LANL FY21 NCSP Highlights

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LANL NCSP Task Manager
Tuesday, February 15, 2022

Both COVID and Experiments Continued in FY21...
Celebrated 10th Anniversary of NCERC Operations

• Special Issue of Nuclear Science and Engineering (NSE) highlights first decade
IE 1: Maintain permanent NCERC Field Staff in DAF and Maintain NCERC staff for HQ
IE 2: Maintain and Train NCERC Team Members
IE 3: LANL Design and Execute Critical Experiments
IE 8: NCERC Small Sample Rabbit Transfer System
IE 14: Control and Data Systems Upgrades and Maintenance
IE 33: IER Collaboration with Other Labs
IE 34: SHEBA Fuel Staging at DAF/NCERC
Focused on a Large Experiment Campaign (IER 488)
MUSIC: Measurements of Uranium Subcritical and Critical

- CED-3b milestone.
- Measured 10 configurations.
  - 2 critical
  - 8 subcritical
- 4 detector systems
- 2 types of subcritical measurements
  - Passive with source
  - Active with neutron generator
- First evaluation will be critical configurations.
- Additional subcritical evaluations in subsequent years.

See talk by Rob Weldon
Demonstrated Flexibility
Pivoted to TEX-TSL (IER 480)

- Hf for IER 532 was not available.
- Designed/procured fixturing. **CED-3a milestone.**
- Conducted Lucite and poly configurations. **CED-3b milestone.**

▲ Upper stack of TEX-TSL poly configuration with LANL He-3 detectors and RTD’s

Rene Sanchez and Alex McSpaden load ZPPR Pu and poly on Planet.
Prepared for FY22 Experiments…

**PFUNS (IER 153)**
- CED-3a milestone.
- Finalized Experiment Plan
- Completed Drawings
- Procured/Weighed Foils
- Developed Irradiation Plan

**Flattop Benchmark (IER 423)**
- CED-2 milestone.
- Determined measurements to reduce uncertainty

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<thead>
<tr>
<th>Effect</th>
<th>$\sigma_{\text{keff}}$</th>
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<tbody>
<tr>
<td>Mass and Volume Uncertainty of HEU Parts</td>
<td>±0.00071</td>
</tr>
<tr>
<td>Mass and Volume Uncertainty of NU Parts</td>
<td>±0.00137</td>
</tr>
<tr>
<td>HEU Isotopics</td>
<td>±0.00018</td>
</tr>
<tr>
<td>Structural Material Mass Densities</td>
<td>±0.00001</td>
</tr>
<tr>
<td>Gaps Between Reflector Parts</td>
<td>±0.00025</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>±0.00157</td>
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Copper Critical Experiment Preliminary Design (IER 537)

- CED-1 milestone.

Molybdenum Experiment Preliminary Design (IER 517)

Molybdenum Optimized Benchmark System
Demonstrating Integral Correlations (MOBY DICK)

See talk by Cole Kostelac

Elastic scatter

See talk by Kelsey Amundson
Wrapped Up Completed Experiments…

Submission of CURIE Evaluation (IER 489)
• Submitted to ICSBEP December Meeting. CED-4a milestone. (FY22)
  - Evaluators: Jeff Favorite, Theresa Cutler, Travis Grove
  - Internal Reviewer: Kelsey Amundson
  - External Reviewers: Jesse Norris, Catherine Percher, Dave Heinrichs, LLNL

Publication of KRUSTY Evaluation (IER 299)
• Final submitted for publication in ICSBEP Handbook.
• CED-4b milestone.
• NCERC-FO coordinated the movement of all remaining KRUSTY waste from the DAF to warehouse 6-911 to prepare for final disposal. In-Situ Object Counting (ISOCs) measurements and walk down evaluations with Waste Generator Services (WGS) were completed.
December 2021 ICSBEP Meeting
4 out of 5 Evaluations were NCERC Experiments

IEU-MET-FAST-025
ZEUS: HEU Jemima plates, natural U, Lead

HEU-MET-INTER-011
CURIE: U-235 Unresolved Resonance Region, HEU Jemima plates, Teflon

PU-MET-FAST-047
JUPITER: Pu PANN ZPPR plates, Lead

HEU-MIX-MET-021
TEX: HEU Jemima plates, HDPE

**NCSP and NCERC are central to generation of new experimental data for benchmark evaluations**
SAVY Container Procurement

• Joint LANL/MSTS Procurement Effort
• DOE M 441.1 container requirements
• 60 3-qt and 60 5-qt SAVYs

Mechanical Material Handling

Implemented P101-40, Mechanical Material Handling, a new policy on how to conduct safe movements of loads and reduce worker injury.

