

From Criticality Safety to Advanced Reactors: The Evolving Role of NCSP and DNCSH in Nuclear Data Development

Luiz Leal,¹ Douglas Bowen,¹ Angela Chambers,² William Wieselquist¹

¹Oak Ridge National Laboratory, Oak Ridge, Tennessee, USA

²NA-ESH-21 Risk Management, NCSP Manager, USA

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Motivation

- Understand the origins and evolution of the Nuclear Criticality Safety Program (NCSP)
- Highlight NCSP's role in developing nuclear data, experiments, and validation infrastructure
- Assess how NCSP supports criticality safety across the nuclear enterprise
- Connect this foundation to emerging needs for advanced reactors
- Introduce the DNCSH initiative addressing HALEU fuel cycle challenges

Origins of NCSP

- Early 1990s: declining criticality infrastructure
- Risk of losing experimental capability
- Need for coordinated national program

DNFSB 93-2 (1993)

- Maintain critical experiment capability
- **Improve nuclear data**
- Support training and expertise
- Integrated experiments, data, codes, benchmarks

Note:

The Defense Nuclear Facilities Safety Board (**DNFSB**) is an independent federal agency that provides technical oversight, analysis, and **recommendations to the Secretary of Energy regarding** public health and safety at US Department of Energy (DOE) defense nuclear facilities. DNFSB ensures safety in the design, construction, operation, and decommissioning of these sites.

DNFSB 97-2 (1997)

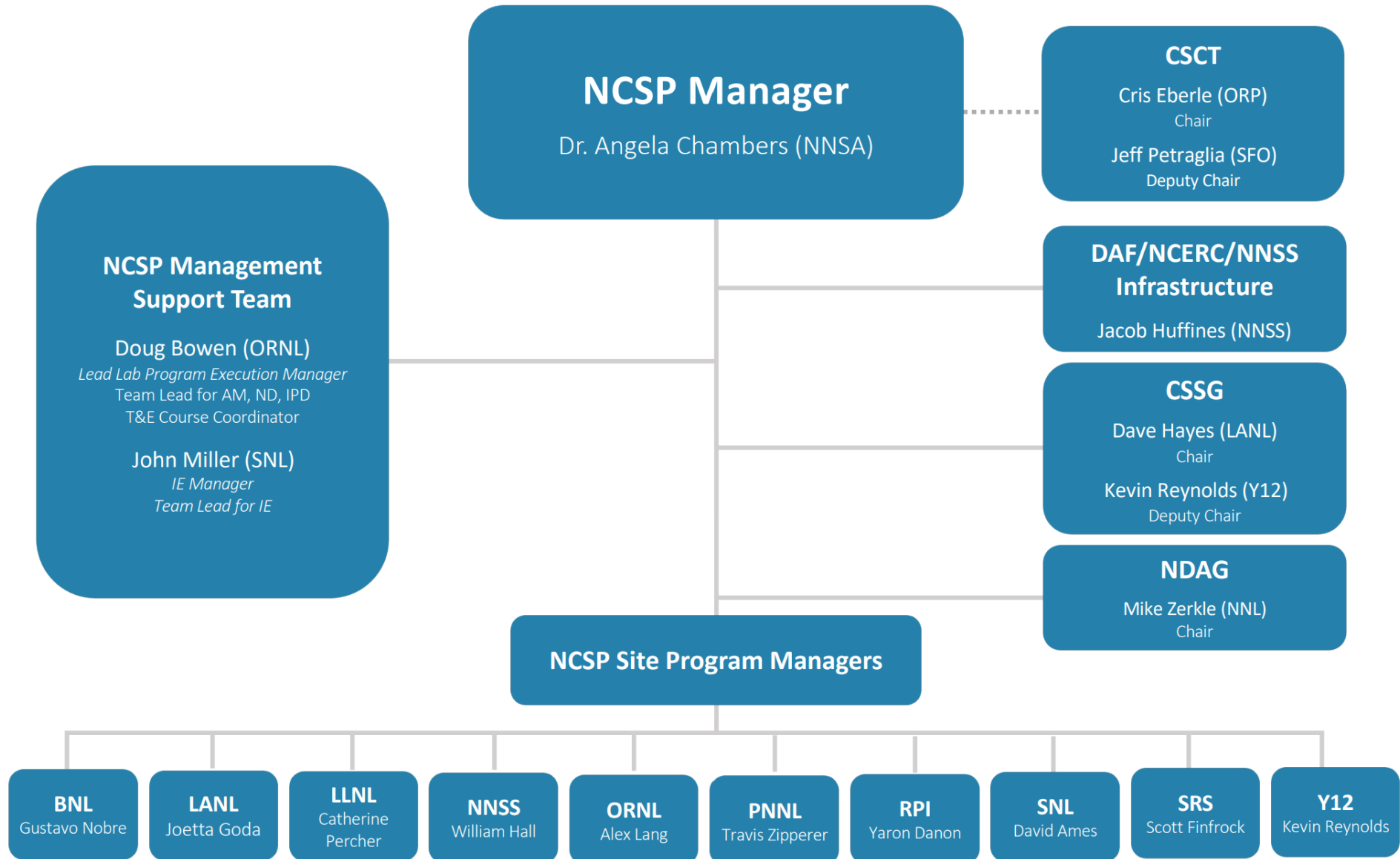
- Expanded scope to full safety system
- Required validation, training, funding
- Led to creation of NCSP

