY 2020 Budget** = $645,004 (includes carryover)
3. **Actual spending for 1st Quarter FY 2020** = $69,642
4. **Actual spending for 2nd Quarter FY 2020**= $130,260
5. **Actual spending for 3rd Quarter FY 2020** = $42,548
6. **Actual spending for 4rd Quarter FY 2020** = $218,920
7. **Projected carryover into FY 2021 =** $183,634 (28%)

MAJOR ACCOMPLISHMENTS

1. Provided registration and logistics support (TE1, TE3) for:
   - 2-week Y-12 course on April 6-17, 2020 at ORNL/NCERC*
   - 1-week Managers course on June 15-19, 2020 at NCERC*
   - 2-week CSE course on Aug 10-21, 2020 at NATM/NCERC/SNL*
   - 2-week Y12 course on Sep 21-22/Nov 2-6, 2020 at ORNL/NCERC
   - 2-week CSE course on Jan 25-Feb 5, 2021 at NATM/NCERC/SNL
   - 1-week Managers/CSO course on April 5-9, 2021 at SNL
   - 1-week Managers/CSO course on June 7-11, 2021 at NCERC
   - 2-week CSE course on Aug 9-20, 2021at NATM/NCERC/SNL

   *Course cancelled due to COVID-19 restrictions
2. For future classes, new tables, chairs, extra PPE including N95 masks and face shields were procured to provide for COVID-19 spacing requirements. Work plans have been written and controls established for the close proximity hands on portion of the class. HRP extensions and travel approvals have been granted for LLNL instructors and essential support personnel. Mandatory in-service inspections were completed on time. As a result of these accomplishments, LLNL is ready to support the special November course for Y12. (TE1)
3. Participated in all T&E teleconferences (TE1, TE3, TE6, TE7).

NCSP Quarterly Progress Report (FY-2020 Q4)

LLNL T&E 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	Update, maintain and support the registration process and provide classroom and "hands on" TACS training in accordance with the schedule approved by the NCSP Manager. (TE1, TE3, TE6, TE7)		
	Conduct subcritical measurements using beryllium shells and finalize training materials addressing the concept of superior reflection. (TE7)		
	Provide a status report of the status of efforts to develop a new CSO/FMH course for the NCSP for piloting in FY20. (TE9)		
Q2	Update, maintain and support the registration process and provide classroom and "hands on" TACS training in accordance with the schedule approved by the NCSP Manager. (TE1, TE3, TE6, TE7)		The 1-week Managers course scheduled for March 30-April 3 was cancelled due to COVID-19 concerns.
	Conduct subcritical measurements using beryllium shells and finalize training materials addressing the concept of superior reflection. (TE7)		Instructors conducted subcritical measurements using beryllium shells in Q2.
	Provide a status report of the status of efforts to develop a new CSO/FMH course for the NCSP for piloting in FY20. (TE9)		
Q3	Update, maintain and support the registration process and provide classroom and "hands on" TACS training in accordance with the schedule approved by the NCSP Manager. (TE1, TE3, TE6, TE7)		The 2-week Y12 course scheduled for April 6-17 and 1-week Manager's course scheduled for June 15-19 were cancelled due to COVID-19 concerns.

	Conduct subcritical measurements using beryllium shells and finalize training materials addressing the concept of superior reflection. (TE7)		
	Provide a status report of the status of efforts to develop a new CSO/FMH course for the NCSP for piloting in FY20. (TE9)		
Q4	Update, maintain and support the registration process and provide classroom and “hands on” TACS training in accordance with the schedule approved by the NCSP Manager. (TE1, TE3, TE6, TE7)		
	Conduct subcritical measurements using beryllium shells and finalize training materials addressing the concept of superior reflection. (TE7)		
	Provide a status report of the status of efforts to develop a new CSO/FMH course for the NCSP for piloting in FY20. (TE9)		

NCSP Quarterly Progress Report (FY-2020 Q4)

Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4			
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	Catherine Percher, "LLNL 2019 Incorporation of Superior Reflectors into the Training Assembly for Criticality Safety," LLNL-PRES-804864, February 12, 2020.	**Yes**	
Q3	**N/A**		
Q4	**N/A**		

NCSP Quarterly Progress Report (FY-2020 Q4)

Task Titles:

TE1 Conduct Hands-on Training at the DAF (TACS)

TE3 Classroom Criticality Safety Training

TE6 Mobile (CAT III or IV material) Hands on Critical or Near Critical Demonstration Capability

TE7 Criticality Simulator to Demonstrate Criticality Physics Fundamentals to Process Operators

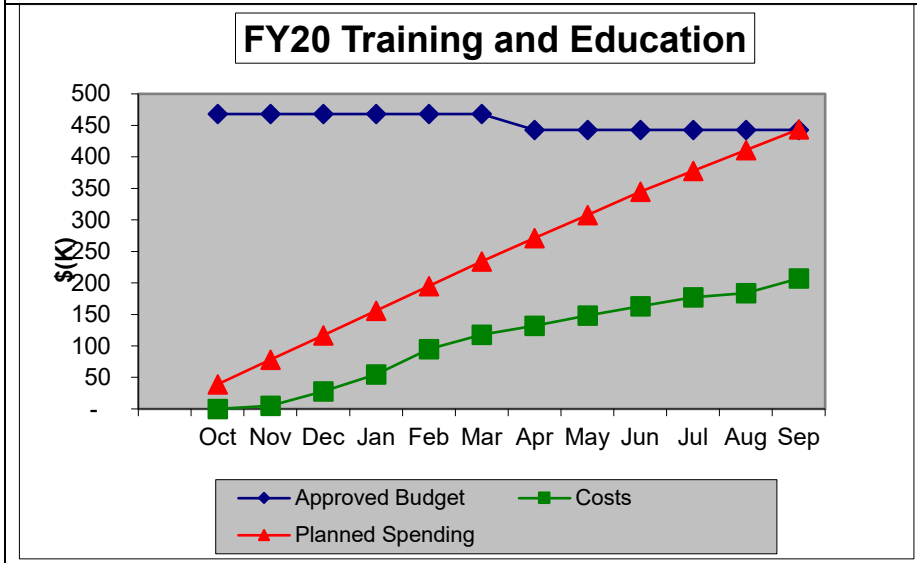
TE9 Design and Develop a New NCSP T&E Course for Criticality Safety Officers at DOE/NNSA Nuclear Facilities

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element and Subtask: TE1, 3, 5, 9, 10
Task Title: see last page
M&O Contractor Name: ORNL
Point of Contact Name: Doug Bowen
Point of Contact Phone: (865) 576-0315

Reference: DP0909010/ORNL
Date of Report: Oct 2020

BUDGET



1. **Carryover into FY 2020 = $128K**
2. **Approved FY 2020 Budget** = **$468K** (includes carryover) (In Q2, the budget was reduced by $25K to account for the movement of funds to RSICC AM1)
3. **Actual spending for 1st Quarter FY 2020 = $28K**
4. **Actual spending for 2nd Quarter FY 2020 = $90K**
5. **Actual spending for 3rd Quarter FY 2020 = $45K**
6. **Actual spending for 4th Quarter FY2020 = $44K**
7. **Projected carryover into FY 2021 = $236K**

MAJOR ACCOMPLISHMENTS

TE1 –Manage and Provide Instruction for the DOE Nuclear Criticality Safety Training & Education Program (Bowen, Marshall, Lousteau)

- All FY20Q4 courses were cancelled due to COVID-19. Late in Q4, telecons were initiated to begin plans for a Y-12 special course at Y-12 (2-day condensed) and 1-week hands-on course at NCERC.

TE3 - Hand-calculation Primer Expansion, LA-14244-M (Bowen, Busch)

- Work began on developing an outline for a primer revision (ORNL document) working with Dr. Robert Busch. Dr. Busch and Doug Bowen met face-to-face in Q4 in Albuquerque, NM, to discuss LA-14244-M errata and resolutions. A web-based hand-calc exercises will be generated for this task that is envisioned to be added to the NCSET module hand-calc offerings for new NCS practitioners.

TE5 - On-Site Introductory Training for the NCS Practitioner on Modern Approaches to Validation using Sensitivity and Uncertainty Analysis Tools (Marshall)

- No progress. A course is tentatively planned with INL once COVID-19 travel restrictions are lifted. Work planned is in collaboration with LANL.

TE9 - Design and Develop a New NCSP T&E Course for Criticality Safety Officers at DOE/NNSA Nuclear Facilities (Bowen + TE team)

- CSO course materials were finalized for a pilot course to be offered in FY21 (NCERC Manager/CSO course).

TE10 - Design of a Subcritical Assembly at ORNL for use with the CSO Courses (Bowen, Holcomb, Hart)

- A final feasibility report for a subcritical assembly has been published as an ORNL report (ORNL TM-2020/1598) was published in August. The results of the study indicate that sufficient quantities of fuel exist at Y-12 to construct a subcritical assembly. ORNL management have been supportive of the proposed assembly and are supporting the effort. Computations indicate an assembly can easily be constructed and operated at ORNL

NCSP Element and Subtask: TE1, 3, 5, 9, 10 **Task Title:** see last page **M&O Contractor Name:** ORNL **Point of Contact Name:** Doug Bowen **Point of Contact Phone:** (865) 576-0315	**Reference:** DP0909010/ORNL **Date of Report:** Oct 2020
	economically. NCSP funds in FY21 will be used to finalize the design for assembly fabrication and fuel shipments from Y-12.

NCSP Quarterly Progress Report (FY-2020 Q4)

ORNL TE 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 and resolution of CSSG comments from CSSG tasking 2016-01. (TE1)		
	Provide a status report on progress made to develop an updated Hand Calculation Primer (TE3)		Lack of funding in Q1 delayed this task.
	Provide a status report in NCSP Quarterly Progress Reports on the progress of 1-day onsite introductory validation training conducted at one or more DOE sites. (TE5)		
	Provide a status report of the status of efforts to develop a new CSO/FMH course for the NCSP for piloting in FY20. (TE9)		
Q2	Provide a status report in NCSP Quarterly Progress Reports on implementation of the NCS training program and resolution of CSSG comments from CSSG tasking 2016-01. (TE1)		Yellow highlight – this was done a long time ago.
	Provide a status report on progress made to develop an updated Hand Calculation Primer (TE3)		
	Provide a status report in NCSP Quarterly Progress Reports on the progress of 1-day onsite introductory validation training conducted at one or more DOE sites. (TE5)		Not know whether we can perform a training course at INL in FY20 or not due to COVID-19 issues.
	Provide a status report of the status of efforts to develop a new CSO/FMH course for the NCSP for piloting in FY20. (TE9)		

	Complete a feasibility report to the NCSP manager for the design and installation of a subcritical assembly at ORNL using existing resources at Y-12. If the concept is feasible, submit a proposal for consideration for FY20. (TE10)		Behind schedule due to delays with Y-12. A proposal was submitted for the next step of this process.
Q3	Provide a status report on progress made to develop an updated Hand Calculation Primer (TE3)		
	Provide a status report in NCSP Quarterly Progress Reports on the progress of 1-day onsite introductory validation training conducted at one or more DOE sites. (TE5)		Delayed due to COVID-19
	Provide a status report of the status of efforts to develop a new CSO/FMH course for the NCSP for piloting in FY20. (TE9)		Delayed due to COVID-19
Q4	Provide a status report on progress made to develop an updated Hand Calculation Primer (TE3)		
	Provide a status report in NCSP Quarterly Progress Reports on the progress of 1-day onsite introductory validation training conducted at one or more DOE sites. (TE5)		Delayed due to COVID-19
	Provide a status report of the status of efforts to develop a new CSO/FMH course for the NCSP for piloting in FY20. (TE9)		Delayed due to COVID-19

NCSP Quarterly Progress Report (FY-2020 Q4)

Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4	**N/A**		
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	**none**	No	
Q2	**none**	No	
Q3	• D. Bowen, A. Holcomb, S. Hart, "Feasibility Study for a Proposed Subcritical Assembly at Oak Ridge National Laboratory," 2020 ANS Winter Meeting.	**yes**	
Q4			

Task Title:

TE1 Manage and Provide Instruction for the DOE Nuclear Criticality Safety Training & Education Program

TE3 Hand-calculation Primer Expansion, LA-14244-M

TE5 On-Site Introductory Training for the NCS Practitioner on Modern Approaches to Validation using Sensitivity and Uncertainty Analysis Tools

TE9 Design and Develop a New NCSP T&E Course for Criticality Safety Officers at DOE/NNSA Nuclear Facilities

