OAK RIDGE National Laboratory

Overview of the DOE/NNSA Nuclear Criticality Safety Program

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U.S. DEPARTMENT OF ENERGY

Background / History and Mission Vision

Early history

- Defense Nuclear Facilities Safety Board (DNFSB) Recommendations:
  - 93-2 (3/23/1993): Need for a general-purpose critical experiment capability that will ensure safety in handling and storage of fissionable material.
  - 97-2 (5/19/1997): Need for improved criticality safety practices and programs to alleviate potential adverse impacts on safety and productivity of DOE operations.
- DOE Implementation Plan for 93-2 and 97-2 recommendations resulted in establishment of the US NCSP

Defense Nuclear Facilities Safety Board

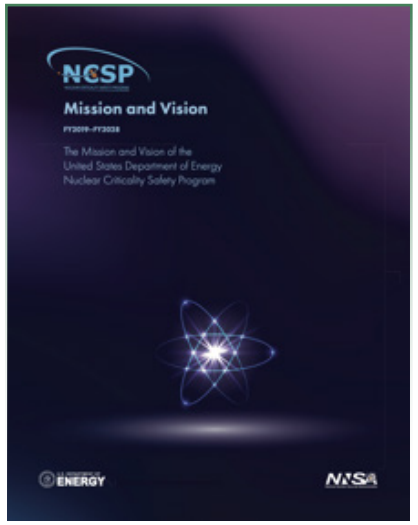
NCSP 5-year plan

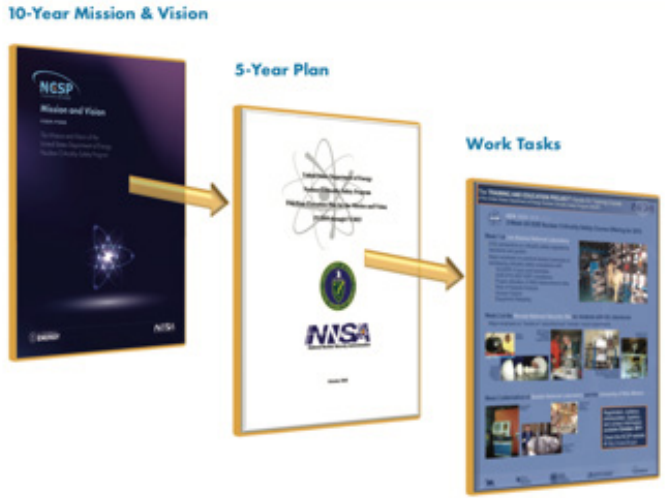
Mission

Provide sustainable expert leadership, direction and the technical infrastructure necessary to develop, maintain, and disseminate the essential technical tools, training, and data required to support safe, efficient fissionable material operations within DOE.

Vision

Continually improving, adaptable, and transparent program that communicates and collaborates globally to incorporate technology, practices, and programs to be responsive to the essential technical needs of those responsible for developing, implementing, and maintaining nuclear criticality safety.





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NCSP Main Functions and Execution Strategy

NCSP NUCLEAR CRITICALITY SAFETY PROGRAM

TS provides management support for daily NCSP execution. The CSSG and NDA groups provide NCS and ND expertise to the DOE through the NCSP manager. CSCT plays a key role in ensuring DOE's criticality safety programs stay within the framework of Integrated Safety Management Principles

NCSP Technical Support

NDAG

CSCT

CSSG

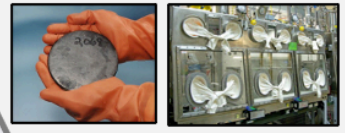
MCNP6

scale

Analytical methods provides support for the development and maintenance of SCALE/MCNP & NCSP site and international collaborations.

Analytical Methods

DOE Nuclear Criticality Safety Applications



Training and Education

DOE NCSP training and education program provides NCS training for NCS engineers per ANSI/ANS-8.26 and CSOs/Managers. TE also provides resource pipelines to attract and train new NCS staff at DOE/NNSA sites.

NCERC

NATIONAL ATOMIC TESTING MUSEUM

Nuclear Data testing involves using MCNP/SCALE to model critical benchmarks. Calculated differences from a critical configuration could indicate a code or nuclear data issue.

