

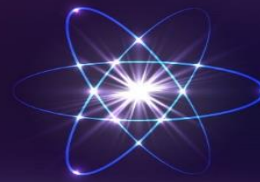


# Overview of the NCSP Nuclear Data Program

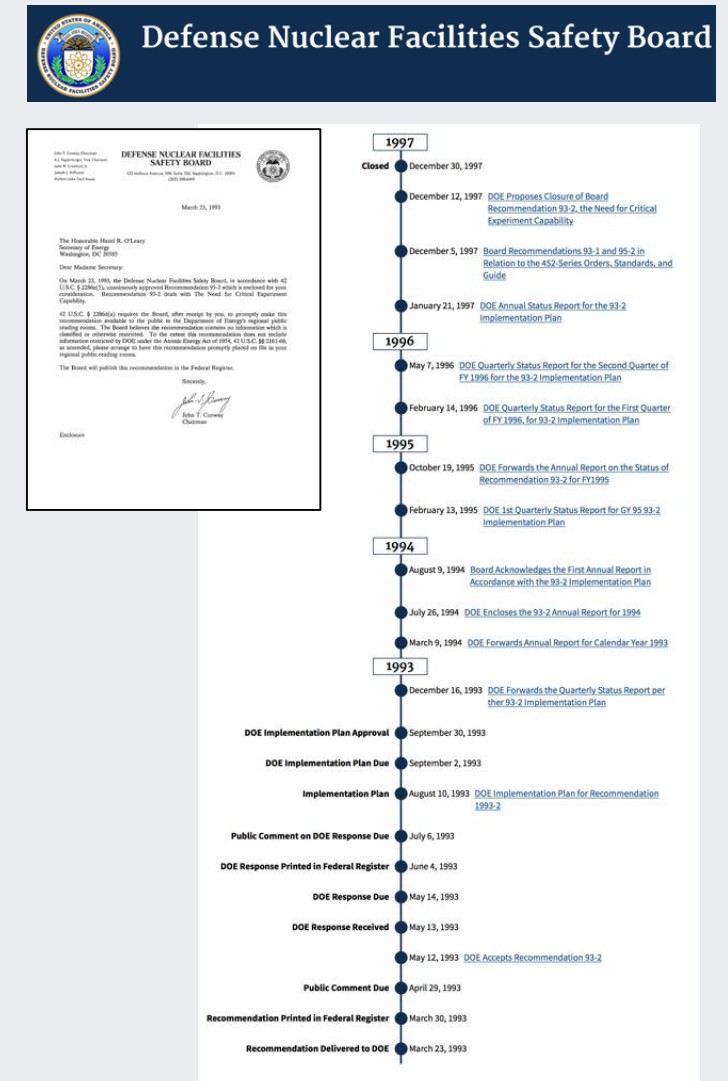
WANDA-2020 Workshop, March 3-6, 2020  
George Washington University, Washington, DC



Presented by:  
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**Chairman, Nuclear Data Advisor Group**  
**Senior Advisor**  
**Naval Nuclear Laboratory**

