Delivering science and technology to protect our nation and promote world stability
Both COVID and Experiments Continued in FY21…
Focused on a Large Experiment Campaign
MUSIC: Measurements of Uranium Subcritical and Critical

• IER 488. **CED-3b milestone.**
• Measured 10 configurations.
  - 2 critical
  - 8 subcritical
• 4 detector systems for subcritical
• 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) when Hf for IER 532 was not available.
• Designed/procured fixturing. **CED-3a milestone.**
• Conducted Lucite and poly configurations. **CED-3b milestone.**
Prepared for FY22 Experiments…

PFUNS (IER 153)

- CED-3a milestone.
- Developed Experiment Plan
- Completed Drawings
- Procured/Weighed Foils
- Irradiation Plan

Flattop Benchmark (IER 423)

- CED-2 milestone.

Total Relative Uncertainty in $k_{eff}$ (Preliminary)

<table>
<thead>
<tr>
<th>Effect</th>
<th>$\sigma k_{eff}$</th>
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<tbody>
<tr>
<td>Mass and Volume Uncertainty of HEU Parts</td>
<td>±0.00071</td>
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<tr>
<td>Mass and Volume Uncertainty of NU Parts</td>
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<td>HEU Isotopics</td>
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<tr>
<td>Structural Material Mass Densities</td>
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<tr>
<td>Gaps Between Reflector Parts</td>
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<tr>
<td>Total</td>
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And Beyond …

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

See talk by Kelsey Amundson
Documented 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
Completed Multi-physics Experiment and Performed CAAS Testing with Godiva

• Already presented at last year’s TPR
• PMT/PD and PDV Measurements (IER 268)
  – Hosted MSTS personnel to collect data in Q1. CED-3b milestone.
• CAAS Testing
  – Preparations for receipt of Mirion equipment and developed plan. CED-3a milestone.
  – Executed Q2. CED-3b milestone.
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
Celebrated 10\textsuperscript{th} Anniversary of NCERC Operations

• Special Issue of Nuclear Science and Engineering (NSE) highlights first decade
Control System Upgrade Project

- Capability Based Investments (CBI) Funding to design and procure upgrades to NCERC Control Systems.
- MSTS developing cost estimate for facility scope
- Receiving components and migrating control programs
- Targeting Installation in FY23Q1 for first control room

Operations barrier

- 4 x 55” screens for class/observers
- 8 x 27” screens for near field, immobilized (tilt only)
SAVY Container Procurement

- DOE M 441.1 container requirements
- Joint LANL/MSTS Procurement Effort
- 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
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

New Plotter

Under Development

Improved Algorithms

and Physics Options

Subcritical BeRP Ball Model
Advanced Fission Modeling at Los Alamos

Chi-Nu PFNS included

$^{239}$Pu PFNS evaluated with new Chi-Nu and CEA data is in IAEA and LANL VIII.1-beta files.

$^{239}$Pu $<\nu>$ evaluated with CGMF is in IAEA and LANL VIII.1-beta files. This is the first use of CGMF for ENDF/B $<\nu>$ eval!

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

PFNS modeling in CGMF

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.
COVID Impacts

• 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
• International Collaborators unable to travel, i.e. IRSN for MUSiC
• Additional Classes to makeup for missed weeks in FY20
• MCNP and NJOY training classes were forced to be 100% virtual.
• ND experiment delayed due to COVID impacts at LLNL delaying PPAC production.
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 Crown Jewels, etc. (IER 533) NA-80
- 1 week University Measurements (IER 543)

Unavailable (6 weeks)
- 3 weeks Holiday Closure
- 2 weeks UPS cutover
- 1 week Ventilation/Radcon Issues
Analytical Methods, FY21 Total

- **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

![Graph showing budget and spending over months](Image)
Integral Experiments, FY21 Total

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
  • IER 121
  • IER 151
  • IER 153
  • IER 268
  • IER 299
  • IER 301
  • IER 423
  • IER 476
  • IER 488
  • IER 489
  • IER 517
  • IER 537
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
Nuclear Data, FY21 Total

<table>
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<tr>
<th>ND1</th>
<th>Nuclear Data Evaluation and Testing</th>
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<tbody>
<tr>
<td>ND2</td>
<td>Prompt Fission Neutron Spectra (PFNS)</td>
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<td>ND3</td>
<td>Measurement of Plutonium-240</td>
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<td>ND4</td>
<td>Unresolved and Fast Measurements of Uranium-233 (n,\gamma)</td>
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<td>ND5</td>
<td>95Mo neutron capture and transmission measurements...evaluation</td>
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Legend:
- Approved Budget
- Planned spending
- Costs
Training & Education, FY21 Total

<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>
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<tr>
<td>TE6</td>
<td>Development of University Pipeline for Criticality Safety Professionals</td>
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</tbody>
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Approved Budget

Planned spending

Costs
Technical Support, FY21

- Costs
- Planned spending
- Approved Budget

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

$0.00 $20,000.00 $40,000.00 $60,000.00 $80,000.00 $100,000.00 $120,000.00 $140,000.00 $160,000.00

TS4 Succession Planning
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)

42+37+29 Publications
72 Work Control Documents issued or revised
34 Surveillances, In-service Inspections, and Maintenance Activities performed

Fissionable Material Moves (CY)
2021 – 277 moves
2020 – 55 moves
2019 – 216 moves
2018 – 179 moves
2017 – 163 moves
2016 – 97 moves
2015/2014 – 44 moves
Acknowledgements

NCERC is supported by the DOE Nuclear Criticality Safety Program, funded and managed by the National Nuclear Security Administration for the Department of Energy.

This work was supported by the US Department of Energy through the Los Alamos National Laboratory. Los Alamos National Laboratory is operated by Triad National Security, LLC, for the National Nuclear Security Administration of the US Department of Energy under Contract No. 89233218CNA000001.
Additional Budget Breakdown Slides for Angela
LANL IE 3 & 33 Budget Breakdown

- IER 488, 34%
- IER 489, 12%
- IER 497, 5%
- IER 498, 9%
- IER 537, 3%
- IER 153, 3%
- IER 268, 7%
- IER 299, 6%
- IER 423, 2%
- IE 33 other, 2%
- IE other, 3%
- IER 480, 14%
- IER 489, 12%
- IE other, 3%

TEX-TSL

MUSIC

Curie