The NCSP Website provides training registration and NCSet training modules and references for use by the community

Nuclear Data

Nuclear data provides support for nuclear data evaluations (SAMMY) and cross section development (AMPX, NJOY). Also, differential nuclear data measurements are performed at RPI and IRMM in Belgium to fix nuclear data issues based on nuclear data testing activities with benchmark IEs. NCSP collaborates with the National Nuclear Data Center at BNL in the development of new Evaluated Nuclear Data Files for use by the NCS community.

NJOY

AMPX

SAMMY

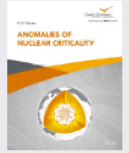
ENDF B-VIII.0

irmm

Rensselaer

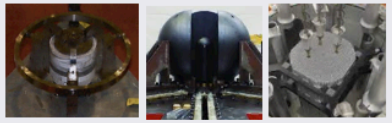
Information Preservation & Dissimination

IPD involves sharing resources with the community via a modern website. Includes news, program management, training registration, references, and training aides



Integral Experiments

Benchmark integral experiments are needed to fill gaps in nuclear data libraries and to perform validation for computational methods.



NCSP IE programs Involve applications of nuclear energy, basic measurements of nuclear parameters, kinetic behavior of chain-reacting systems, nuclear weapons safety, detector development, and nuclear criticality safety.