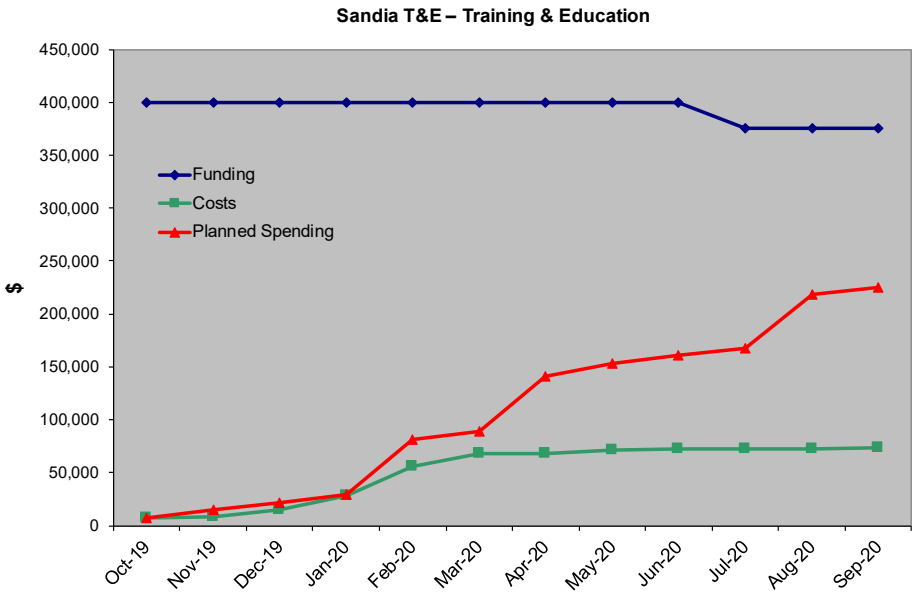
TE10 Design of a Subcritical Assembly at ORNL for use with the CSO/FMH Courses

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element: SNL TE1, 2
Task Titles:
TE1 Prepare for and Conduct Hands-on Criticality Safety Training at SNL
TE2 Design and Develop a New NCSP T&E Course Criticality Safety Officers at DOE/NNSA Nuclear Facilities
M&O Contractor Name: Sandia National Laboratories (SNL)
Point of Contact Name: Gary A. Harms
Point of Contact Phone: (505)845-3244

Reference: B&R DP 0909010
Date of Report: September 30, 2020

BUDGET



1. **Carryover into FY 2020** = $374,875
2. **Approved FY 2020 Budget** = $399,875 (includes carryover)
3. **Actual spending for 1st Quarter FY 2020** = $15,052
4. **Actual spending for 2nd Quarter FY 2020** = $52,775
5. **Actual spending for 3rd Quarter FY 2020** = $4,424
6. **Actual spending for 4rd Quarter FY 2020** = $1,614
7. **Projected carryover into FY 2021 =** $301,010

MAJOR ACCOMPLISHMENTS

- The March/April Hands-On criticality safety course for Managers was postponed by the NCSP for COVID-19 concerns.
- The Sandia portion of the August Hands-On criticality safety course for NCSEs was cancelled by the NCSP for low student count.

NCSP Quarterly Progress Report (FY-2020 Q4)

SNL T&E Milestones:

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

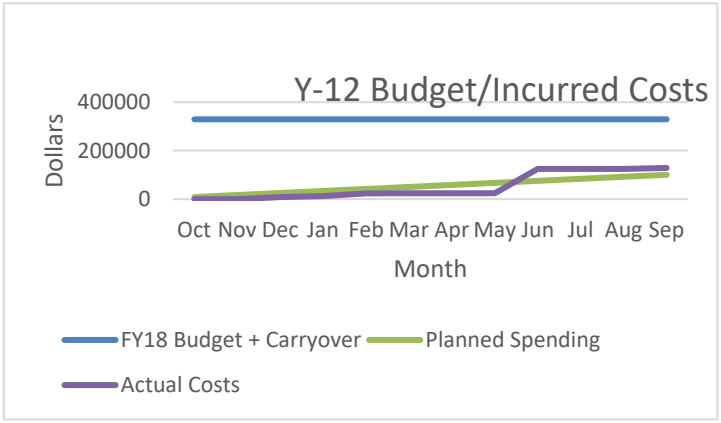
Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	MILESTONE	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)		
	Work with LLNL, ORNL, LANL to develop and deploy a 1-week hands-on NCSP T&E course for fissile material handlers and criticality safety officer. (TE2)		
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)		
	Work with LLNL, ORNL, LANL to develop and deploy a 1-week hands-on NCSP T&E course for fissile material handlers and criticality safety officer. (TE2)		
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)		
	Work with LLNL, ORNL, LANL to develop and deploy a 1-week hands-on NCSP T&E course for fissile material handlers and criticality safety officer. (TE2)		
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)		
	Work with LLNL, ORNL, LANL to develop and deploy a 1-week hands-on NCSP T&E course for fissile material handlers and criticality safety officer. (TE2)		

NCSP Quarterly Progress Report (FY-2020 Q4)

Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4	**N/A**		
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1			
Q2			
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2020 Q3)

NCSP Element and Subtasks: Y12 TE1, 3, 4 **Task Title:** TE1 Conduct Hands-On Criticality Safety Training Course (Lecture support week 1 of 2-week hands-on course and course material development) TE3 Design of a Subcritical Assembly at ORNL for use with the CSO Courses TE4 Design and Develop a New NCSP T&E Course for Criticality Safety Officers at DOE/NNSA Nuclear Facilities **M&O Contractor Name:** Y12 **Point of Contact Name:** Kevin Reynolds **Point of Contact Phone:** (865) 241-9067	**Reference: B&R DP0909010** **Date of Report: July 8, 2020**
BUDGET	**MAJOR ACCOMPLISHMENTS**
 1. **Carryover into FY 2020** = $229,223.19 2. **Approved FY 2020 Budget** = $100,000 + $229,223.19 = $329,223.19 (includes carryover) 3. **Actual spending for 1st Quarter FY 2020** = $7,938.80 4. **Actual spending for 2nd Quarter FY 2020** = $16,263.71 5. **Actual spending for 3rd Quarter FY 2020** = $100,000 (transfer to LANL) no other costs 6. **Actual spending for 4rd Quarter FY 2020** = $4,260.84 7. **Projected carryover into FY 2021 =** $200,759.84	Q1: No actions taken this quarter. Q2: Travel to Las Vegas to support course, time at course and prep prior to travel. Q3: No travel due to COVID impacts. No costs. Q4: Special Hands on class held at Y-12 (classroom portion only) – hands on portion to occur in November 2020 at NCERC.

Y12 TE 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, TE3)		
	Provide a progress report on Y12 support to ORNL for a subcritical assembly feasibility study (TE4)		
Q2	Conduct hands-on training classes at NFO and NCERC to support the training classes in accordance with the approved schedule. (TE1, TE3)		
	Provide a progress report on Y12 support to ORNL for a subcritical assembly feasibility study (TE4)		
Q3	Conduct hands-on training classes at NFO and NCERC to support the training classes in accordance with the approved schedule. (TE1, TE3)		
	Provide a progress report on Y12 support to ORNL for a subcritical assembly feasibility study (TE4)		
Q4	Conduct hands-on training classes at NFO and NCERC to support the training classes in accordance with the approved schedule. (TE1, TE3)		
	Provide a progress report on Y12 support to ORNL for a subcritical assembly feasibility study (TE4)		

NCSP Quarterly Progress Report (FY-2020 Q3)

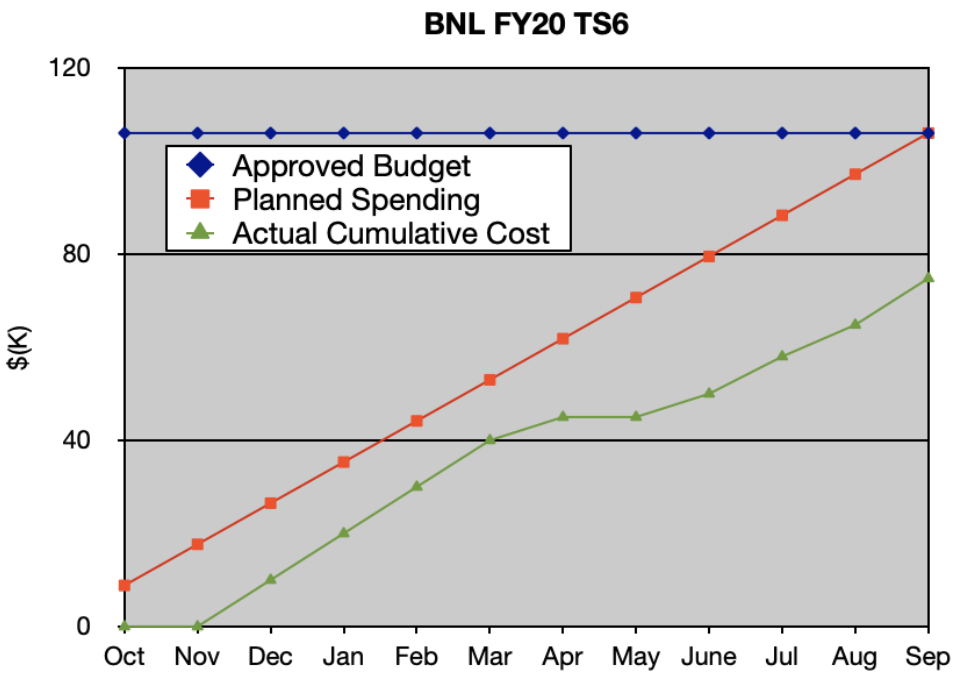
Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4	**N/A**		
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4	**N/A**		

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element and Subtask: NCSP Technical Support TS6
Task Title: ND Succession Planning
M&O Contractor Name: BNL
Point of Contact Name: David Brown
Point of Contact Phone: 631-344-2814

Reference: DP0902000
Date of Report: Oct. 15, 2020

BUDGET



1. **Carryover into FY 2020** = $0
2. **Approved FY 2020 Budget** = 106,000
3. **Actual spending for 1st Quarter FY 2020** = $10,000
4. **Actual spending for 2nd Quarter FY 2020** = $30,000
5. **Actual spending for 3rd Quarter FY 2020** = $10,000
6. **Actual spending for 4rd Quarter FY 2020** = $24,800
7. **Projected carryover into FY 2021 =** $31,200

ACCOMPLISHMENTS

Sophia Hollick (a DOE SULI student collaborator, Fall 2019) completed development of new algorithm to estimate the mean resonance spacing D from resonance data. This algorithm performed far better than any existing technique for estimating D. However, it ran into trouble with missing and misclassified resonances.

Following on Sophia's work, Pedro Rodriguez (a DOE SULI student collaborator, Spring 2020) began the development of a Bayesian classifier that can both pinpoint missing resonances and suggest the appropriate spin group for misclassified resonances using some results from Random Matrix Theory (RMT).

Both students returned in Summer 2020 and successfully created a resonance reclassifier using a decision tree. Rather than publish this work as is, we have a third student, Sergey Scoville (a DOE SULI student collaborator, Fall 2020) working to refine the features used in Sophia and Pedro's work. A Phys. Rev. C paper is in preparation.

NCSP Quarterly Progress Report (FY-2020 Q4)

BNL TS6 Milestones:

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

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	MILESTONE	STATUS	ISSUES/PATH FORWARD
Q1	NONE		
Q2	NONE		
Q3	NONE		This summer, Sophia and Pedro are combining efforts to extend the classifier with more RMT physics and unleash the classifier on the resonance data within the Atlas of Neutron Resonances. We aim to submit this work for publication this FY.
Q4	Provide NCSP Manager annual report of succession planning efforts.		A BNL report describing the work of the Summer 2020 students has been completed: BNL-219908-2020-INRE; we would like to apply the carry forward from this task to the deficit in task AM5.