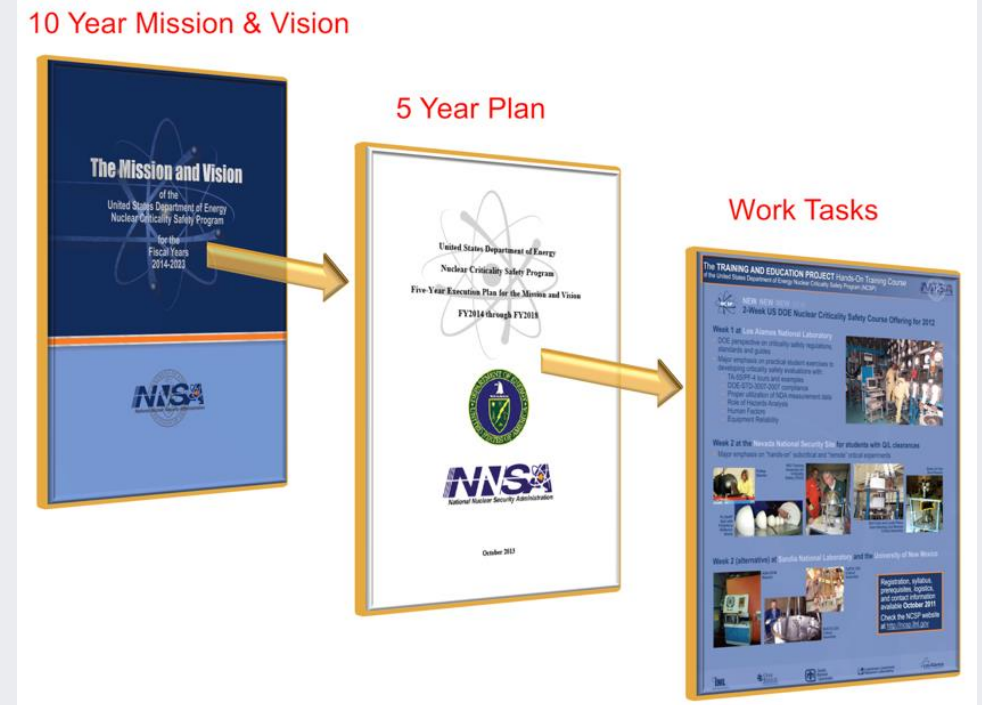


- Defense Nuclear Facilities Safety Board (DNFSB)  
Recommendations 93-2 and 97-2:
  - 93-2 (3/23/1993): Need for a general-purpose critical experiment capability that will ensure safety in handling and storage of fissionable material.
  - 97-2 (5/19/1997): Need for improved criticality safety practices and programs to alleviate potential adverse impacts on safety and productivity of DOE operations.
- 97-2 encompassed ongoing DOE activities of 93-2 while broadening scope to address important cross-cutting safety activities needed to ensure NCS throughout the Complex.
- DOE Implementation Plan for Board Recommendation 93-2 and 97-2 resulted in establishment of the US Nuclear Criticality Safety Program (NCSP)

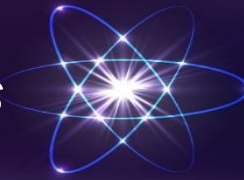




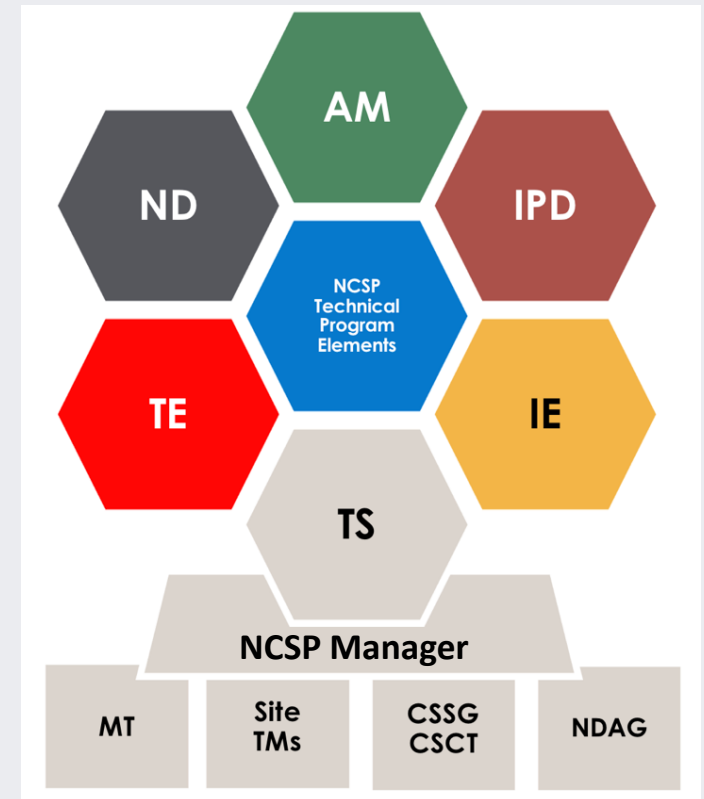
- Mission
  - Provide sustainable expert leadership, direction and the technical infrastructure necessary to develop, maintain and disseminate the essential technical tools, training and data required to support safe, efficient fissionable material operations within the Department of Energy.
- Vision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



# NCSP Technical Program Elements



- **Analytical Methods (AM) – 15% of budget (\$4.15M)**
  - Maintain and improve the Production Codes and Methods for Criticality Safety Engineers (MCNP/SCALE, NJOY/AMPX)
- **Nuclear Data (ND) – 16% of budget (\$4.50M)**
  - Perform Measurements of Basic Nuclear (Neutron) Physics Cross-Sections and Generate New Evaluated Cross-Section Libraries and Covariance Data for Use in Production Criticality Safety Codes
- **Integral Experiments (IE) – 52% of budget (\$14.88M)**
  - Critical and Subcritical Experiments at the National Criticality Experiments Research Center (NCERC) at the Device Assembly Facility (DAF) in Nevada and Sandia National Laboratory Pulse Reactor Facility– provides integral tests of codes and data
- **Information Preservation and Dissemination (IPD) – 4% of budget (\$1.23M)**
  - Protects Valuable Analyses and Information Related to Criticality Safety (includes ICSBEP)
- **Training and Education (TE) – 6% of budget (\$1.64M)**
  - Web-based training modules and 1- & 2-week Hands-On Criticality Safety courses for Criticality Safety Engineers, Line Management, and Oversight Personnel
- **Technical Support (TS) – 8% of budget (\$2.06M)**
  - Managerial and technical support