NCERC

NCSP Budget

FY2022 budget is $29.387 Million

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

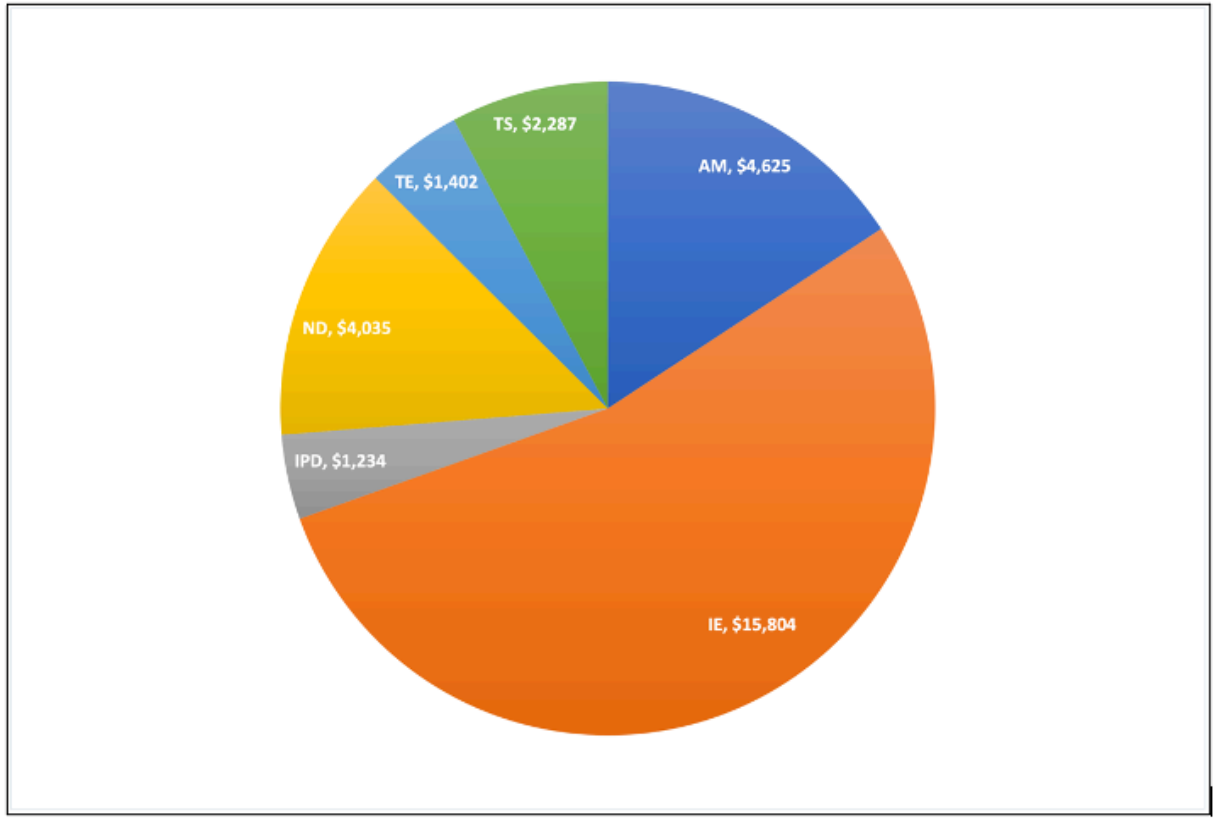
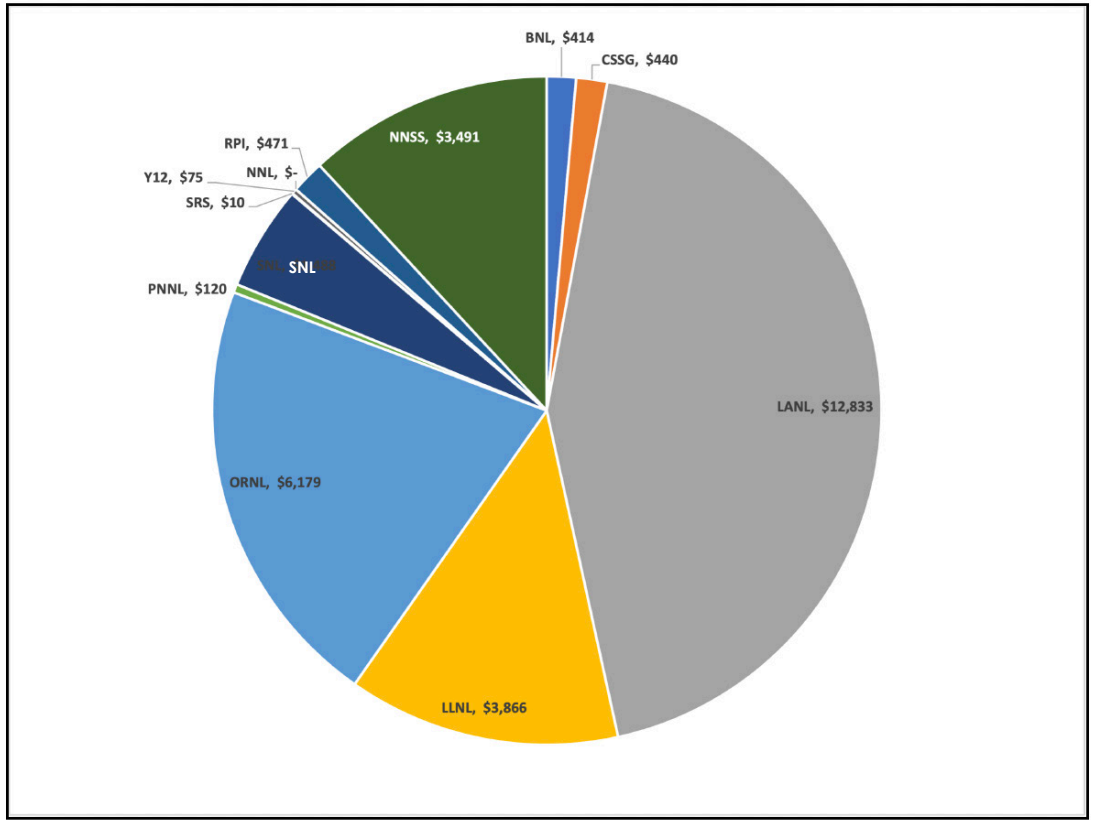