Creation of NCSP

- Formalized late 1990s
- Stable funding ~2002
- Established long-term infrastructure

Nuclear Criticality Safety Program (NCSP)

Organization Chart



Managers



Douglas Bowen
NCSP Program Execution
Manager

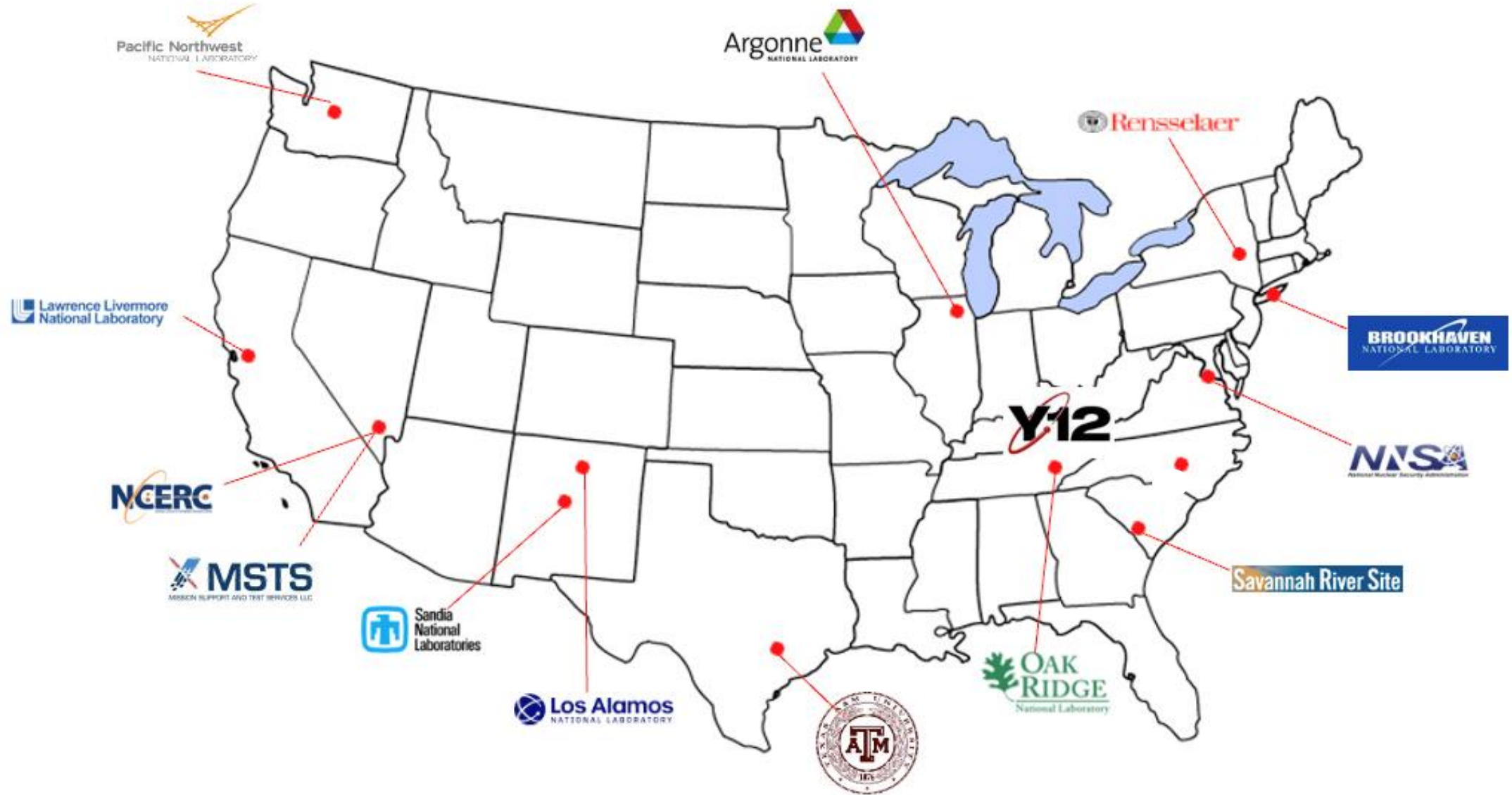


Angela Chambers
NCSP Manager



William Wieselquist
National Technical
Director: **DNC SH**

NCSP Work Sites



NCSP Technical Program Elements

- Nuclear Data (ND)
- Integral Experiments (IE)
- Analytical Methods (AM)
- ICSBEP Benchmark Evaluations
- Training & Qualification
- Information Preservation

