1ST QUARTER 2023 EDITION

THE NEUTRON PULSE

NCERC

Critical Assembly Operations

NCERC experimenters performed eight weeks of critical assembly operations including Godiva-IV Characterization Measurements, Godiva-IV Baseline Critical Configuration Measurements, and Experiments Underpinned by Computational Learning for Improvements in nuclear Data (EUCLID).

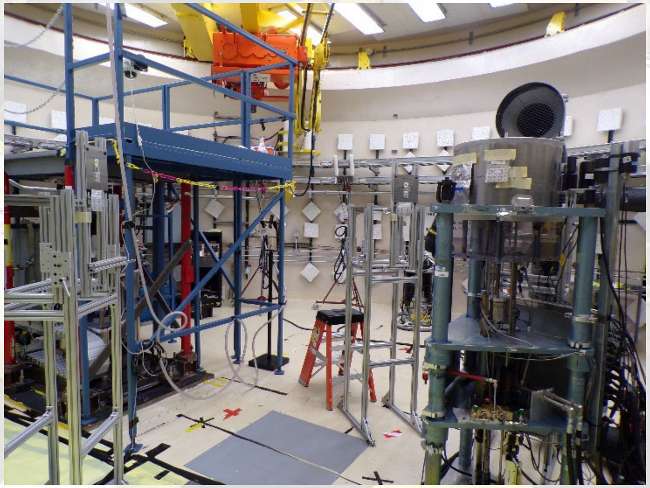
Godiva-IV Characterization Measurements

Godiva-IV Characterization Measurements were performed to better define the photon and neutron field produced by Godiva-IV during steady state and burst operations. These measurements were a collaborative effort by LANL and SNL personnel. NCERC experimenters performed equipment setup and Godiva-IV operations, while SNL personnel provided the sample equipment and performed counting operations. The measurements occurred over four weeks, consisting of preliminary measurements, equipment setup, steady state operations, and burst operations. Four steady state and five 250°C ΔT burst irradiations were performed in total.

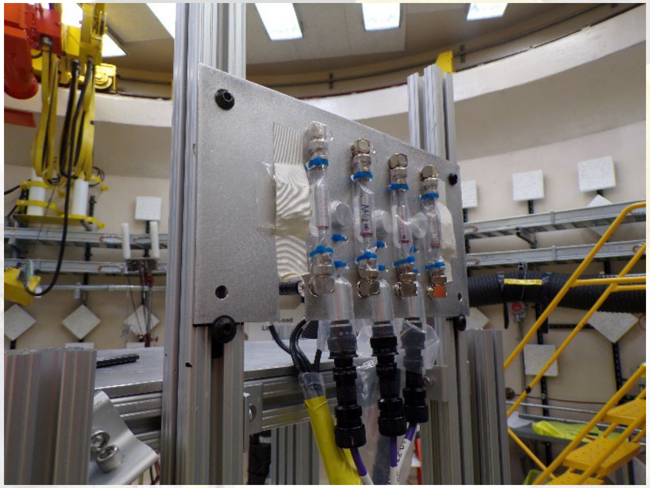
A large amount of sample equipment was necessary for the characterization including:

- Activation foil sets
- Dosimetry packs
- Cadmium covers
- Thermoluminescent dosimeters
- Nickel Foils
- Pocket ionization chambers
- Sulfur Pellets
- Active dosimetry detectors and associated equipment
- Fission foils (HEU, DU, Np, Pu)

Sample were positioned in the Godiva-IV glory hole, on the surface of the Godiva-IV top hat, one meter and two meters away. Activation foils, fission foils, and cadmium covered activation foils were used to determine the neutron and photon fluence during steady state operations. Activation foils, active dosimetry (Si, Au, and C calorimeters, PCDs), dosimetry packs, and TLDs were used during the 250°C ΔT burst.



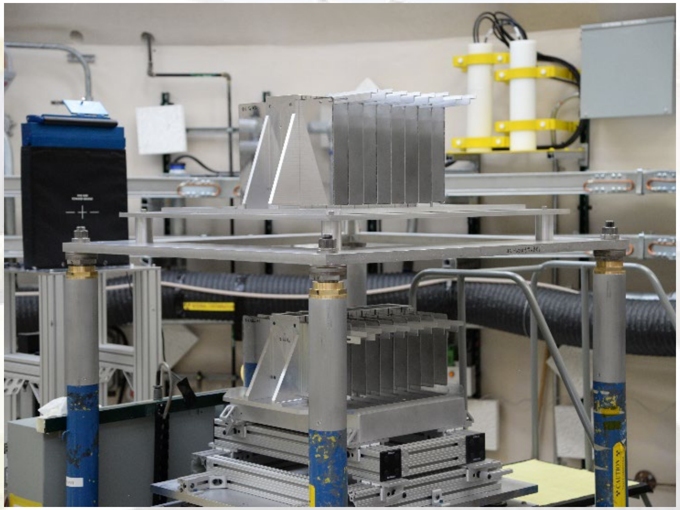
◄ *Activation foils and dosimetry positioned on the Godiva-IV top hat, and on stands one meter and two meters away.*



◄ *Sandia photo-conducting diode (PCD) and calorimeter detectors which were placed near the Godiva Top Hat.*

EUCLID on Planet

The EUCLID experiment was designed to reduce compensating errors in nuclear data for ^{239}Pu systems with fast neutron spectra. This experiment marks the first time Artificial Intelligence (AI) and machine learning (ML) were used to optimize an experimental configuration to reduce unconstrained physics spaces in nuclear data. New tools were created to simulate sensitivities of various responses, perform nuclear data adjustment, and perform experiment optimization which can be used to investigate other isotopes. The experiment included measurements of six responses: critical, neutron leakage spectra, reactivity coefficients, subcritical neutron noise, Rossi-alpha, and reaction rate ratios. Two optimal configurations were designed and built, a “low mass” configuration with low neutron leakage and a “high mass” configuration with maximum neutron leakage. The “high mass” configuration used the most Pu fuel in any NCERC experiment at 110 kg.



▲ *EUCLID “high mass” configuration on Planet.*

Criticality Safety Classes

NCERC hosted one Nuclear Criticality Safety Program’s (NCSP) class. This class focuses on fundamentals of criticality, DOE criticality safety standards, and provides a hands-on training experience to address changing parameters important to nuclear criticality safety. Participants use the approach-to-critical experiment methodology to guide the construction of a critical configuration after reviewing fundamentals of criticality and observing demonstrations of many of the criticality safety parameters.

▲ *Rene Sanchez (NEN-2) and NCSP class participants stack laminated uranium class foils on Planet.*

Additional Support Operations

NEN-2 and NCERC-FO CSEs completed a permanent modification and subsequent post modification test to Planet’s analog power supply, digital power supply, and stepper motor drive. This modification will add to critical assembly reliability by minimizing component exposure to high levels of ionizing radiation. Additionally, NCERC-FO completed the NCERC Vital Safety System Assessment and will use feedback from this assessment to improve Conduct of Engineering and Configuration Management.