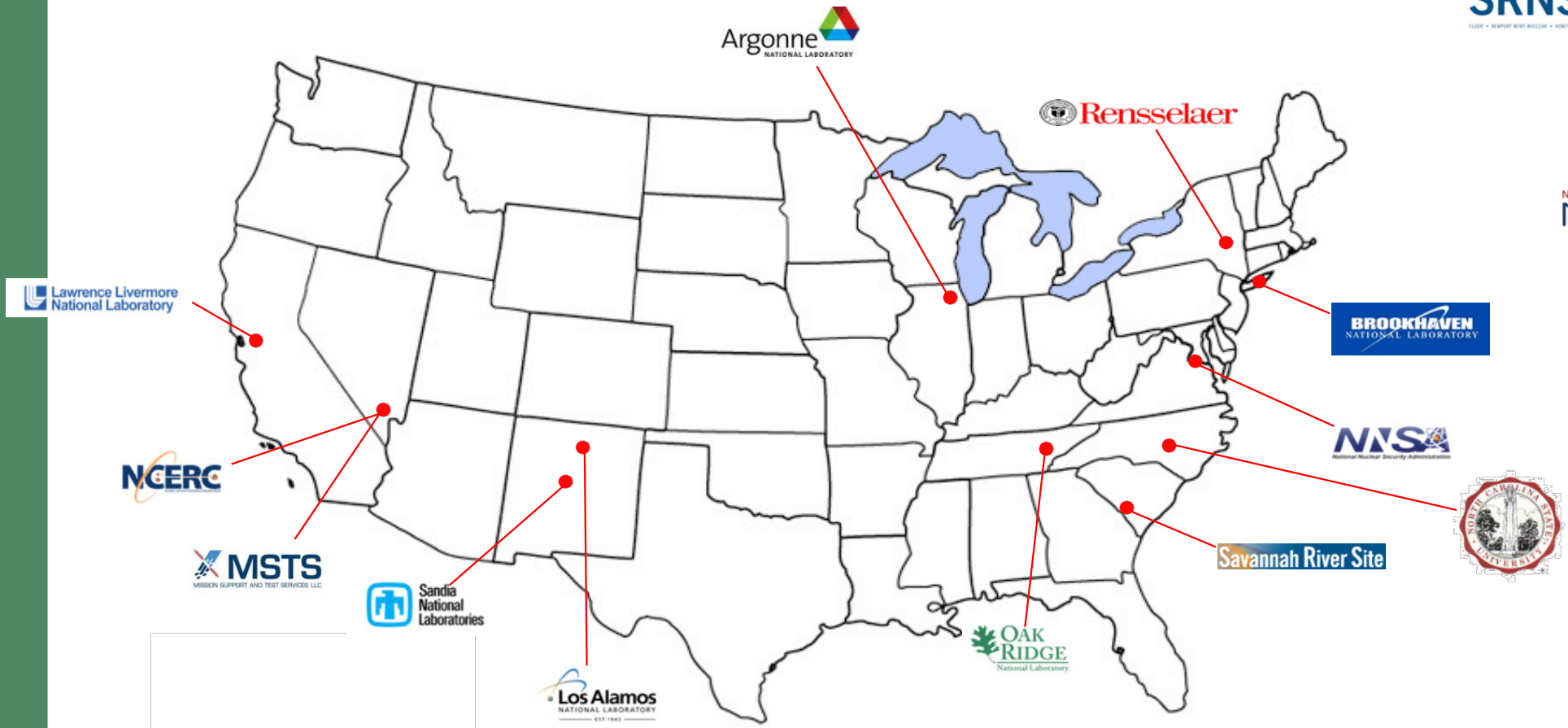
Figure 2.0-5 NCSP Funding Overview (FY2022) – By Site



TS – Technical Support
AM – Analytical Methods
IE – Integral Experiments
IPD – Information Preservation and Dissemination
ND – Nuclear Data
TE – Training and Education

Costs in thousands of US Dollars

Current NCSP Work Sites



Accomplishments, Challenges, Initiatives

ACCOMPLISHMENTS

- Completed UPF CAAS testing
- 7 Critical Experiment Campaigns Executed (CED 3b completed during FY21)
- 5 Critical Experiment Benchmark Reports Completed for ICSBEP Handbook
- 9 NCSP Criticality Safety Classes
- 94 Hands-on NCS students
  - Had 1st ever virtual course work
- 391 MCNP students (all virtual)
- 173 SCALE students (all virtual)
- 1st Ever MCNP Users' Group Workshop (500+ attendees)
- 5th Annual SCALE Users' Group Workshop (173 attendees)
- 1st ever NCSP ND measurement at LANSCE (U-233)
- NCSP IE Managers using G2 for IER process
- Planet Leveling Upgrade

CHALLENGES

- RPI accelerator refurbishment schedule impacted by COVID (NR reported 8-month delay)
- NCERC-FO personnel impacted by LANL vaccination LWOP policy
- Travel costs are low due to COVID restrictions => more carryover
- TEX-Hf IE delayed to FY22 due to delayed NR Hf procurement
- RTO operations were impacted by COVID
- SPRF/CX Facility activities impacted by COVID
- COVID impacts to training
- Criticality Accident Dosimetry Exercise delayed due to COVID travel restrictions
- ICSBEP Chair leaving INL
- CSSG Panel discussion at ANS meeting delayed
- Nuclear Data measurements at GELINA delayed due to COVID closure
- Supplies - Prices rising; lead times increasing