NCSP Quarterly Progress Report (FY-2020 Q4)

Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**	**No**	
Q2	**N/A**	**No**	
Q3	**N/A**	**No**	
Q4	**N/A**	**No**	

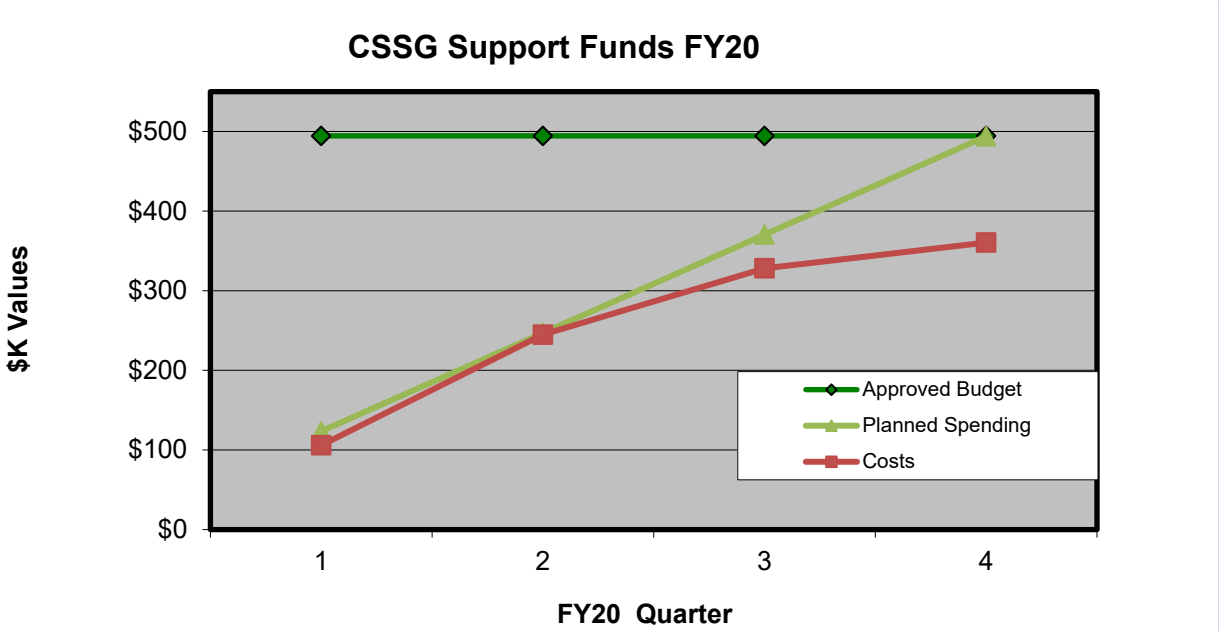
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	**Lab report BNL-219908-2020-INRE**	No	**Preparing submission for Phys. Rev. C**
Q2		**no**	
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element and Subtask: TS1
Task Title: CSSG Support
M&O Contractor Name(s): ANL, LANL, LLNL, ORNL, SRS
Point of Contact Name: David Hayes (CSSG Deputy Chair)
Point of Contact Phone: 505-667-4523

Reference: B&R DP 0909010
Date of Report: October 16, 2020

BUDGET



1. **Carryover into FY 2020** = $ 21,452
2. **Approved FY 2020 Budget** = $ 494,452
3. **Actual spending for 1st Quarter FY 2020** = $105,931
4. **Actual spending for 2nd Quarter FY 2020** = $138,916
5. **Actual spending for 3rd Quarter FY 2020** = $83,262
6. **Actual spending for 4rd Quarter FY 2020** = $32.345
7. **Projected carryover into FY 2021** = $133,998

MAJOR ACCOMPLISHMENTS

- Tasking 2020-04 Issued (SRPPF NNSA Technical Assist)
  - Will likely use up carryover
- Drafted Tasking 2021-01 nee 2020-05 (CSSG Review of Proposed Re-Issue of DOE-STD_1134)
- CSSG Telecons

NCSP Quarterly Progress Report (FY-2020 Q4)

CSSG TS Milestones:

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

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	MILESTONE	STATUS	ISSUES/PATH FORWARD
Q1	Provide the NCSP manager with a summary of CSSG activities, meetings, and tasks. (TS1)		**No Issues**
Q2	Provide the NCSP manager with a summary of CSSG activities, meetings, and tasks. (TS1)		**Taskings 2020-01, 2020-02, 2020-03 all behind schedule. Expect completion by EO APR.**
Q3	Provide the NCSP manager with a summary of CSSG activities, meetings, and tasks. (TS1)		**Taskings 2020-01, 2020-02, 2020-03 all completed. Tasking 2020-04 awaiting issuance.**
Q4	Provide the NCSP manager with a summary of CSSG activities, meetings, and tasks. (TS1)		**No Issues**

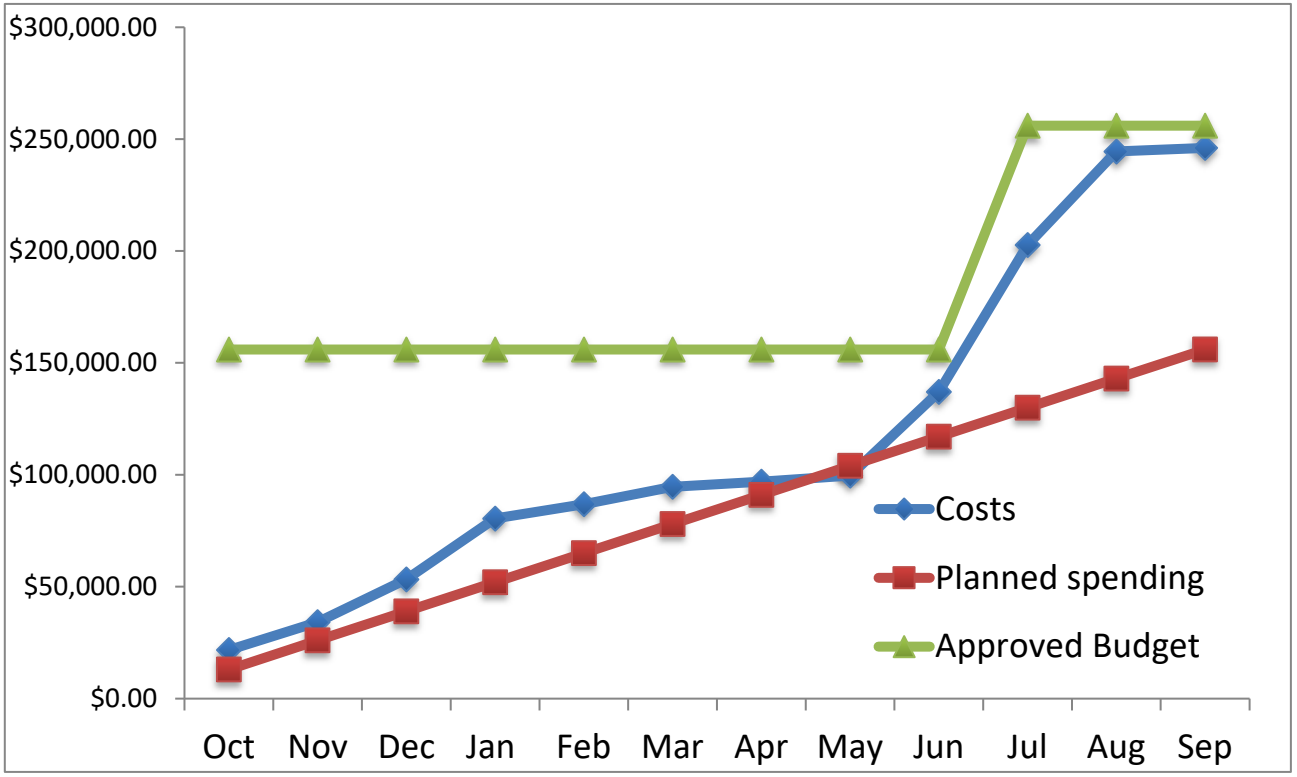
Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4	**N/A**		
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4	**N/A**		

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element: LANL TS4
Task Title: AM, IE, ND Succession Planning
M&O Contractor Name: Los Alamos National Laboratory (LANL)
Point of Contact Name: Joetta Goda
Point of Contact Phone: (505) 667-2812

Reference: B&R DP0909010
Date of Report: October 12, 2020

BUDGET



1. **Carryover into FY 2020** = $0K
2. **Approved FY 2020 Budget** = $156K (includes carryover)
3. **Actual spending for 1st Quarter FY 2020** = $53K
4. **Actual spending for 2nd Quarter FY 2020** = $41K
5. **Actual spending for 3rd Quarter FY 2020** = $42K
6. **Actual spending for 4rd Quarter FY 2020** = $109K
7. **Projected carryover into FY 2021** = $0K

MAJOR ACCOMPLISHMENTS

- Students working virtually for summer.
- Select students continue working in fall.

Added $100k to approved budget.

NCSP Quarterly Progress Report (FY-2020 Q4)

LANL TS4 Milestones:

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

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	MILESTONE	STATUS	ISSUES/PATH FORWARD
Q1	NONE		
Q2	NONE		
Q3	NONE		
Q4	Provide NCSP Manager annual report of succession planning efforts.		

NCSP Quarterly Progress Report (FY-2020 Q4)

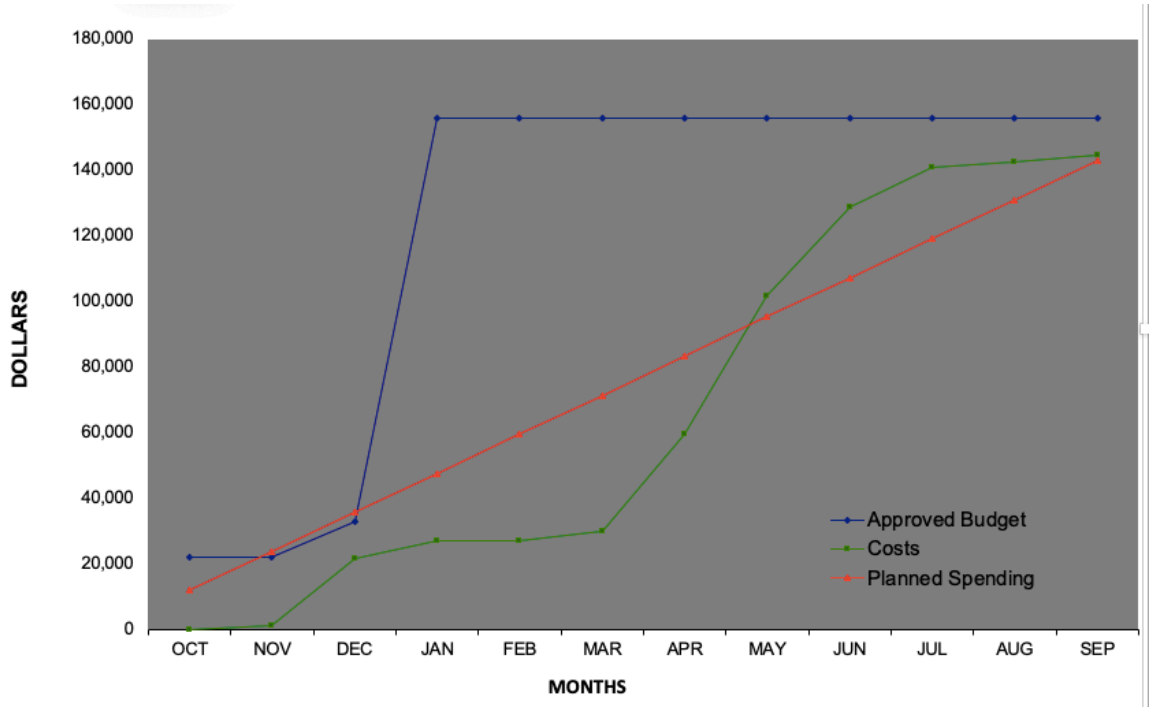
Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4	**N/A**		
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4			

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element and Subtasks: TS5
Task Title: LLNL Succession Planning
M&O Contractor Name: Lawrence Livermore National Laboratory
Point of Contact Name: David Heinrichs
Point of Contact Phone: (925) 424-5679

Reference: B&R DP0909010
Date of Report: October 16, 2020

BUDGET



1. **Carryover into FY 2020** = $0
2. **Approved FY 2020 Budget** = $156,000 (includes carryover)
3. **Actual spending for 1st Quarter FY 2020** = $21,715
4. **Actual spending for 2nd Quarter FY 2020** = $ 8,259
5. **Actual spending for 3rd Quarter FY 2020** = $98,756
6. **Actual spending for 4rd Quarter FY 2020** = $16,015
7. **Projected carryover into FY 2021** = $11,255 (7%)

MAJOR ACCOMPLISHMENTS

1. Pam Williams is now leading the development and maintenance of the https://ncp.llnl.gov and https://nda.llnl.gov websites with backup from Stacy Peterson (IPD, TS).
2. John Scorby will retire effective Nov. 1, 2020. His responsibilities in Nevada are transitioning to Will Zywiec and Soon Kim (IE, ND).
3. Arnika Chidambaram and Ruby Araj completed "Introduction to MCNP6" and "Intermediate MCNP6" via WebEx on July 20-24 and September 28 - October 2, 2020, respectively (AM, IE).
4. Software and limited hardware purchases for security requirements in Enhanced Security Areas in B234, B332 and NSF deferred until next period.
5. Alan Yamanaka received formal qualification as an LLNL and NMO (Nevada) Criticality Safety Engineer and TACS Instructor on August 5, 2020, and October 12, 2020, respectively (IE, T&E).
6. Catherine Percher attended the 2020 Working Party on Nuclear Criticality Safety (WPNCS) online meetings on July 6-10, 2020 (AM, IE, IP&D, ND).
7. Caleb Mattoon attended the Working Party on International Nuclear Data Evaluation Co-operation (WPEC) Subgroup 50 meeting on September 14-15, 2020 for "Developing an Automatically Readable, Comprehensive and Curated Experimental Reaction Database" (ND).
8. Godfree Gert registered for "Nuclear Data Fundamentals and AMPX Libraries Generation Course" offered online on October 26-30, 2020 (AM, ND, TS).