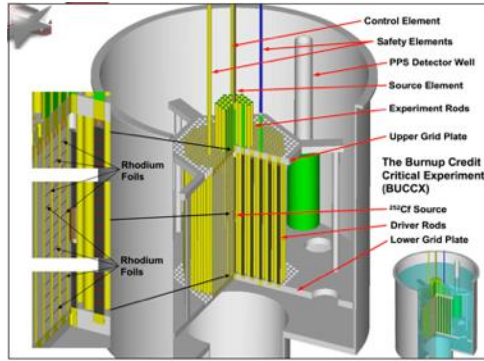
NCSP Facilities & Capabilities

- NCERC (Nevada), Sandia Critical Experiments
- GELINA (Belgium), RPI LINAC
- LANL LANSCE neutron facilities
- SNS (ORNL)

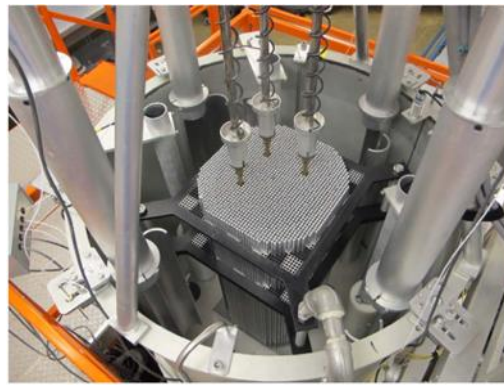
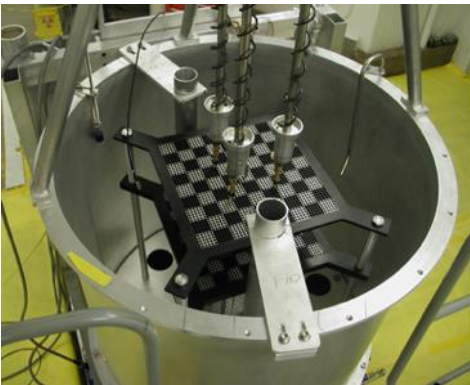
NCSP Critical Assemblies

Sandia National Laboratories

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



SNL – 7uPCX – U(6.9) UO₂ rods



NCERC/DAF



NCERC – Godiva IV



NCERC – Flattop



NCERC – Comet

NCERC – Planet



NCSP Differential Experiments (Nuclear Data)

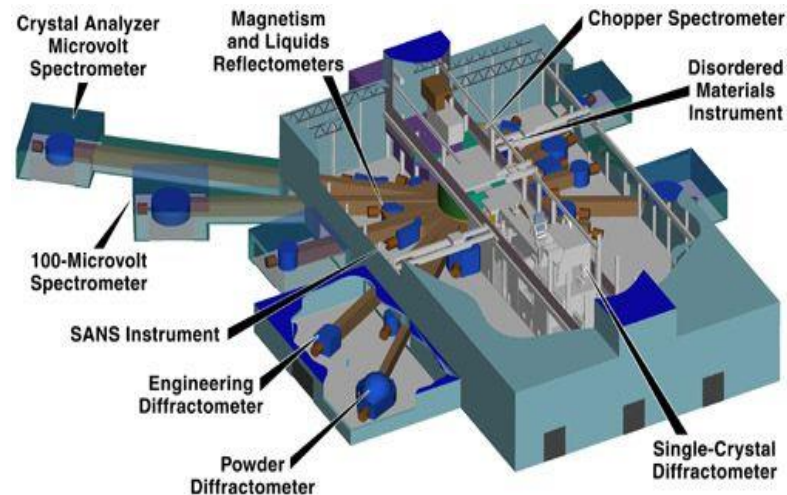
- NCSP differential nuclear data measurements are performed at
 - JRC-Geel GELINA Facility (Geel, Belgium)
 - RPI LINAC (Troy, NY)
 - LANL (Los Alamos, NM) LANSCE/Lujan Neutron Scattering Center
 - SNS/VENUS