INITIATIVES

- Capabilities Based Investment (NA-19) funding ($2.3M for FY21) for NCERC Control Room upgrades
- Horizontal split table
- FY22 NCSP MIHL
- Implemented wait-list function on T&E section of webpage
- New chairs for CSCT and CSSG
- Pu-240 Measurement at LANSCE
- Low temperature TEX
- Criticality Accident Dosimetry Exercise
- Working with OSTI to create NCS library
- DRACO

FY22 NCSP Make It Happen List

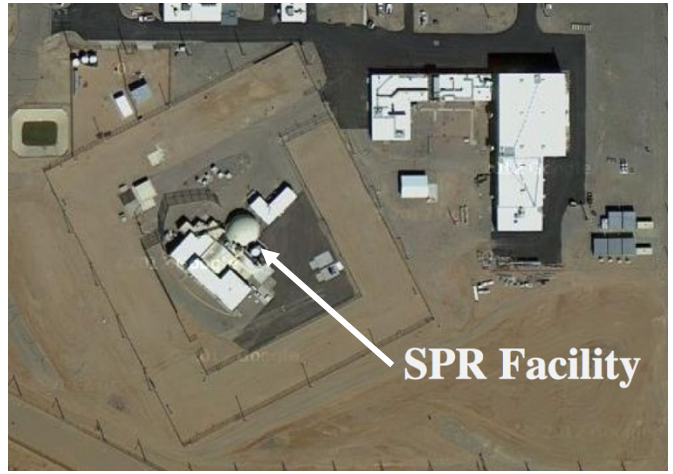
1. Production and delivery of hafnium to NCERC in support of TEX-Hf (IER 532) - NNL **Complete**
2. Conduct nuclear accident dosimetry exercise (IER 538) – LLNL
3. Complete TEX low temperature DU surrogate testing (IER 547) - LLNL
4. Submit TEX HEU benchmark report to the International Criticality Safety Benchmark Experiment Program (IER 297) - LLNL
5. Complete critical experiments with UO_2 Rods and molybdenum foils (IER 305) - SNL
6. Complete measurements for the Flattop benchmark (IER 423) - LANL
7. Complete fabrication of lithium for critical experiment (IER 499) – Y-12
8. Complete high multiplication neutron subcritical measurements (IER 518) - Multiple
9. Measure the fission neutron spectrum shape using threshold activation detectors (IER 153) - LANL
10. Promote use of MCNP Version 6.3 at DOE sites - LANL
11. Complete prompt fission neutron spectrum (PFNS) measurement of Plutonium-240 at LANSCE - LANL
12. Complete Zr-91 measurements at GELINA - ORNL
13. Complete site acceptance tests for accelerator section #1 at RPI - NNL
14. Complete GELINA neutron production target – Y-12 **Complete**
15. Complete Sandia CSO/Manager course pilot course - SNL **Complete**