NCSP Quarterly Progress Report (FY-2020 Q4)

LLNL TS5 Milestones:

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

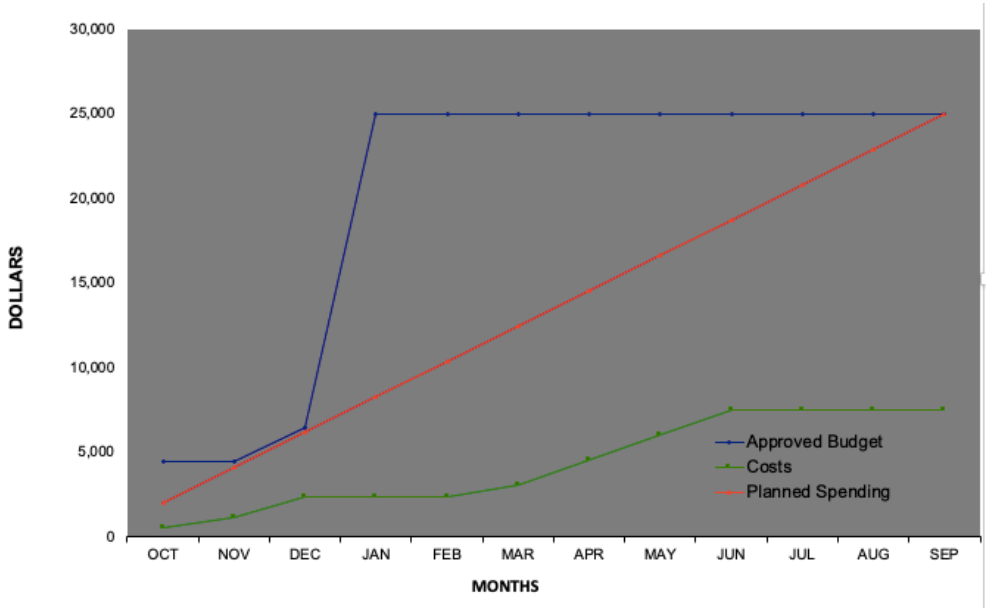
Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	MILESTONE	STATUS	ISSUES/PATH FORWARD
Q1	NONE		
Q2	NONE		
Q3	NONE		
Q4	Provide NCSP Manager annual report of succession planning efforts.		**Report is in preparation.**

Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4	**N/A**		
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4	**N/A**		

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element and Subtasks: TS16 **Task Title:** LLNL - NDA Website Support **M&O Contractor Name:** Lawrence Livermore National Laboratory **Point of Contact Name:** David Heinrichs **Point of Contact Phone:** (925) 424-5679	**Reference: B&R DP0909010** **Date of Report: October 16, 2020**
BUDGET	**MAJOR ACCOMPLISHMENTS**



1. **Carryover into FY 2020** = $0
2. **Approved FY 2020 Budget** = $25,000 (includes carryover)
3. **Actual spending for 1st Quarter FY 2020** = $2,400
4. **Actual spending for 2nd Quarter FY 2020** = $716
5. **Actual spending for 3rd Quarter FY 2020** = $4,440
6. **Actual spending for 4th Quarter FY 2020** = $0
7. **Projected carryover into FY 2021 =** $17,444 (70%)

1. No activity this period.

NCSP Quarterly Progress Report (FY-2020 Q4)

LLNL TS5 Milestones:

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

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	MILESTONE	STATUS	ISSUES/PATH FORWARD
Q1	Provide the NCSP manager with a summary of NDA Website support		
Q2	Provide the NCSP manager with a summary of NDA Website support		
Q3	Provide the NCSP manager with a summary of NDA Website support		
Q4	Provide the NCSP manager with a summary of NDA Website support		

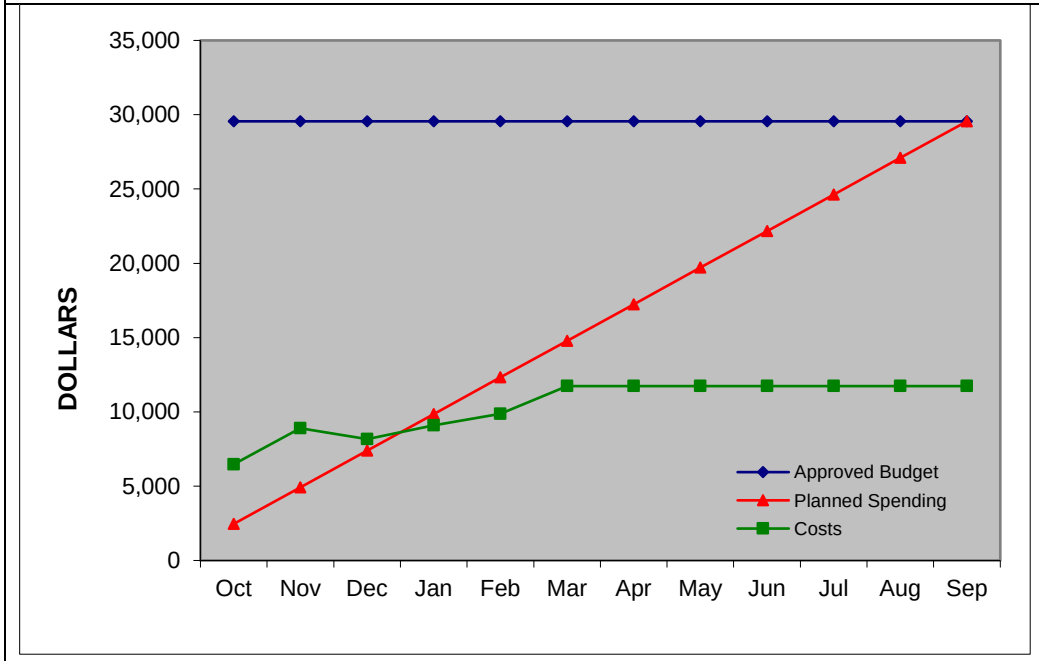
Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4	**N/A**		
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	"DOE NNSA Nondestructive Assay Program," LLNL-WEB-765077, Approved: January 3, 2019.	**Yes**	
Q3	**N/A**		
Q4	**N/A**		

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element and Subtasks: NNL TS9
Task Title: NNL – Support for NDAG Chair activities
M&O Contractor Name: NNL
Point of Contact Name: Mike Zerkle
Point of Contact Phone: (412) 476-6188

Reference: B&R DP0909010
Date of Report: October 27, 2020

BUDGET



1. **Carryover into FY 2020** = $0.5k
2. **Approved FY 2020 Budget** = $29.5k (includes carryover)
3. **Actual spending for 1st Quarter FY 2020** = $8k
4. **Actual spending for 2nd Quarter FY 2020** = $4k
5. **Actual spending for 3rd Quarter FY 2020** = $0k
6. **Actual spending for 4rd Quarter FY 2020** = $0k
7. **Projected carryover into FY 2020 =** $17k (61%)

MAJOR ACCOMPLISHMENTS

1. Coordinated nuclear data section of NCSP FY2021 budget including Appendix B update.
2. Participated in remote NCSP budget execution meeting.
3. Contributed to WANDA-2020 Proceeding issued August 2020.
4. Participated in NDWG virtual meetings representing NCSP.
5. Participated in Monthly NCSP IE status meetings remotely as NDAG Chair.
6. Participated in virtual WPNCS SG5 and SG8 meetings (Aug/Sep).
7. CEdT process support as NDAG Chair and CEdT Team Member for several IERs.
8. Recent publications:
    a. J. L. Wormald, A. I. Hawari and M. L. Zerkle, "Impact of Magnetic Structure and Thermal Effects on Vibrational Excitations and Neutron Scattering in Uranium Mononitride," *Annals of Nuclear Energy*, **143**, 107447 (2020).
    b. 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* (accepted).

NCSP Quarterly Progress Report (FY-2020 Q4)

NNL TS9 Milestones:

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

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	MILESTONE	STATUS	ISSUES/PATH FORWARD
Q1	Provide the NCSP manager with a summary of NDAG chair activities, meetings, and tasks. (TS9)		
Q2	Provide the NCSP manager with a summary of NDAG chair activities, meetings, and tasks. (TS9)		
Q3	Provide the NCSP manager with a summary of NDAG chair activities, meetings, and tasks. (TS9)		
Q4	Provide the NCSP manager with a summary of NDAG chair activities, meetings, and tasks. (TS9)		

Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	OECD/NEA Paris, France Oct-19 TS9 ICSBEP and IRPhE Technical Review Meetings (Zerkle) Provide oversight of NCSP IE tasks as ICSBEP tasks are the end product of the NCSP IE process.	No	Report prepared, release approval delayed due to COVID-19 emergency.
Q3	Cambridge, England Apr-20 TS9 Attend PHYSOR 2020 meeting of the ANS. NCSP task that travel. (Zerkle) Present paper on thermal neutron scattering.	No	Conference cancelled due to the COVID-19 emergency.
	OECD/NEA Paris, France May-20 TS9 Participate in WPEC annual meeting (Zerkle) As NDAG Chair, participate in WPEC.	No	Meeting held online due to COVID-19 emergency.
Q4	**N/A**		

Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	M. L. Zerkle, J. C. Holmes, and J. L. Wormald, "Re-evaluation of the TSL for Yttrium Hydride," *PHYSOR-2020*, Cambridge, UK, March 29-April 2, 2020 (accepted).	Yes	Submitted in Q4 once proceedings available, delayed due to COVID-19
	J. L. Wormald, M. L. Zerkle, and J. C. Holmes, "Generation of the TSL for Zirconium Hydrides from Ab Initio Methods," *PHYSOR-2020*, Cambridge, UK, March 29-April 2, 2020 (accepted)	Yes	Submitted in Q4 once proceedings available, delayed due to COVID-19
	J. C. Holmes, M. L. Zerkle, and A. I. Hawari, "Validation of Thermal Scattering Laws for Light Water at Elevated Temperatures with Diffusion Experiments," PHYSOR-2020, Cambridge, UK, March 29-April 2, 2020 (accepted)	Yes	Submitted in Q4 once proceedings available, delayed due to COVID-19
Q2	**N/A**		
Q3	**N/A**		

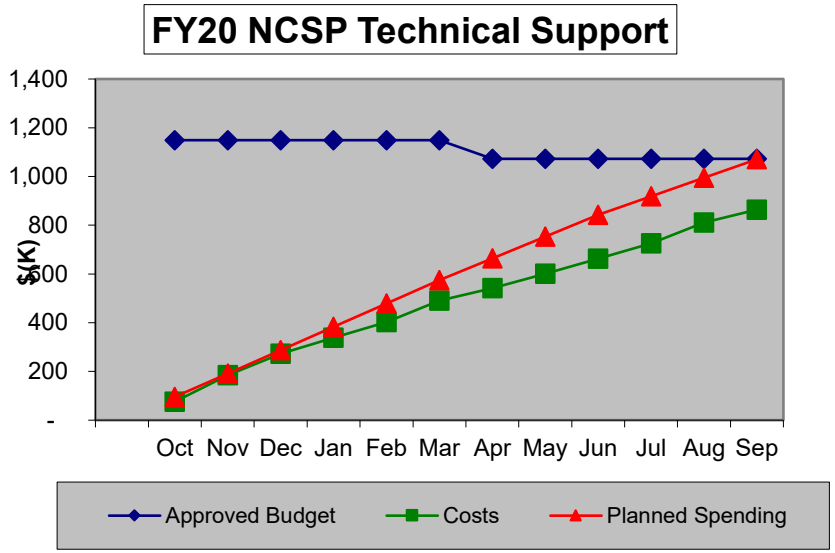
Q4	J. L. Wormald, A. I. Hawari and M. L. Zerkle, "Impact of Magnetic Structure and Thermal Effects on Vibrational Excitations and Neutron Scattering in Uranium Mononitride," *Annals of Nuclear Energy*, **143**, 107447 (2020).	No	Copyrighted, DOI to access provided below: https://doi.org/10.1016/j.anucene.2020.107447
	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* (accepted).	No	Will provide DOI when available.