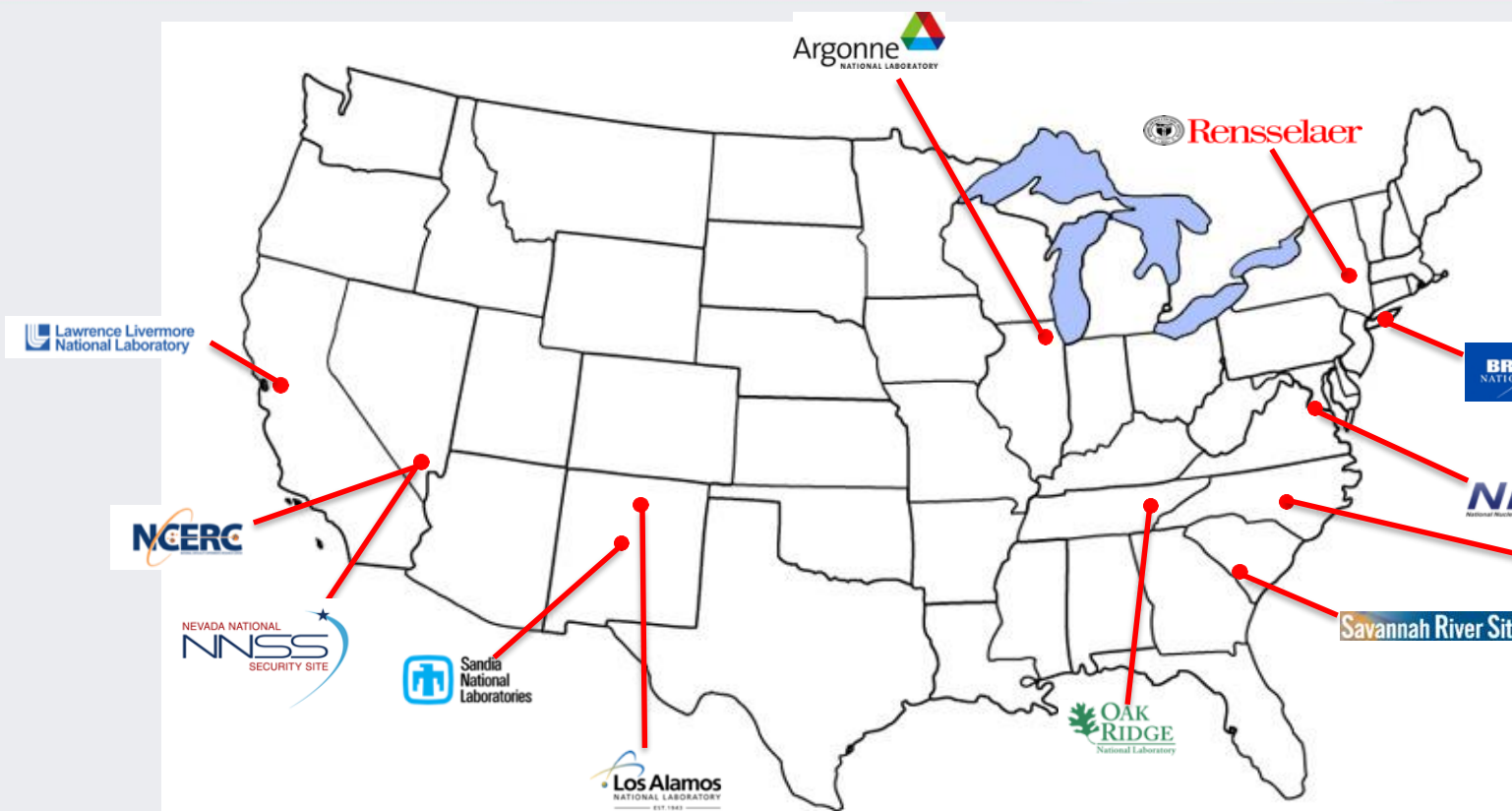
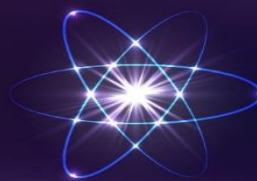


TS – Technical Support  
MT – Management team  
TMs – Task managers  
CSSG – Criticality Safety Support Group  
CSCT – Criticality Safety Coordinating Team  
NDAG – Nuclear Data Advisory Group