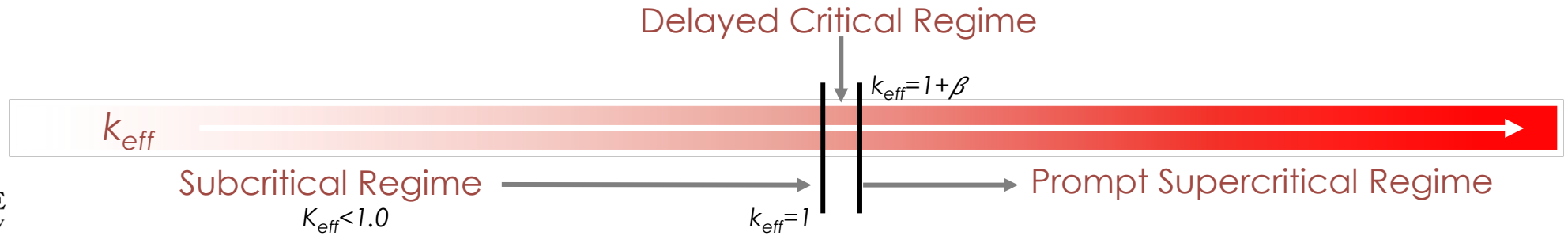
NCSP Integral Experiments

- NCSP integral measurements are performed at
  - Sandia National Laboratories (SNL) and
  - National Criticality Experiments Research Center (NCERC), currently operated by Los Alamos National Laboratory
    - NCERC is located at the Nevada National Security Site (NNSS) inside the Device Assembly Facility (DAF)
- Types of experiments that can be performed
  - Subcritical
    - Rocky Flats shells, BeRP ball, Np-237 sphere, TACS shells, etc.
  - Critical/Delayed Supercritical
    - NCERC: Planet, Comet, Godiva IV, Flattop
    - Sandia: Sandia Pulse Reactor critical assembly (2 fuel types, currently)
  - Prompt Supercritical
    - NCERC: Godiva IV (< 300 deg. C pulse)

DAF/NCERC

SNL/TA-V/SPR Facility

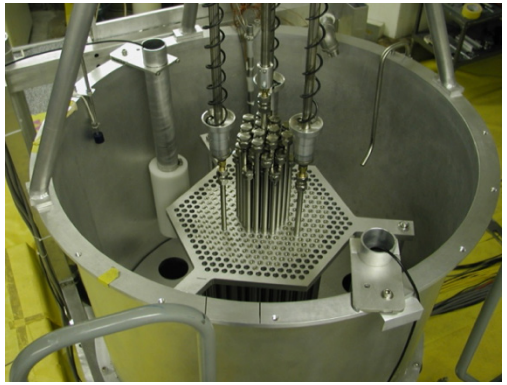


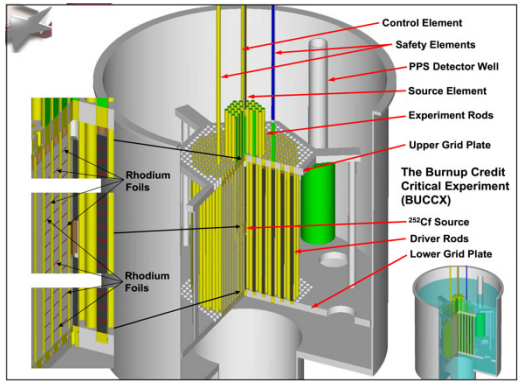


NCSP Critical Assemblies

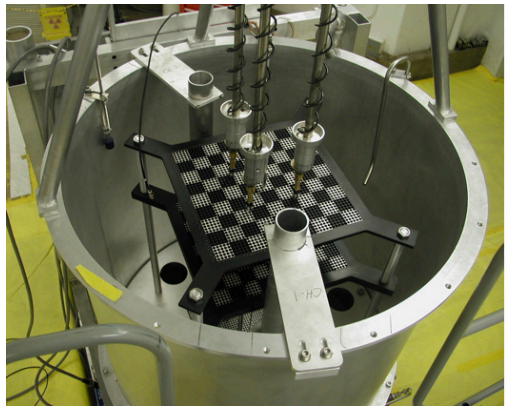
Sandia National Laboratory

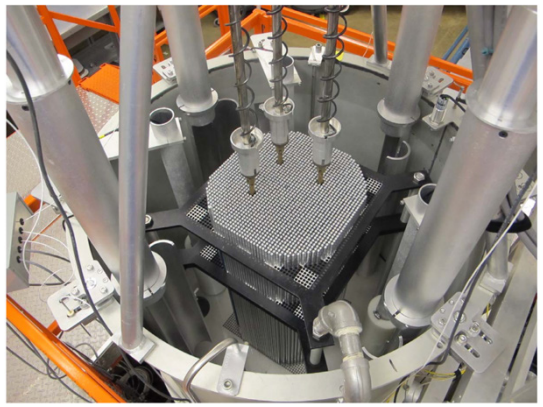
SNL – BUCCX – U(4.31)/Fission Product Experiments