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element and Subtask: TS2 (Support for Lead Lab to Execute the NCSP**), TS7** (AM/ND Succession Planning), **TS8** (NCSP MGT Tool Development), **TS11** (CEdT Manager Support), **TS13** (NDA Technical Support Group and NDA Technical Infrastructure Project)
M&O Contractor Name: ORNL
Point of Contact Name: Doug Bowen
Point of Contact Phone: (865) 576-0315

Reference: DP0909010/ORNL
Date of Report: Oct 2020

BUDGET



1. **Carryover into FY 2020** = $183
2. **Approved FY 2020 Budget** = $ (includes carryover) $1149K (Budget reduced in Q2 by $77K to account for the movement of funds to RSICC AM1)
3. **Actual spending for 1st Quarter FY 2020** = $273K
4. **Actual spending for 2nd Quarter FY 2020** = $ 218K
5. **Actual spending for 3rd Quarter FY 2020** = $ 171K
6. **Actual spending for 4rd Quarter FY 2020** = $202K
7. **Projected carryover into FY 2021 = $164K**

MAJOR ACCOMPLISHMENTS

TS2 – NCSP execution

- Prepare and maintain elements of NCSP Plan and associated activities:
  - Monitor Five-Year Plan progress,
  - 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 Q3 QPRs into a single bookmarked PDF file for use in QPR. Conducted Q3 tele-con.
- Henley completed work on the FY20 Spring Newsletter
- 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.
- Continue the process to populate the NDA website (http://nda.llnl.gov) with materials to support the NDA Technical Infrastructure Project.
- Working on NCSP website enhancements and fixes
- Rev. 4 of the FY20 Main 5-year plan and Rev. 2 of the Integral Experiment section were completed in Q4.
- Continued to train Marsha Henley on NCSP MGT teamwork.
- Henley/Scott is working on adding legacy and FY20 foreign travel reports to the NCSP website. Work is complete.
- Working with Leidos Project MGT, Scott transferred all NCSP files to ORNL to be archived. Scott and Bowen worked to turn over remaining Scott work to Henley in preparation for Lori's last day, Sept. 30, 2020.

TS7 – 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.

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element and Subtask: TS2 (Support for Lead Lab to Execute the NCSP**), TS7** (AM/ND Succession Planning), **TS8** (NCSP MGT Tool Development), **TS11** (CEdT Manager Support), **TS13** (NDA Technical Support Group and NDA Technical Infrastructure Project) **M&O Contractor Name:** ORNL **Point of Contact Name:** Doug Bowen **Point of Contact Phone:** (865) 576-0315	**Reference:** DP0909010/ORNL **Date of Report:** Oct 2020
	TS8 – IER Database • 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. A list of IER enhancements and fixes have been prioritized and funded and will be fixed in the various G2 update campaigns. **TS11 – CEDT 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 Q4 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 Program** • Efforts continue on the TSG efforts to generate the new ANSI/ANS-8.28 standard for NDA administrative requirements in NCS programs. The first ANS-8 ballot was completed. A second ANS-8 ballot is expected after the winter ANS meeting. COVID has impacted progress. • Bowen had three telecons with Chambers, Berg, and Dolin regarding the "reboot" of the NDA program. The NCSP Mission and Vision is being finalized at ORNL that will describe the various aspects of the NDA program. Further telecons will help Berg in his planning efforts with his new program with assistance of the TSG chair, Dolin, and ORNL, Bowen.

NCSP Quarterly Progress Report (FY-2020 Q4)

ORNL TS 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 CEdT process and coordinate execution of planned IERs each FY. (TS2)		
	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)		
	Provide NCSP Manager a status report of progress on the development of a program management tool. (TS8)		Implementation of IER system is due in Q2 or Q3 of FY2020. Reorg efforts with the G2 system programmers has led to some delays and mistakes.
	Provide the NCSP manager with a summary of NCSP CEdT support. (TS11)		
	Provide the NCSP manager an update of NDA Technical Support Group and NDA Technical Infrastructure Project activities. (TS13)		
Q2	Manage CEdT process and coordinate execution of planned IERs each FY. (TS2)		
	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)		
	Provide NCSP Manager a status report of progress on the development of a program management tool. (TS8)		

	Provide the NCSP manager with a summary of NCSP CEdT support. (TS11)		
	Provide the NCSP manager an update of NDA Technical Support Group and NDA Technical Infrastructure Project activities. (TS13)		
Q3	Manage CEdT process and coordinate execution of planned IERs each FY. (TS2)		
	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)		
	Provide NCSP Manager a status report of progress on the development of a program management tool. (TS8)		
	Provide the NCSP manager with a summary of NCSP CEdT support. (TS11)		
	Provide the NCSP manager an update of NDA Technical Support Group and NDA Technical Infrastructure Project activities. (TS13)		
Q4	Manage CEdT process and coordinate execution of planned IERs each FY. (TS2)		
	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)		
	Provide NCSP Manager a status report of progress on the development of a program management tool. (TS8)		
	Provide the NCSP manager with a summary of NCSP CEdT support. (TS11)		

	Participate in Q4 Budget Execution Meeting and assist NCSP Manager in finalization of approved tasks for next FY. (TS2)		
	Publish final Five-Year Plan. (TS2)		
	Provide NCSP Manager annual report of succession planning efforts. (TS7)		
	Provide the NCSP manager an update of NDA Technical Support Group and NDA Technical Infrastructure Project activities. (TS13)		

NCSP Quarterly Progress Report (FY-2020 Q4)

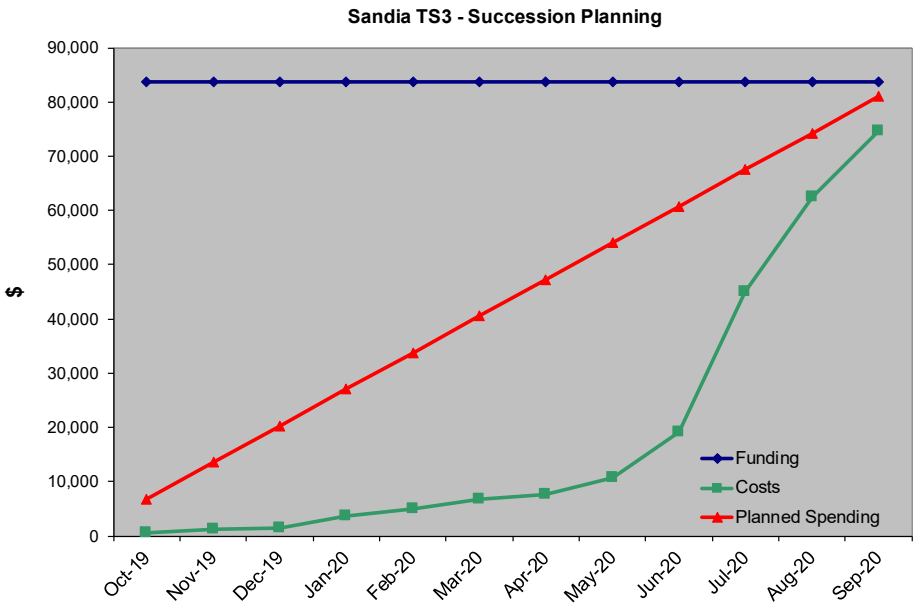
Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	London, UK Jun-20 NCSP-TS2 ISO TC85/SC5 Plenary and WG8 Nuclear Criticality Safety Meetings (Bowen) Continue to provide US leadership with ISO Nuclear Criticality	**No**	**Cancelled**
Q4	Aldermaston, United Kingdom Mar 20 NCSP-TS2 Coordinate NCSP work as described in Appendix F of the Five Year Execution Plan. Bowen invited to participate.	**No**	**Cancelled**
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	5-year plans (main and IE sections)	Yes	
Q2	Rev. 1 and 2 of main 5-year plan. Rev. 1 of IE section of the 5-year plan.	Yes	
Q3	Spring NCSP newsletter	Yes	
Q4	none		

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element: SNL TS3
Task Title: Support for Experimentalist Succession Planning
M&O Contractor Name: Sandia National Laboratories (SNL)
Point of Contact Name: Gary A. Harms
Point of Contact Phone: (505)845-3244

Reference: B&R DP 0909010
Date of Report: September 30, 2020

BUDGET



1. **Carryover into FY 2019** = $2,593
2. **Approved FY 2020 Budget** = $83,593 (includes carryover)
3. **Actual spending for 1st Quarter FY 2020** = $1,400
4. **Actual spending for 2nd Quarter FY 2020** = $5,250
5. **Actual spending for 3rd Quarter FY 2020** = $12,527
6. **Actual spending for 4rd Quarter FY 2020** = $55,511
7. **Projected carryover into FY 2021 =** $8,905

MAJOR ACCOMPLISHMENTS

- We have a matrixed employee who is performing as an experimenter.
- The new experimenter is working on the IER-230 experiments.
- The new experimenter has been actively participating in the NCS community by attending conferences and publishing papers.
- Our year-round graduate student intern is making substantial progress on documenting some critical experiments done at Sandia in the late ‘80s and early ‘90s.

NCSP Quarterly Progress Report (FY-2020 Q4)

SNL TS3 Milestones:

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

Complete	On Schedule	Behind Schedule	Missed Milestone

QUARTER	MILESTONE	STATUS	ISSUES/PATH FORWARD
Q1	NONE		
Q2	NONE		
Q3	NONE		
Q4	Provide NCSP Manager annual report of succession planning efforts.		

NCSP Quarterly Progress Report (FY-2020 Q4)

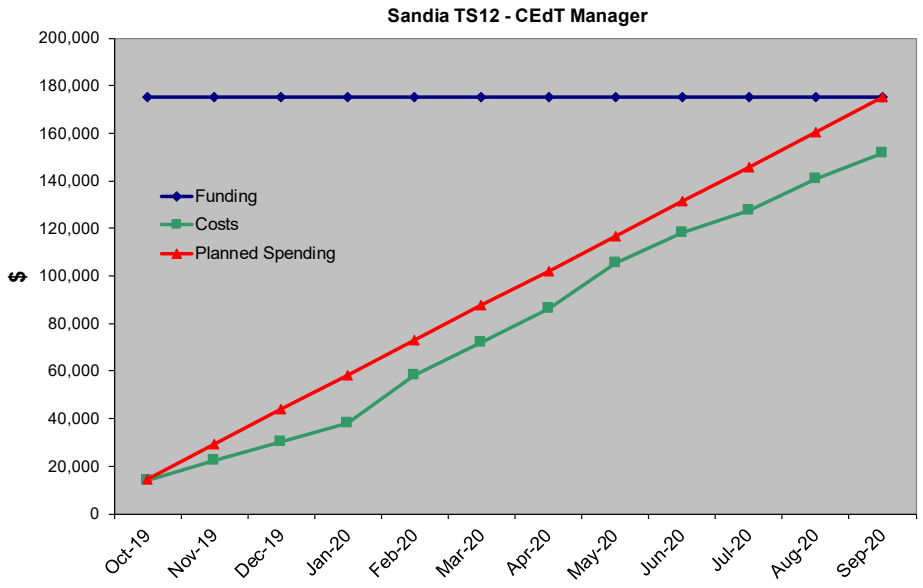
Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4	**N/A**		
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	D. E. Ames, TITANIUM AND ALUMINUM SLEEVE EXPERIMENTS IN FULLY-REFLECTED WATER-MODERATED U(4.31)O_2 FUEL ROD LATTICES WITH 2.8 CM PITCH, LEU-COMP-THERM-099, International Handbook of Evaluated Criticality Safety Benchmark Experiments, NEA/NSC/DOC(95)3, September, 2019.	Yes	
	D. E. Ames, "Sandia BUCCX Titanium and Aluminum Sleeve Experiments," ANS Winter Meeting and Expo, Washington DC, Nov. 2019.	Yes	
Q2			
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element: SNL TS12
Task Title: Sandia – NCSP C_EdT Manager Support
M&O Contractor Name: Sandia National Laboratories (SNL)
Point of Contact Name: Gary A. Harms
Point of Contact Phone: (505)845-3244

Reference: B&R DP 0909010
Date of Report: September 30, 2020

BUDGET



1. **Carryover into FY 2019** = $0
2. **Approved FY 2020 Budget** = $175,000 (includes carryover)
3. **Actual spending for 1st Quarter FY 2020** = $30,102
4. **Actual spending for 2nd Quarter FY 2020** = $41,846
5. **Actual spending for 3rd Quarter FY 2020** = $46,145
6. **Actual spending for 4rd Quarter FY 2020** = $33,324
7. **Projected carryover into FY 2021 =** $23,583

MAJOR ACCOMPLISHMENTS

- 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.
- Tracked progress and BCRs on IER action items and 2020 milestones including WFO IER action items.
- Worked in the IER database and assisted others in the transition to the new database.
- Assisted the DOE NCS Program Management Team on a broad scope of items.