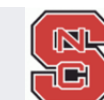
**FY2020 NCSP Budget: \$28.5 million**



# Current NCSP Work Sites



**FY2020 NCSP Budget: \$28.5 million**

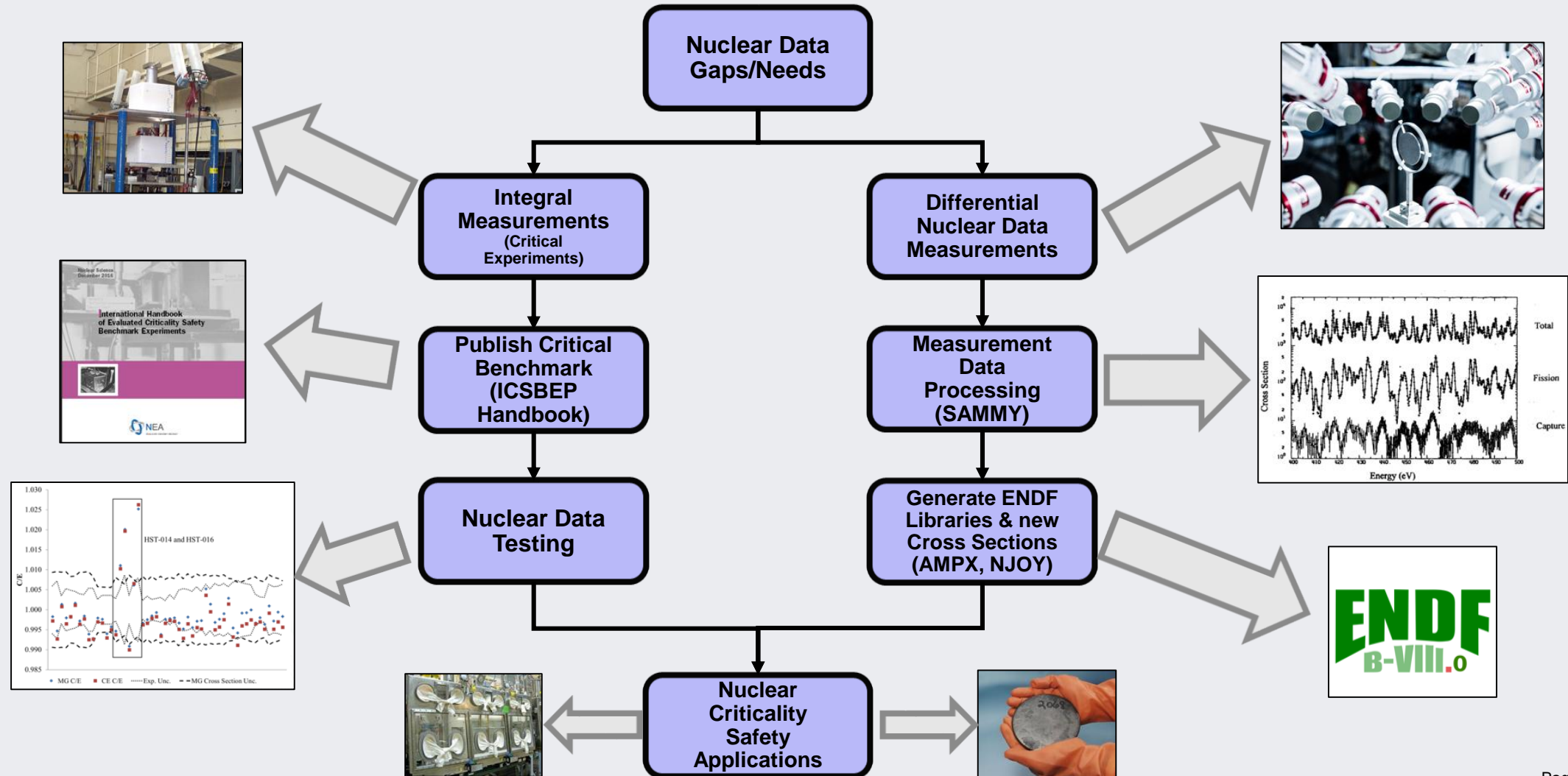
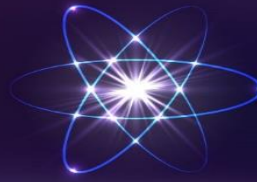


# Nuclear Data Measurements & Evaluation Work for NCSP



- **Objective:** Provide measured and evaluated thermal, resonance, unresolved resonance, and fast region cross section data to address the priority NCSP nuclear data needs
- **Vision:** Addresses multiple Nuclear Data 5- and 10-year goals and attributes identified in the NCSP Vision
- **Final product:** Rigorous ENDF/B evaluations produced from cross section measurements and analyses.
- Measurement work effort focused on NCSP priorities by NCSP Nuclear Data Advisory Group (NDAG)
- NCSP 5-year plan provides a listing of Nuclear Data measurement and evaluation priorities for the program