Change Notice 9

• Change to NCERC-TSR’s
• Introduces Critical Assembly Operational Modes
Began Control System Upgrade Project

- Capability Based Investments (CBI) Funding to design and procure upgrades to NCERC Control Systems.
- MSTS has scope for facility upgrades
- Replacing components and migrating control programs
- Targeting Installation in FY23Q1 for first control room
Training & Education

<table>
<thead>
<tr>
<th>TE3</th>
<th>Conduct Hands-On Criticality Safety Training Course at NCERC</th>
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<tbody>
<tr>
<td>TE4</td>
<td>On-Site Introductory Training for the NCS Practitioner on Modern Approaches to Validation using Sensitivity and Uncertainty Analysis Tools</td>
</tr>
<tr>
<td>TE6</td>
<td>Development of University Pipeline for Criticality Safety Professionals</td>
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See talk by Norann Calhoun
Record Number of NCSP Classes in 1 Year

- November – Special class for Y-12
- June – Manager’s Course
- July – Makeup CSE Class
- August – Makeup CSE Class
- August – CSE Class
Analytical Methods

- **AM1** MCNP Maintenance and Support, Uncertainty Analysis Development, and Modernization
- **AM2** NJOY Development and Maintenance, Uncertainty Analysis Development, and Modernization
- **AM3** Development of an Adaptive-in-temperature Method...in MCNP6
- **AM4** Sensitivity/Uncertainty Comparison Study with a Focus on Upper Subcritical Limits
- **AM5** Proposed Benchmark Intercomparison Study
- **AM7** Incorporation of Benchmark Experiment Correlations into Whisper

**See talk by Mike Rising**
Analytical Methods Highlight -- MCNP6.3

For the MCNP6.3 release, the finishing touches are being worked on now (see M. Rising talk for more details)

Lots of simultaneous new features, bug fixes, and improvements always ongoing

New Particle Track and Output Formats

New Plotter Under Development

Improved Algorithms and Physics Options

Subcritical BeRP Ball Model

Documentation and V&V Testing Overhaul

Enhancements include:
- Improved Algorithms and Physics Options
- New Particle Track and Output Formats
- New Plotter Under Development
- Documentation and V&V Testing Overhaul
- Improved Convergence and Stabilization

For the MCNP6.3 release, the finishing touches are being worked on now (see M. Rising talk for more details)
Nuclear Data

See talk by Amy Lovell, Denise Neudecker

<table>
<thead>
<tr>
<th>ND1</th>
<th>Nuclear Data Evaluation and Testing</th>
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<tr>
<td>ND2</td>
<td>Prompt Fission Neutron Spectra (PFNS) Measurement of Plutonium-240</td>
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<td>ND3</td>
<td>Unresolved and Fast Measurements of Uranium-233 (n,\gamma)</td>
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<tr>
<td>ND4</td>
<td>Mo-95 neutron capture and transmission measurements...evaluation</td>
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Approved Budget

Planned spending

Costs

Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep

$0 $200,000 $400,000 $600,000 $800,000 $1,000,000 $1,200,000 $1,400,000 $1,600,000
Advanced Fission Modeling at Los Alamos

Chi-Nu PFNS included

$^{239}$Pu $\bar{\nu}$ evaluation with CGMF

PFNS modeling in CGMF

$^{239}$Pu PFNS evaluated with new Chi-Nu and CEA data is in IAEA and LANL VIII.1-beta files. This is the first use of CGMF for ENDF/B $\bar{\nu}$ eval!

The PFNS is challenging to model in Hauser-Feshbach codes such as CGMF. Studies are underway to identify a model space that can lead to a harder spectrum.

Combination of new $\bar{\nu}$, PFNS & (n,f) cross section gives realistic $k_{\text{eff}}$ (1.00047) of Jezebel!
Technical Support

- Costs
- Planned spending
- Approved Budget

TS4 Succession Planning
COVID Impacts to NCSP Work

• Staffing Challenges:
  − At one point 6 out of 12 NCERC-FO staff were out for various reasons.
  − Limited staff when personnel were quarantining or self-isolating
  − High risk of execution delayed on short notice

• Had to cancel one NCSP Class due to COVID
  − Able to schedule makeup class to makeup for missed weeks
  − Students affected by COVID resulted in smaller classes

• International Collaborators unable to travel, i.e. IRSN for MUSiC

• MCNP and NJOY training classes were forced to be 100% virtual.

• Secondary effect: COVID impacts at LLNL delayed PPAC production which delayed start of PFNS Measurements on Pu-240.
NCERC UTILIZATION

NCSP (28 weeks)
- 4 weeks Godiva PDV (IER 268)
- 1 week CAAS (IER 497)
- 9 weeks MUSIC (IER 488)
- 4 weeks TEX-TSL (IER 480)
- 5 weeks NCSP Classes (IER 462)
- 5 weeks MNT/SRV/ISI/decon/defuel (IER 466)

Non-NCSP (19 weeks)
- 3 weeks PF4 Class (IER 540) NA-10
- 2 weeks ER Class (IER 506) NA-80
- 1 week Godiva SLFY (IER 504) NA-22
- 4 weeks Flattop (IER 504) NA-22
- 2 weeks Hypatia (IER 525) DOE-NE
- 5 weeks RTO measurements (IER 533) NA-80
- 1 week Univ. Measurements (IER 543) NA-22

Unavailable (6 weeks)
- 3 weeks Holiday Closure
- 2 weeks UPS cutover
- 1 week Ventilation/Radcon Issues
Conclusion – FY21 was a productive year!

- CED-1: Copper (IER 537)
- CED-2: Flattop (IER 423)
- CED-3a: PFUNS (IER 153), TEX-TSL (IER 480), CAAS (IER 497)
- CED-3b: MUSIC (IER 488), TEX-TSL (IER 480), PDV (IER 268) and CAAS (IER 497)
- CED-4a: CURIE (IER 489) (FY22 milestone)
- CED-4b: KRUSTY (IER 299)

>100 Publications between IE, AM, and ND
72 Work Control Documents issued or revised
34 Surveillances, In-service Inspections, and Maintenance Activities performed
Acknowledgements

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Additional Budget Slides for Angela
Staffing, percentage on JREE

* Staff greater than 10% who are not students/retirees