NCSP Quarterly Progress Report (FY-2020 Q4)

SNL TS3 Milestones:

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

Complete	On Schedule	Behind Schedule	Missed Milestone

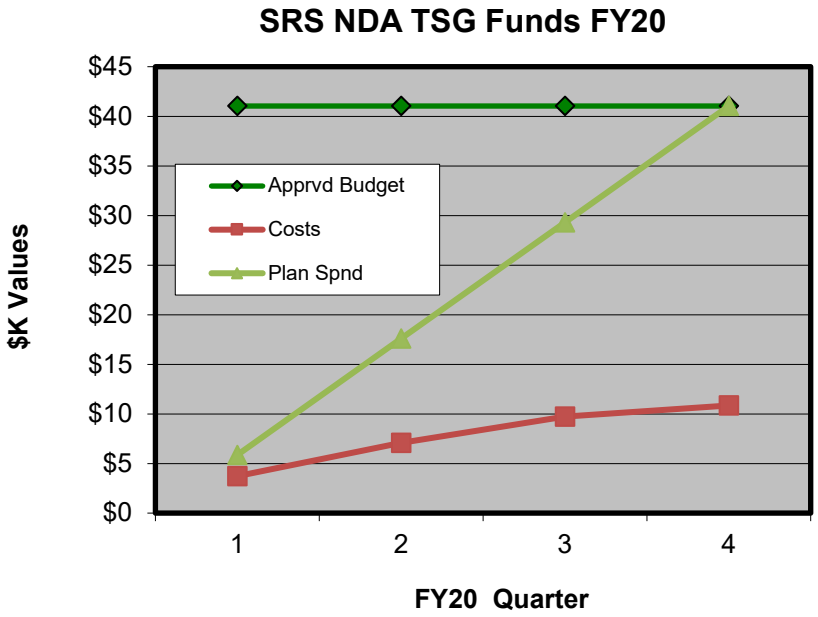
QUARTER	MILESTONE	STATUS	ISSUES/PATH FORWARD
Q1	Provide the NCSP manager with a summary of NCSP CEdT support. (TS12)		
Q2	Provide the NCSP manager with a summary of NCSP CEdT support. (TS12)		
Q3	Provide the NCSP manager with a summary of NCSP CEdT support. (TS12)		
Q4	Provide the NCSP manager with a summary of NCSP CEdT support. (TS12)		

NCSP Quarterly Progress Report (FY-2020 Q4)

Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4	**N/A**		
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1			
Q2			
Q3			
Q4			

NCSP Quarterly Progress Report (FY-2020 Q4)

NCSP Element and Subtask: SRS TSG **Task Title:** Support the NDA TSG **M&O Contractor Name(s):** SRNS **Point of Contact Name:** David Erickson **Point of Contact Phone:** 803-557-9445	**Reference: B&R DP 09090200** **Date of Report: October 15, 2020**
BUDGET	**MAJOR ACCOMPLISHMENTS**



1. **Carryover into FY 2020** = $41K
2. **Approved FY 2020 Budget** = $41K (includes carryover)
3. **Actual spending for 1st Quarter FY 2020** = $3.7K
4. **Actual spending for 2nd Quarter FY 2020** = $3.1K
5. **Actual spending for 3rd Quarter FY 2020** = $2.6K
6. **Actual spending for 4rd Quarter FY 2020** = $1.1K
7. **Projected carryover into FY 2021** = $30.1K

- Weekly review/edit of ANSI/ANS-8.28 NDA for Criticality Safety (and impact to potential new DOE Std.)
- Normal correspondence/reviews

NCSP Quarterly Progress Report (FY-2020 Q4)

SRS TSG 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 NDA TSG.		
Q2	Provide status reports on SRS progress with NDA TSG.		
Q3	Provide status reports on SRS progress with NDA TSG.		
Q4	Provide status reports on SRS progress with NDA TSG.		

NCSP Quarterly Progress Report (FY-2020 Q4)

Foreign Trip Reports (from Appendix C – 5YP)			
Quarter	**Foreign Trip Report** (please provide details for reports not listed below)	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3	**N/A**		
Q4	**N/A**		
Publications (add each publication on an individual line)			
Quarter	**Publication Reference**	**Submitted yes/no**	**If no, state status of submittal**
Q1	**N/A**		
Q2	**N/A**		
Q3			
Q4			

2020-10-05

Summary of MCNP Criticality Classes in FY 2020 – Q1, Q2, Q3, Q4

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

FY2020 – Q4 classes are highlighted in red.

Total Students

- FY2020 – Q1: 100 students (Criticality, UNM, Intro, Intermediate, VR, UM, NJOY classes)
- FY2020 – Q2: 36 students (Criticality, UNM, Intro classes)
- FY2020 – Q3: 86 students (UNM class, online: Intro, Variance Reduction, S/U)
- FY2020 – Q4: 93 students (UNM, online: Intro, Intermediate)
- **FY2020 – TOTAL: 315 students**

Due to COVID-19 & travel restrictions, many classes & site visits were cancelled. Completed successful transition to online delivery of all classes. Importantly, offering online classes has significantly increased class enrollment.

Classes sponsored by DOE-NNSA-NCSP

- **Criticality Calculations with MCNP6 (LANL-AM1)**
  - **Oct 21-24, 2019 Y-12 22 students**
  - **March 9-13, 2020 LANL 10 students**

  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)**
  - **June 23, 2020 online 15 students, LANL NCS & NEN-2**

  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 24 – Dec 6, 2019 UNM 18 students**
  - **Aug 21 – Dec 4, 2020 UNM+online 13 students**

  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)**
  - **Jan 23 – May 7, 2020 UNM+online 11 graduate students**

  Advanced class covering details of transport theory, Monte Carlo, advanced computing methods, & 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**
  - **Oct 21-25, 2019, LANL 14 students**
  - **March 2-6, 2020 LANL 15 students**
  - **April 27-30, 2020 online (LANL-only pilot) 40 students**
  - **July 20-24, 2020 online 40 students**

  Introductory class, includes 1/2 day on criticality calculations (without NCS validation & Whisper).
- **Intermediate MCNP6**
  - **Oct 7-11, 2019, OECD-NEA, Paris 13 students**
  - **Oct 28 – Nov 1, 2019 LANL 13 students**
  - **Aug 24-28, 2020 online 40 students**
- **Unstructured Mesh with Attila4MC**
  - **Nov 5-9, 2019 LANL 9 students**
- **Variance Reduction**
  - **Oct 14-18, 2019 OECD-NEA, Paris 11 students**
  - **May 18, 2020 online 20 students**

2020 Q4 – SCALE Training Courses Report for the Nuclear Criticality Safety Program

Class Name	Frequent Fulcrum Functions: The Basics of SCALE's Graphical User Interface
Class Dates	July 27, 2020
Location	Virtual - Oak Ridge National Lab, Oak Ridge, TN
Number of Attendees	25
Short Description	This tutorial will introduce the Fulcrum graphical user interface and the basic functions that enhance the common activities of creating, editing, navigating, executing, and visualizing SCALE input files. This tutorial will help attendees become familiar with the Fulcrum input file text editor and the integrated input development environment features of autocompletion, automatic checking, cursor context, and input navigation. In addition, the Fulcrum and SCALE runtime environment will be reviewed to improve understanding of job execution workflow. No prior experience with SCALE is required. Attendees can follow along using SCALE 6.2.3 or 6.3.0-beta.

Class Name	Generation of SCALE Multigroup Libraries for Advanced Reactors using AMPX
Class Dates	July 27, 2020
Location	Virtual - Oak Ridge National Lab, Oak Ridge, TN
Number of Attendees	25
Short Description	AMPX is the nuclear data processing tool used to create the SCALE nuclear data libraries. A brief overview of the data used in SCALE and its provenance will be presented. We will present a high-level overview of AMPX and the library generation workflow. Users will be taught to use Exsite, the AMPX template expansion graphical user interface, to generate all of the inputs necessary to create a multigroup library for SCALE. We will discuss some of the user choices that influence the domain of applicability for multigroup libraries. Users will be shown how to run SCALE models with custom libraries. No prior experience with SCALE is required. Attendees can follow along using SCALE 6.3.0-beta.

Class Name	Light Water Reactor Depletion Analysis with Polaris
Class Dates	July 28, 2020
Location	Virtual - Oak Ridge National Lab, Oak Ridge, TN
Number of Attendees	25
Short Description	This tutorial will walk through the use of Polaris for 2-D LWR depletion analysis. Polaris provides an easy-to-use input for defining lattice geometries, material compositions, and reactor state conditions. Attendees will learn how to model a standard PWR lattice, with user-defined time-dependent state conditions, such as control rod insertion and removal and visualization of the burnt-fuel inventories in Fulcrum. A quick run-through will be provided of LTR or LTA analysis using advanced technologies such as doped fuel or coated cladding. No prior experience with SCALE is required. Attendees can follow along using SCALE 6.3.0-beta.

Class Name	Advanced User Interface for Advanced Reactors
Class Dates	July 28, 2020
Location	Virtual - Oak Ridge National Lab, Oak Ridge, TN
Number of Attendees	25
Short Description	This tutorial will review the data plotting and geometry visualization capabilities in the Fulcrum graphical user interface. This tutorial will help attendees become familiar with Fulcrum's 2D plot, and 2D and 3D geometry visualization features. Attendees will learn how to identify plottable data items, compose and export plot and plot data for SCALE plot formats (SDF, Ampx MG/CE, PLT, F71, PTP, SPF, ORIGEN gamma data, etc.) and visualize, navigate, cut, hide, and export the geometry and spatial data (fission map, dose map, etc.) overlays in 2D and 3D. No prior experience with SCALE is required. Attendees can follow along using SCALE 6.3.0-beta.

Class Name	Crossing the Streams – Sampler and the TemplateEngine
Class Dates	July 28, 2020
Location	Virtual - Oak Ridge National Lab, Oak Ridge, TN
Number of Attendees	25
Short Description	This tutorial will introduce the SCALE TemplateEngine and its uses for generating inputs with repeated components. This approach can be very useful for creating arrays with each instance created uniquely, which can facilitate more detailed models and greater output granularity. Combining this automated model expansion with Sampler allows detailed modeling of general disarray and/or the location of individual elements within an array. The culmination of this tutorial is using Sampler to generate a KENO V.a model of an LWR fuel assembly with each rod positioned randomly and uniquely. The concepts are also directly applicable to KENO-VI and TRITON. No prior experience with SCALE is required. Attendees can follow along using SCALE 6.2.3 or 6.3.0-beta.

Class Name	Activation Analysis with ORIGEN/MAVRIC for Advanced Reactors
Class Dates	July 28, 2020
Location	Virtual - Oak Ridge National Lab, Oak Ridge, TN
Number of Attendees	25
Short Description	This tutorial will demonstrate the application of ORIGEN and MAVRIC for activation analysis for an advanced reactor concept. ORIGEN will be used to generate the activation source terms and MAVRIC will be employed to calculate dose rates due to activated materials. No prior experience with SCALE is required. No prior experience with SCALE is required. Attendees can follow along using SCALE 6.3.0-beta.