Appendix B Nuclear Data Priorities, Basis Statements, and Milestones							
Nuclear Data Measurements							
Materials	Pre-FY2019	FY2019	FY2020	FY2021	FY2022	FY2023	Post-FY2023
Cerium ( $^{142}\text{Ce}$ )							
Basis	Neutron transmission and capture of $^{142}\text{Ce}$ in the resonance range. Cerium is an element that is predominately $^{142}\text{Ce}$ (88.450 a/o) and $^{140}\text{Ce}$ (11.114 a/o) and can be found in chemical processing streams because it is commercially used as a catalyst or additive for chemical applications (e.g., glass polishing powder). As a result, cerium appears as an admixed material in process streams. $^{142}\text{Ce}$ is also a stable fission product. The primary interest for cerium cross sections is for poison credit in NCS analyses. The need for improved cerium cross sections has been specifically identified for the Hanford Plutonium Finishing Plant and other similar operations. Isotopically enriched sample required.						
Chlorine ( $^{35}\text{Cl}$ )							
Basis	Measurement of the $^{35}\text{Cl}$ (n,p) cross section in the resonance range. Chlorine is present in fuel cycle facilities in Pu solutions, electrowinning processes, chloride salts, and as brine/drift in some repository environments. Improved $^{35}\text{Cl}$ (n,p) cross sections needed for poison credit in these environments. A need for improved $^{35}\text{Cl}$ cross sections has been specifically identified at LANL and Y-12.						
Lanthanum ( $^{139}\text{La}$ )							
Basis	Measurement of neutron transmission and yield of $^{139}\text{La}$ in the resonance range. Lanthanum is an element that is predominately $^{139}\text{La}$ (99.910 a/o) and a stable fission product. The primary NCS interest is for fission product credit. In the latest edition of the ENDF nuclear data library, the resonance analysis is based on parameters obtained with an experimental set up which is known to have certain problems. Currently, ENDF/B-VIII evaluations for La do not have adequate covariance data based on experimental data. Improved covariance data are needed to support sensitivity/uncertainty analyses for fission product credit applications. Natural samples can be used.						
Molybdenum ( $^{98}\text{Mo}$ )							
Basis	Measurement of neutron capture in $^{98}\text{Mo}$ in resonance range, URR. Neutron transmission measurements previously completed at RPI. $^{98}\text{Mo}$ is a stable fission product and the primary absorbing nuclide in natural Molybdenum. Molybdenum isotopes are currently encountered in irradiated fuel as fission products or in molybdenum alloys in research reactors and space reactors. The current primary interest in NCS is for fission product credit for transport casks, irradiated fuel storage, and reprocessing plants (UPU-MoZr deposits in French reprocessing plant equipment for example). Needs identified by NR and IRSN for fission product credit and Y-12 for U-Mo applications (lower priority). Isotopically enriched sample required.						
Neptunium ( $^{237}\text{Np}$ )							
Basis	Measurement of $^{237}\text{Np}$ fission cross section in fast energy range. $^{237}\text{Np}$ is an actinide of interest in nuclear criticality safety for applications at ORNL and other sites. Applications include $^{237}\text{Np}$ production w/ HFIR at ORNL (low NCS priority) and fast burst reactor for LANL. Nuclear data improvements will improve critical mass estimates. On the HFIR, there is a request for fission cross section in the energy range from 200 keV to 20 MeV. The application list was fast systems, and the required accuracy is 1.5-4%. This requirement comes from the desire to improve the current low accuracy in the covariance matrix (6-8%).						
Tantalum ( $^{181}\text{Ta}$ )							







- 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)