RPI



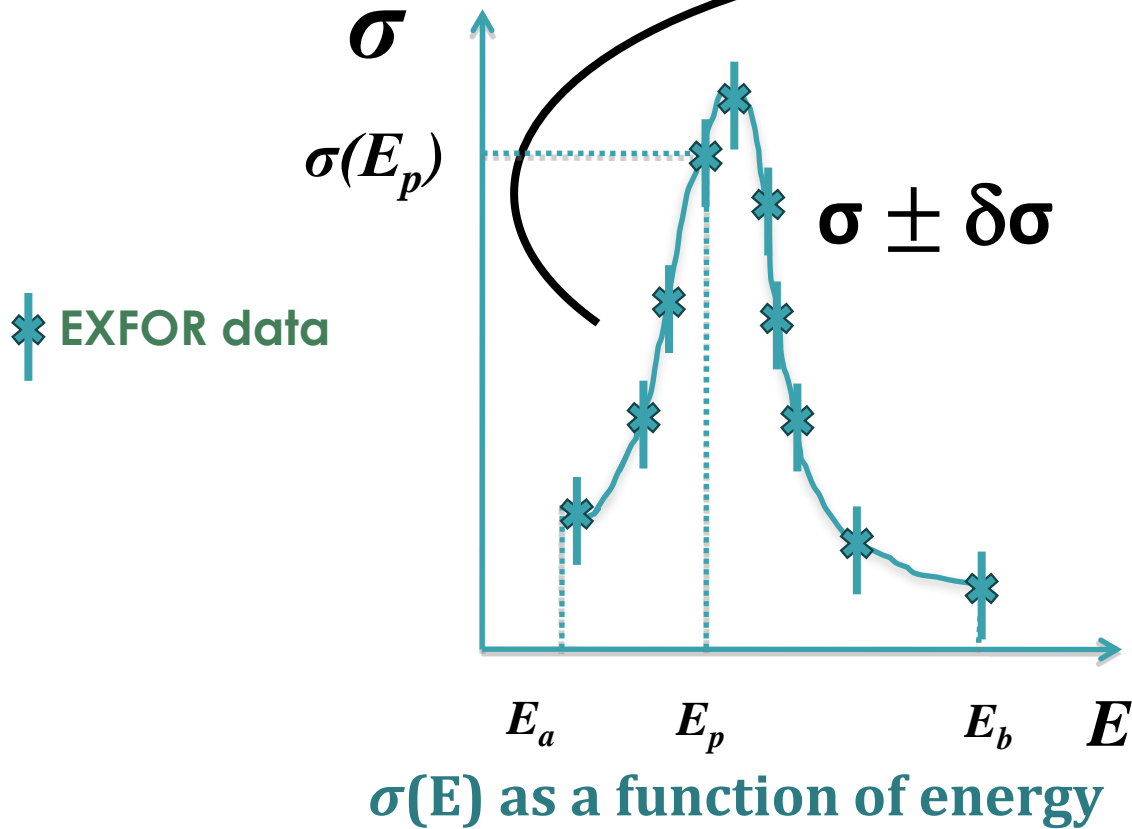
GELINA



SNS



LANL - DANCE



$$R = \int_{E_a}^{E_b} \sigma(E) \varphi(E) dE$$

$$R \pm \delta R$$

R is the reaction rate
(measured quantity)

Differential

Integral

Nuclear data evaluators should be aware of the role of differential and integral data in completing a successful nuclear data evaluation

Role of Integral Experiments

- Integrated validation of nuclear data and codes
- Identify deficiencies in nuclear data
- Guide improvements in evaluations

NCSP Experimental Capability

- Critical assemblies: Godiva IV, Planet, Comet
- Subcritical and supercritical experiments
- Direct testing of nuclear data in realistic systems

NCSP Achievements

- Improved ENDF nuclear data libraries
- Expansion of benchmark databases (ICSBEP)
- Reduced bias and uncertainty in k_{eff} predictions

Why This Matters

- ~50 years since last DOE criticality accident
- Strong safety record supported by NCSP
- Data + experiments + validation enable safety

Current Challenges

- HALEU and advanced reactor systems
- Limited benchmark coverage
- New materials and neutron spectra
- Growing demand for validation

DNCSH Initiative

- DOE/NRC collaboration
- Extends NCSP to advanced systems
- Supports HALEU fuel cycle applications

DNCSH Objectives

- Identify nuclear data gaps
- Prioritize new experiments
- Develop new validation benchmarks

NCSP + DNCSH Framework

- NCSP provides foundation
- DNCSH extends to new applications
- Integrated system for future reactors

Concluding Remarks

- NCSP established to preserve critical capability
- Provides validated nuclear data infrastructure
- Supports safety across the nuclear enterprise
- DNCSH extends capabilities to advanced reactors
- Integrated approach essential for future systems