Class Name	SCALE Utilities for Nuclear Data Interrogation, Comparison, and Visualization
Class Dates	July 29, 2020
Location	Virtual - Oak Ridge National Lab, Oak Ridge, TN
Number of Attendees	25
Short Description	This tutorial is intended as an introduction to the tools available to interrogate, compare, and visualize the SCALE nuclear data. We will use Fulcrum to plot continuous energy and multigroup cross section data, multigroup scattering

	matrices, covariance matrices, and correlation matrices. We will also demonstrate how to use Fulcrum to compare cross section and uncertainty data from different ENDF releases. Users will get the chance to use a new tool, OBIWAN (ORIGEN Binary Interrogation Without A SCALE iNput) to view/patch/diff/convert data found on F33 and F71 files. Lastly, a variety of AMPX tools will be used to compare covariance libraries, compare working and master libraries, and print/manipulate the data stored on a multigroup library. No prior experience with SCALE is required. Attendees can follow along using SCALE 6.2.3 or 6.3.0-beta.

Class Name	Advanced Reactor Source Terms for Safeguards Application
Class Dates	July 29, 2020
Location	Virtual - Oak Ridge National Lab, Oak Ridge, TN
Number of Attendees	25
Short Description	This tutorial will demonstrate the application of ORIGEN for calculation of source terms of interest in nuclear safeguards, using as example a simplified model representative for HTGR fuel. Attendees will learn how to generate neutron and gamma spectra, and how to calculate U and total Pu inventory in spent fuel as a function of cooling time after fuel discharge from the reactor. The results will be compared to source term data representative of LWR spent fuel. No prior experience with SCALE is required. Attendees can follow along using SCALE 6.2.3 or 6.3.0-beta.

SCALE Users' Group Workshop – Information about attendance:

a) Total number of attendees - 251
b) Total number of ORNL attendees - 37
c) Total number of attendees from international institutions - 87
d) Breakdown of total number of attendees by:
    1. NRC - 6
    2. DOE & other labs - 81
    3. Academia – US 48, FN 32
    4. Industry – US 29, FN 55

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. Planned release of a modified version of this report to the NCSP has been delayed due to approvals process. However, report can now be shared with the NCSP.						
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.						
AWE-IE13	Characterization of AFRRI TRIGA reactor radiation field	LLNL-IE18 SNL-IE4	Provide support to experiment design	P. ANGUS	A. ROMANYUKHA	LLNL

Reference			AWE Contributions and POCs			
AWE Reference	**Task Description**	**NCSP Reference**	**FY2018 AWE Contribution**	**AWE Technical POC**	**Collaborator POC**	**DOE Lab**
	AWE will provide onsite measurement					
AWE was fully prepared for July 2019 trial, prior to the regulatory shut-down of TRIGA. If trial is re-scheduled for 2020 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
on the
International Collaboration with the Institut de Radioprotection et de Sûreté Nucléaire (IRSN) for FY2020

	REFERENCE		IRSN Contribution / POC			
IRSN Reference	**Task Title**	**DOE Reference**	**FY 2020 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 MIRTE 1 experiments. To be discussed with ORNL.	N. LECLAIRE	B.J. MARSHAL	ORNL
This task was initiated in the frame of the OECD/NEA UACSA expert group. Experimental correlations were established for LCT007 and LCT039 – need to contact Brad Rearden to discuss about the experiments of interest for the FY2019. 2019-Q4: IRSN proposal to work on experimental correlations of MIRTE 1 experiments but a lot of discussions about the calculations of experimental correlations on the SG1 subgroup of the OCDE/AEN/WPNCS Will also be discussed at the ICSBEP meeting in October 2019 FY20-Q1: No progress FY20-Q2: MIRTE 1 final evaluation provided to ICSBEP – ORNL calculated keff results for all the experiments (received by IRSN – analysis in progress) FY20-Q3: common paper about the use of TSUNAMI for experiments design and analysis proposed for the ANS winter meeting. FY20-Q4: Abstract will be presented by Justin CLARITY at the 2020 ANS Winter meeting.						
IRSN-AM5	Update of the slide rule	ORNL-AM6 LLNL-AM3 AWE-AM1	Subtask 2 of IRSN proposal Update of the “slide rule” for the rapid response estimation of a criticality accident (using COG, MCNP, MAVRIC, ATTILA…)	M. DULUC	D. BOWEN D. HEINRICHS R. JONES	ORNL LLNL AWE
The next step will be in particular the number of fissions estimate (meeting about this subject during the TPR meeting, Amarillo). IRSN has to propose a new technical POC following the change of position of M. Duluc (decision in progress). FY2020-Q3: short report about the number of fission estimate in progress FY2020-Q4: report sent September 11th to Doug BOWEN and Dave HEINRICHS for review						
IRSN-AM7	ACE QA testing and implementation	LANL-AM2	Implementation of the defined QA tests in ACEtk and integration in GAIA	L. LEAL	J. CONLIN	LANL
Report provided by LANL to IRSN by Wim Haeck with detailed descriptions. Integration in GAIA in progress						
IRSN-AM8	Analytical Methods Working Group	NCSP-TS2	IRSN participation to NCSP analytical methods Working Group and IRSN participation to TPR meeting	S. PIGNET	F. BROWN D. BOWEN	NCSP
IRSN participation to TPR in February 2020 and presentation at AMWG meeting Participation of Luiz LEAL to the NDAG meeting November 2020						
IRSN-AM9	Cross sections processing validation	ORNL-AM3	Development of an interface between GAIA and AMPX and test interface capabilities.	R. ICHOU	D. WIARDA D. BOWEN	ORNL
Tool for generating AMPX multigroup cross section library with DRAGON. Task needs completion.						

	REFERENCE		IRSN Contribution / POC			
IRSN Reference	**Task Title**	**DOE Reference**	**FY 2020 IRSN Contribution**	**IRSN Technical POC**	**DOE Technical POC**	**DOE LAB**
AMPX training course planned in May 2020 at IRSN postponed due to COVID-19. FY2020-Q4: Two IRSN employees will participate in the Oct/2020 AMPX workshop organized by ORNL.						
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. (Completion of this task before ORNL-AM9 and LANL-AM4 would be useful to identify common benchmarks.) IEU and LEU systems will be included in FY 2020.	N. LECLAIRE	D. HEINRICHS D. BOWEN F. BROWN	LLNL ORNL LANL
FY20-Q1: MCNP feedback on identified errors were received and integrated by IRSN – Analysis of LEU and IEU results is in progress – Discussions are planned during the AM meeting in February in Santa Fe and a brief synthesis will be presented during the TPR meeting FY2020-Q2: presentation on LEU and IEU comparison during the AM meeting in February – discussions with DOE labs to increase the number of common cases (IRSN, LLNL and ORNL have provided LCT 074 results) – Addition of PST41 and LCT074 results from IRSN , LLNL and ORNL in the database FY20-Q3: Discrepancies analysis for LEU and IEU systems is in progress; feedback to DOE labs is envisioned end of July Contribution to LANL report on the Pu and HEU systems comparison Study and Subsequent Revision						
IRSN-AM14	Sensitivity/Uncertainty comparison study with a focus on Upper Subcritical Limits	ORNL-AM9 LANL-AM4	Definition of three test cases Calculations and intercomparison technical report	A. BARDELAY	F. BROWN D. BOWEN	LANL ORNL
In progress – LANL and ORNL results are available FY20-Q1: ORNL/LANL/IRSN meeting during the 2019 ANS winter meeting in November–Discussions are planned during the AM meeting in February in Santa Fe FY-2020-Q2: IRSN results sent in January 2020 – presentation of the comparison by Jen Alvin during the AM meeting in February; IRSN intend to send additional results using other covariances soon. FY20-Q3: Common paper on the comparison on the first 4 cases proposed for the ANS winter meeting MACSENS calculations have been performed using ENDF/B.VII.1 covariances data (56 groups) and are being analyzing before sending to DOE labs FY20-Q4 : Abstract will be presented by Jen Alvin at the 2020 ANS Winter meeting.						
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
FY20-Q1: Iteration over the finalization of the EGAMCT report (issues with D. Mennerdhal's comments). Action to be closed as soon as OCDE/NEA report is published						
IRSN-AM17	Technical Data for the Pitzer Formulation of Solution Compositions to Include Uranium/Plutonium Solutions with Selected Admixed Absorbers	ORNL-AM16 LANL-AM6 LLNL-AM7	Contribution to measurements definition. Comparison of density laws (isopiestic law for instance)…	N. LECLAIRE	D. BOWEN	ORNL
Plutonium sulfate densities should be retrieved from US laboratories and a comparison could be done with plutonium nitrate densities. It is also planned to make density vs temperature measurements. Action to be revived when measurements planned. FY20-Q2-Q4: No progress						
Integral Experiments						

	REFERENCE		IRSN Contribution / POC			
IRSN Reference	**Task Title**	**DOE Reference**	**FY 2020 IRSN Contribution**	**IRSN Technical POC**	**DOE Technical POC**	**DOE LAB**
IRSN-IE1 **IER 184**	TEX - Ta experiment	LLNL-IE4	Sensitivity/uncertainty calculations Contribution to the evaluation of the first experiments.	M. BROVCHENKO	C. PERCHER	LLNL
IRSN is involved in TEX program since the beginning in 2011 and participated in the kick-off meeting. IRSN is part of the CED team and review the CED reports. In addition, in 2014 and 2015, IRSN performed sensitivities calculations on the designed configurations for TEX-Ta experiments. Regular VTC were organized to discuss the status of experiments. IRSN participated at the 2 last experiments in NNSS and will be involved in the ICSBEP evaluation in 2019 as independent reviewer. FY2019-Q4: IRSN contributed to the ICSBEP evaluation as the independent reviewer FY2020-Q1 and Q2: exchanges on the ICSBEP review for the baselines experiments FY2020-Q4 : ICSBEP evaluation under development						
IRSN-IE3 **IER 209**	New 7uPCX experiment	SNL-IE1	Contribution to ICSBEP reevaluation.	N. LECLAIRE	G. HARMS	SNL
FY2019 –Q4: These experiments were presented at the ICSBEP 2019 meeting. IRSN was the independent reviewer. FY2020-Q2 : Review finalization : MORET 5 k_{eff} calculations were performed, as well as sensitivity calculations, and sent to SNL. FY2020-Q4 : The work has been completed.						
IRSN-IE6 **IER 306**	Rh experiment	SNL-IE1	IRSN proposal: preliminary evaluation of experimental uncertainties prior to the experiment's CED-2 report.	N. LECLAIRE	G. HARMS	SNL
CED 1 report has been reviewed by the NCSP team and has been validated by IRSN. It was issued in January 2020. Preliminary effects on keff of experimental uncertainties have been calculated and will be added in the CED-2 report in 2021. (supported by a sub-contract) Some comments from Gary Harms, David Ames, Mike Zerkle, Dave Heinrichs (NCSP team) have been received and will be incorporated in the CED-2 report. In particular, the NCSP review team asked for investigating a configuration involving rhodium in a resin block. Additional configurations involving a block of resin of rhodium pierced with holes hosting UO_2 rods have been tested and will be added to the CED-2 report.						
IRSN-IE7 **IER 305**	Mo experiment	SNL-IE1	IRSN proposal: Leading the CED-3a report; Supplying the Mo rods for the experiment.	N. LECLAIRE	G. HARMS	SNL
FY2020-Q2: A first review of the CED-2 report has been done by IRSN. FY2020-Q3: A draft version has been sent at the beginning of June to Gary Harms who has delivered it to the NCSP review team. The report has been under IRSN further steps review process. FY2020-Q4: Gary Harms, David Ames and Mike Zerkle sent their comments, which have been accounted for in the CED2 report. Gary Harms pointed out technical issues with the thickness of the gap between the 7uPCX rods and the Mo sleeves. He proposed increasing it. At the same time, he looked for sleeves available in American companies. A thickness of sleeves of 0.03 inches could be done with an external diameter of sleeves of 0.5 inches. As a result, these characteristics are being tested by IRSN to see if sensitivities of k_{eff} to ^{95}Mo capture remain the same. These works have been added to the CED-2 report. The report will finally incorporate these works and all the remarks from the reviewers. It will undergo final IRSN review and will be distributed end of November. IRSN also looked at potential suppliers for the Mo sleeves and estimated the costs. IRSN prepared the technical specifications.						
IRSN-IE8 **IER 451**	Ti experiment	SNL-IE1	Analysis of the experiments Comparison with MIRTE program	N. LECLAIRE	G. HARMS	SNL
The independent review of experiments was done for the ICSBEP October 2018 meeting. The experiments were calculated with MORET 5. Some comparisons of sensitivity profiles were expected with the sensitivity obtained with TSUNAMI. In addition, we also planned to compare them with the sensitivities obtained for the MIRTE experiments. A feedback on titanium						