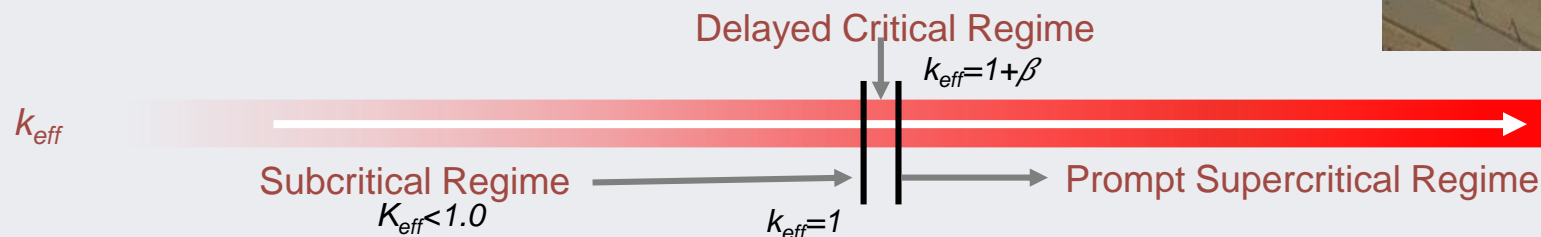
DAF/NCERC



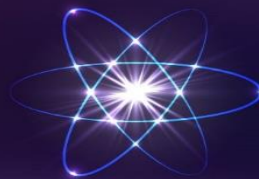
SNL/TA-V/SPR Facility



SPR Facility

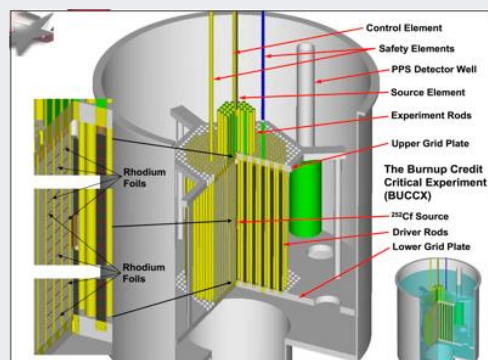
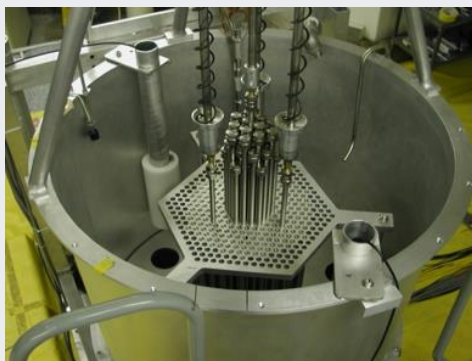




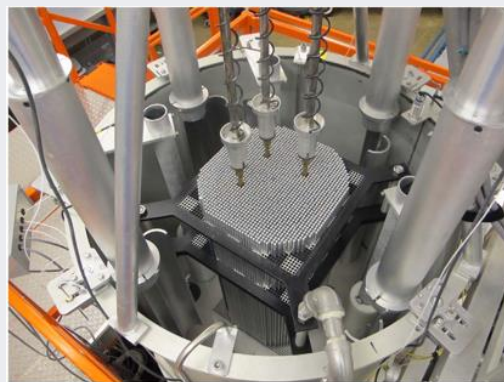


## Sandia National Laboratory

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



SNL – 7uPCX – U(6.9) UO<sub>2</sub> rods



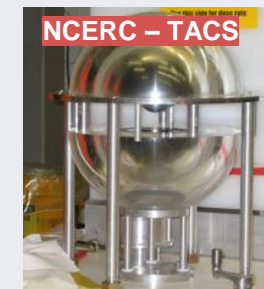
## NCERC/DAF



NCERC – Np-237 Sphere



NCERC – BeRP Ball



NCERC – TACS



NCERC – Godiva IV



NCERC – Flattop



NCERC – Comet



NCERC – Planet

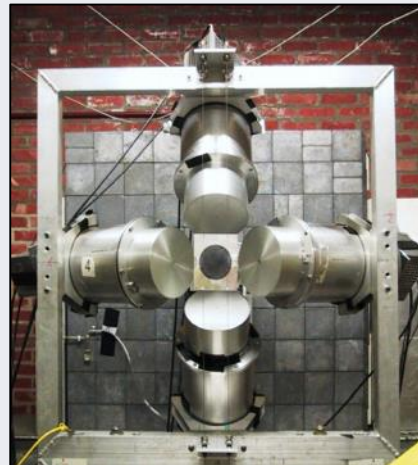
# NCSP Differential Experiments

- NCSP differential measurements are performed at
  - JRC-Geel GELINA Facility (Geel, Belgium)
  - RPI LINAC (Troy, NY)
- Types of experiments that are performed
  - Total cross section/Transmission measurements
  - Capture measurements

JRC-Geel (GELINA)