SNL – 7uPCX – U(6.9) UO_2 rods





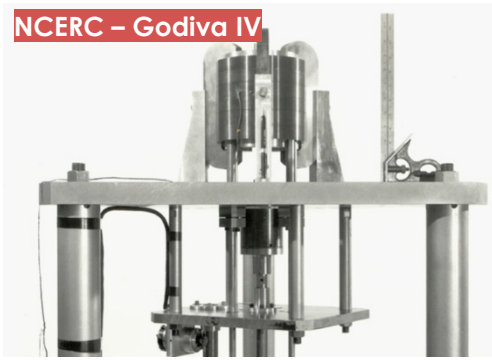
NCERC/DAF

NCERC – Np-237 Sphere

NCERC – BeRP Ball

NCERC – TACS

NCERC – Godiva IV

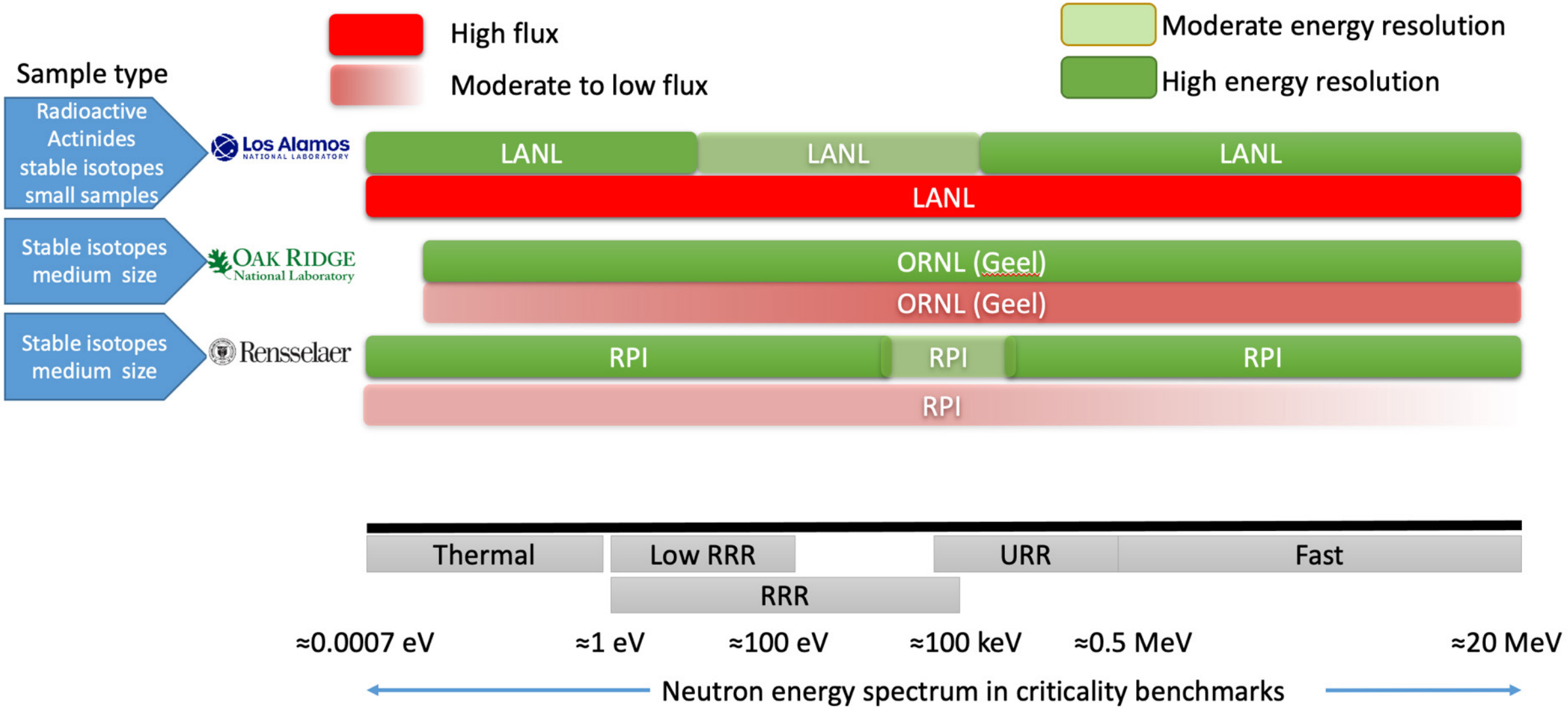


NCERC – Flattop

NCERC – Comet

NCERC – Planet

Current NCSP capabilities for (n,γ), (n,tot) and (n,f) measurements



Questions