	REFERENCE		IRSN Contribution / POC			
IRSN Reference	**Task Title**	**DOE Reference**	**FY 2020 IRSN Contribution**	**IRSN Technical POC**	**DOE Technical POC**	**DOE LAB**
cross sections was also provided (prior and posterior uncertainty analysis using GLLSM). These tasks were subject to a subcontract beginning in May 2019, which is now finished. A report from the subcontractor was issued. FY2020-Q2: comparison with MIRTE Ti experiments in progress – report to be published before end of the year. FY2020- Q4: Report ready for IRSN internal review						
IRSN-IE11 **IER 297**	TEX - Hf experiment	LLNL-IE4	Contribution to Jemima plates characterization. Contribution to CED report.	M. BROVCHENKO	C. PERCHER	LLNL
IRSN was involved in the review of the CED2 report and provide some sensitivity calculations to LLNL. The status of the program has been discussed regularly during VTC until 2017 with LLNL. FY20-Q2: Experiments delayed. Stand-by						
IRSN-IE19	Solution reactor	Y12-IE2	Strong IRSN interest for participation in the design, specification… of a solution reactor	M. DULUC	P. ANGELO	Y-12
Task started in 2019. A first contact with Peter Angelo. Reports about the CRAC and SILENE review sent to NCSP in Q1FY2020 – no feedback since.						
IRSN-IE25 **IER 296**	TEX - MOX experiment	LLNL-IE4	IRSN leads this proposal for design and will author the CED-1 & 2 reports with LLNL support. Characterization of moderator and reflector plates. IRSN contribution to the moderator and reflector plates funding.	M. BROVCHENKO	C. PERCHER	LLNL
Design optimization for TEX-MOX ongoing. (Supported by sub-contracts in 2018 and 2019) CED1 report has been sent to Catherine Percher for distribution to CED-team. Waiting for feedbacks Ongoing studies about possible additional measurements for flux map and temperature. FY2020-Q4 : Comparative Studies of TEX-MOX as to the French commercial fuel reprocessing and fabrication facilities (MELOX, LA HAGUE)						
IRSN-IE26 **IER 295**	TEX - Iron experiment	LLNL-IE4	Contribution to the experiments design. Contribution to CED reports and review.	M. BROVCHENKO	C. PERCHER	LLNL
Not funded in FY2020.						
IRSN-IE27 **IER 498**	GODIVA CAAS benchmark	ORNL-IE4	Participation in the design. Provide IRSN materials for irradiation, analysis of results.	M. DULUC F. TROMPIER	D. BOWEN	ORNL
Some contacts with Doug BOWEN and Riley CUMBERLAND. Discussions on detectors. VTC in Q1-FY2020. A list of detectors that could be provided by IRSN has been sent in January. FY2020-Q3: Four VTC were organized since January to discuss the design FY2020-Q4 : Four additional VTC took place to discuss the design						
IRSN-IE28 **IER 406**	Cf-252 CAAS benchmark	LLNL-IE1	Participation in the design. Provide IRSN materials for irradiation, analysis of results	M. DULUC F. TROMPIER	D. HEINRICHS	LLNL
Discussion in progress to perform additional measurements. Experiments postponed due to COVID-19 to later date (contingent upon LLNL communication)						
IRSN-IE29	Correction factor for dosimetry linked to the orientation of the victim	LLNL-IE1 AWE-IE7	Participation in the design. Provide IRSN materials for irradiation, analysis of results.	M. DULUC F. TROMPIER	D. HEINRICHS P. ANGUS	LLNL AWE
Task not started						

	REFERENCE		IRSN Contribution / POC			
IRSN Reference	**Task Title**	**DOE Reference**	**FY 2020 IRSN Contribution**	**IRSN Technical POC**	**DOE Technical POC**	**DOE LAB**
IRSN-IE30	Full dosimetry exercise around GODIVA/FLATTOP reactors or TRIGA (AFFRI)	LLNL-IE1	Participation in the design. Provide IRSN materials for irradiation, analysis of results	M. DULUC F. TROMPIER	D. HEINRICHS	LLNL
Task not started						
IRSN-IE33	Sodium activation experiment around GODIVA/FLATTOP	LLNL-IE1	Participation in the design. Provide IRSN materials for irradiation, analysis of results	M. DULUC F. TROMPIER	D. HEINRICHS	LLNL
Task not started						
IRSN-IE34 **IER 488**	MUSIC (HEU) critical and Subcritical measurements.	LANL-IE23	Participation in the definition and the design of the experiment	W. MONANGE	J. HUTCHINSON	LANL
Task in progress. IRSN's simulations in progress. IRSN staff waiting for schedule of experiments. Not sure to be allowed to go to US before October 2020. FY2020-Q4 : VTC with LANL - Experiments Scheduled for March 21. Experiment set up concluded.						
IRSN-IE35 **IER 434**	Godiva benchmark for time dependent code validation	LANL-IE3	Participation in the preliminary design and CED-1 report.	M. DULUC	J. GODA	LANL
Task not started						
IRSN-IE36 **IER 514**	ICSBEP/SINBAD Shielding benchmarks for shipping containers	LLNL-IE1 AWE-IE8	Participation in the preliminary design and CED-1 report	M. DULUC	D. HEINRICHS R. JONES	LLNL AWE
Task not started						
IRSN-IE37	Critical and subcritical measurements with a Zero-Power research reactor (On going task)	LANL-IE21	Analysis of the experiments, participation in the final technical report.	W.MONANGE	J. HUTCHINSON	LANL
Delay (problems with HPC at IRSN still make it difficult to finish the simulation program) VTC with LANL team to discuss about the common paper to finalize the task. FY2020-Q4 : Common paper reviewed by IRSN and submitted to Nature.						
IRSN-IE40	CAAS performance testing	LLNL-IE21	Participation in testing activities. Provide IRSN materials and French CAAS probes. To be discussed with LLNL.	M. DULUC	D. HEINRICHS	LLNL
Task not started						
IRSN-IE41 **IER 499**	Thermal/Epithermal Experiments (TEX) with Chlorine and Lithium	LLNL-IE23	Participation in experiments design and CED reports. To be discussed with LLNL.	M. BROVCHENKO	D. HEINRICHS	LLNL
Task not started.						

	REFERENCE		IRSN Contribution / POC			
IRSN Reference	**Task Title**	**DOE Reference**	**FY 2020 IRSN Contribution**	**IRSN Technical POC**	**DOE Technical POC**	**DOE LAB**
IRSN-IE42 **IER 121**	Neptunium Subcritical Observations (NeSO) experiment	LANL-IE3	Independent review of the ICSBEP evaluation.	W. MONANGE	J. HUTCHINSON	LANL
Participation to the experiments in 2019. Independent review of the ICSBEP evaluation planned in FY2020.						
IRSN-IE43 **IER 515**	Critical experiment with americium	LANL-IE3	Participation in experiments design and CED reports.	M. BROVCHENKO	G. MCKENZIE	LANL
Not funded in FY2020. To be proposed for FY2021.						
IRSN-IE44 **IER 516**	ZTA (Zirconium Test Assembly)	LANL-IE3	Participation in experiments design and CED reports.	N. LECLAIRE	T. CUTLER	LANL
Not funded in FY2020. To be proposed for FY2021.						
IRSN-IE45 **IER 517**	Integral Experiments for Validation of Molybdenum Neutron Cross Sections	LANL-IE3	Participation in experiments design and CED reports.	J.B. CLAVEL	D. HAYES T. CUTLER	LANL
Not funded in FY2020. To be proposed for FY2021.						
IRSN-IE46 **IER 518**	High Multiplication Subcritical (Multiplicity) Benchmark Experiments	LLNL-IE1	Participation in experiments design and CED reports.	W. MONANGE	D. HEINRICHS G. HARMS	LLNL SNL
Not funded in FY2020. To be proposed for FY2021.						
Information Preservation and Dissemination						
IRSN-IPD1	ICSBEP reviewing	LLNL-IPD1	IRSN ICSBEP reviewing tasks are reported in the IE tasks	I. DUHAMEL	D. HEINRICHS	LLNL
Review of LCT101 (SNL) and TEX-Ta (LLNL) done for October ICSBEP 2019 meeting FY-2020-Q2: review of the LCT101 (SNL) and TEX-Ta (LLNL) evaluations following the ICSBEP meeting – Collaboration with ORNL and LLNL on PST041 and LCT074 evaluation (KENO and COG results were included in the ICSBEP evaluation and included in the benchmark intercomparison)						
IRSN-IPD3	ICSBEP benchmark reviewing	LLNL-IPD1	IRSN ICSBEP reviewing tasks	I. DUHAMEL	J. FAVORITE	LANL
Task not started – IRSN interest for FLATTOP re-evaluation						

	REFERENCE		IRSN Contribution / POC			
IRSN Reference	**Task Title**	**DOE Reference**	**FY 2020 IRSN Contribution**	**IRSN Technical POC**	**DOE Technical POC**	**DOE LAB**
Nuclear Data						
IRSN-ND1	Contribution to new evaluations	ORNL-ND1	Contribution to new evaluation and validation for ^{54}Fe, ^{103}Rh, ^{55}Mo, Gd, Hf and ^{239}Pu isotopes.	L. LEAL	D. BOWEN	ORNL
FY2019: ^{103}Rh resolved evaluation completed. Progress on the ^{54}Fe and ^{56}Fe and preliminary resonance evaluation generated. IRSN benchmark assembled for testing the ^{55}Mo evaluation. New capture data from NTOF included in the Gd-155 and Gd-157 evaluation. Improved Gd resonance parameters available. Paper on Gd for ND2019 conference. Generation of covariance data for ^{155,157}Gd. Testing of the Gd evaluation has started. FY2020-Q1: The Fe resonance evaluation continues FY2020-Q2: work in progress for Rh URR evaluation with RPI Benchmarks testing for Iron (56 and 54) to test the new evaluations Gd 156, 158, 160 evaluations provided to IRSN by ORNL for final tests, IRSN and RPI working for improvements in URR Preliminary evaluation of Mo isotopes up to 100 eV using IRSN measurements at J-PARC on natural Molybdenum (cf. Physor conference) Hf postponed, Pb to be started very soon. Working on Pu239 evaluation in progress combining integral and differential data. FY2020-Q3: - Hafnium benchmark calculations with MORET 5 and various libraries in progress - Test of new fluorine evaluation on few ICSBEP benchmarks and generation of HF S(a,b) for HST039 analysis - Evaluation of Mo isotopes up to 100 eV using IRSN measurements at J-PARC on natural Molybdenum is underway. Transmission and capture data from LANL are needed. FY2020-Q4 : Ongoing work on the unresolved region for Rh103 with RPI Ongoing work on the unresolved region for Gd 156, 158, 160. No progress on obtaining data for Molybdenum from LANL (transmission and capture)						
IRSN-ND2	Nuclear data processing	LANL-ND1	Benchmark testing of ^{235}U and ^{239}Pu cross section library	L. LEAL	J. CONLIN	LANL
Test performed and new ^{235}U and ^{239}Pu resonance parameters generated. Benchmark testing on the ^{235}U and ^{239}Pu underway. Sensitivity analysis of the benchmark results will be done New Pu239 capture data measured at LANL by Shea Mosby included in the evaluation; Testing of the evaluation on the TEX experiments are under way FY20-Q1: Full paper submitted to Physor 2020 FY20-Q2 and Q3 : benchmark testing of new Pu9 evaluation on TEX experiments and PST experiments in progress FY20-Q4 : review of TEX-Pu9 calculations using IRSN Pu9 evaluation						
IRSN-ND3	Nuclear data processing	LLNL-ND4	Resonance evaluation of ^{233}U (Pending prioritization of ^{233}U ND tasks for the NCSP)	L. LEAL	D. HEINRICHS	LLNL
Existing resonance evaluation extended to 2 keV. New resonance parameters derived. New ^{233}U fission and capture cross section data from n_TOF may become available shortly. The data will be incorporated in the evaluation and benchmark testing will be performed. FY2020-Q3: Generation of sensitivity profiles for various U233 benchmarks for testing FY2020-Q4 : investigation of the URR following benchmark indication.						

	REFERENCE		IRSN Contribution / POC			
IRSN Reference	**Task Title**	**DOE Reference**	**FY 2020 IRSN Contribution**	**IRSN Technical POC**	**DOE Technical POC**	**DOE LAB**
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
2 IRSN staff authorized to attend the hands-on training in 2020. Cancelled due to COVID 19						