RPI LINAC  Rensselaer

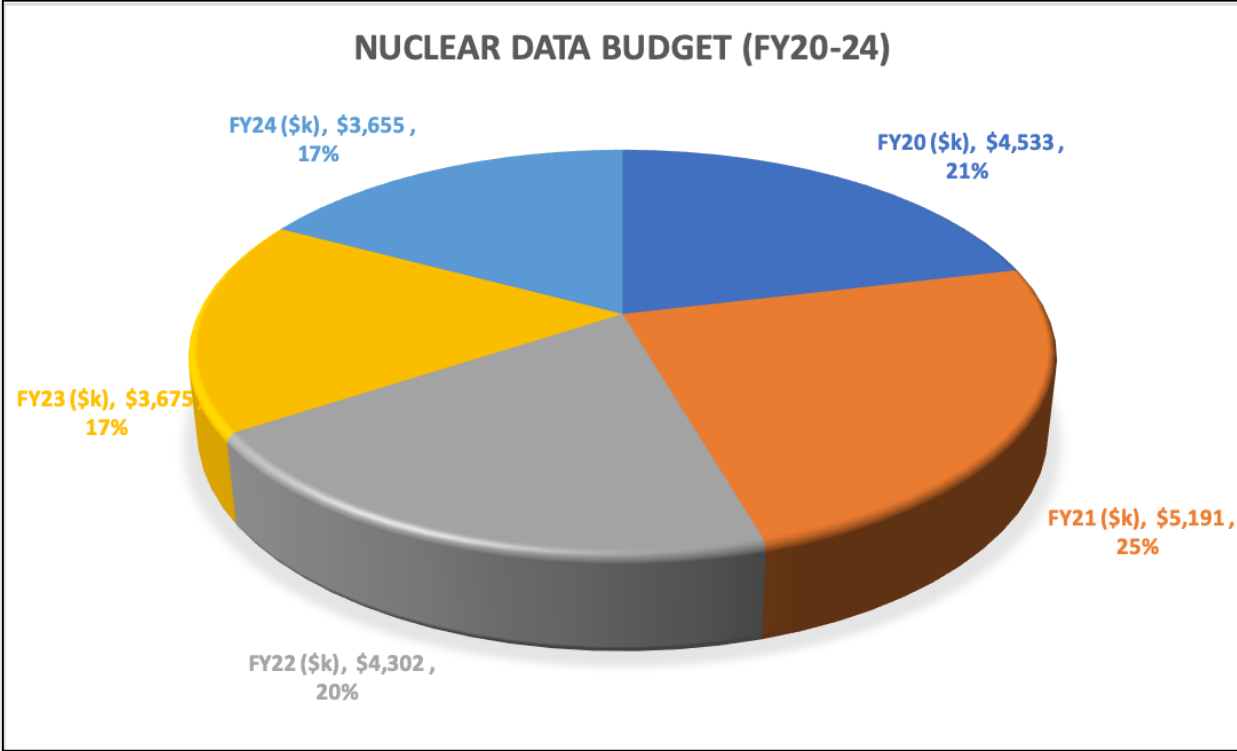
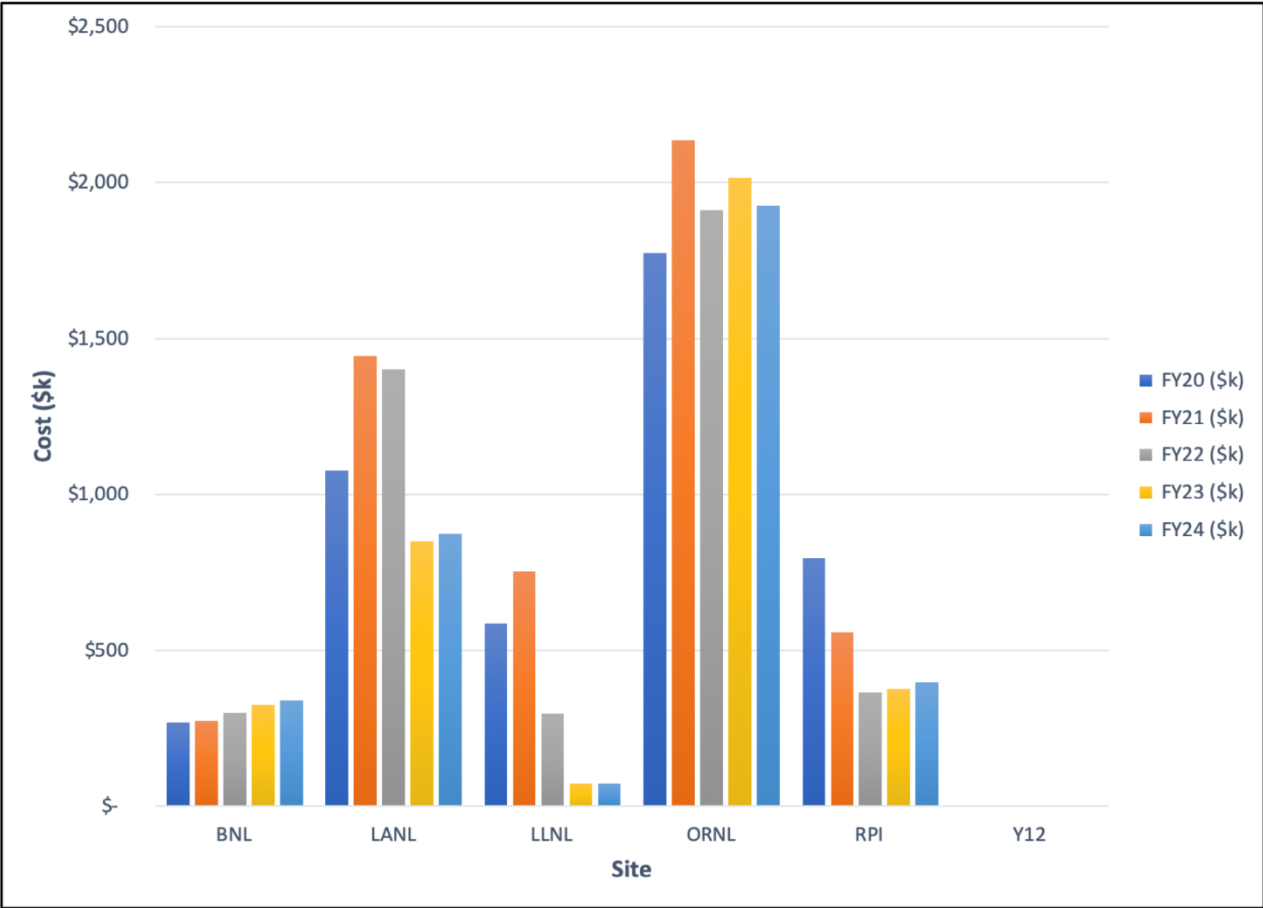
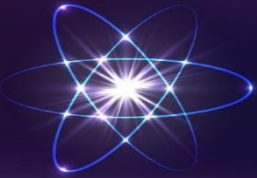


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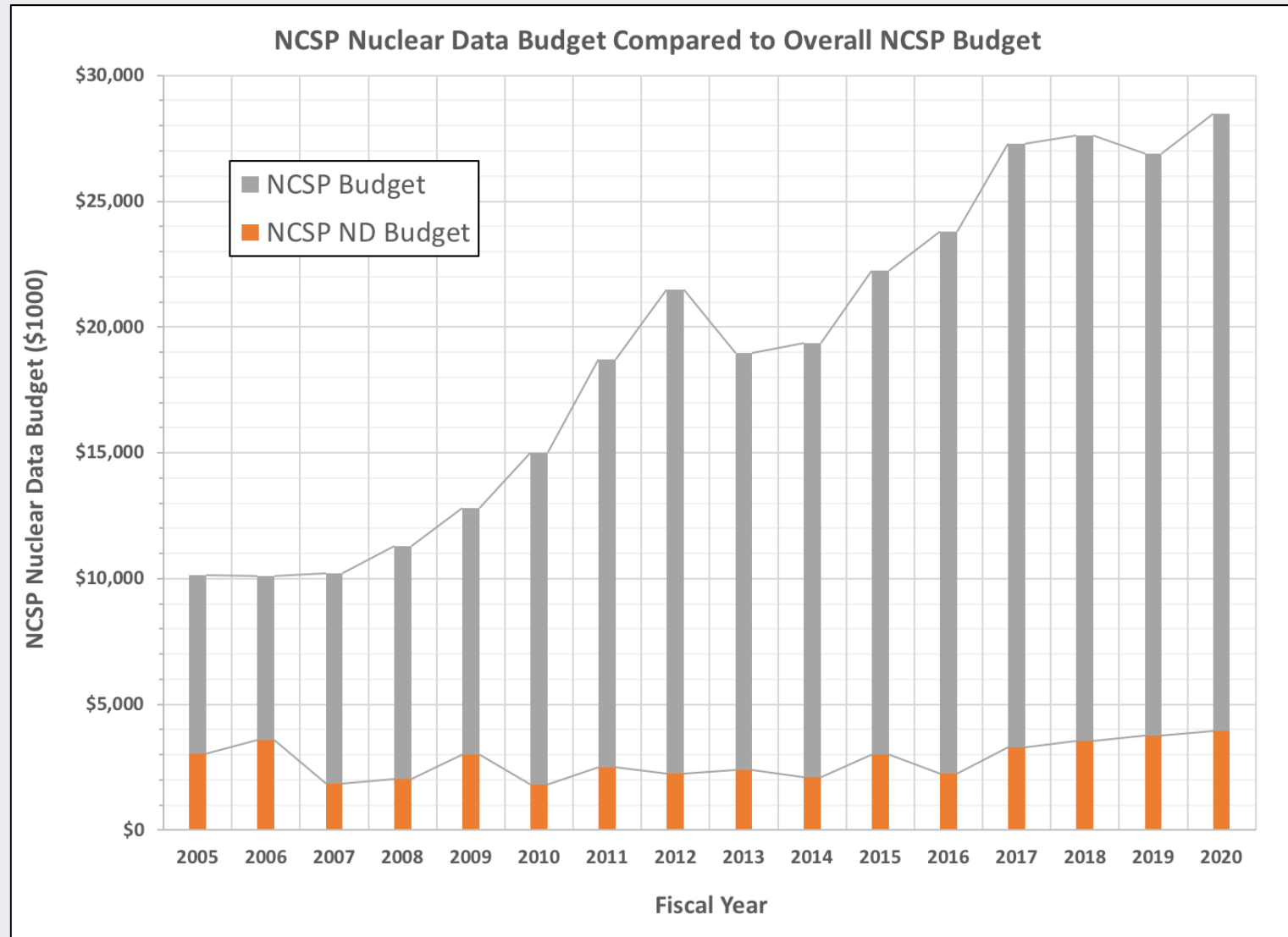
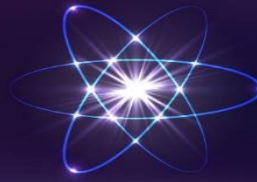
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# NCSP Nuclear Data Budget – by site and by year



# NCSP Nuclear Data Budget – 2005-Present





# Questions

