IER 499: TEX-CI: Ushering in a New Era of Critical Experiments with a Revamped Control System

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NCSP Technical Program Review

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SCRAM
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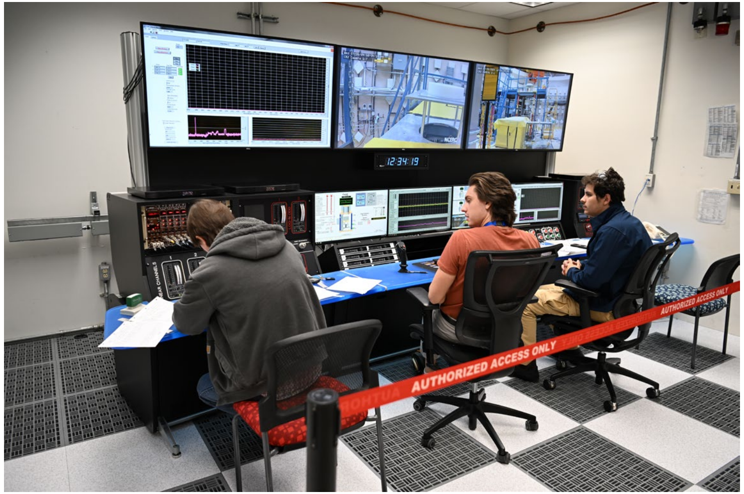
Overview

- TEX-Cl Experiment
  - Jemima HEU plates (15 inch diameter) interleaved with polyethylene plates and packed NaCl salt in aluminum containers
  - Collaboration between LLNL and LANL
  - 3rd in the TEX-HEU series, preceded by TEX-HEU and TEX-Hf
- Control Room Upgrades
  - Renovation of NCERC Control Room including software and hardware
  - Use the latest versions of equipment to maximize time to obsolescence
  - Maximize usable space in the room

The Pathway to Success

- TEX-CI did not follow the “usual” progression, but it was uniquely successful
- Design challenges and revisions
  - Decision during CED-3a to switch to a new moderator material
  - Fabrication and procurement of new parts
  - Inevitable delays associated with the changes
- Control Room Upgrades
  - Control Room equipment installation began during the revised CED-3a phase
  - Lots of testing was necessary before loading nuclear material on Comet
- End result
  - A completed experiment with higher quality data and a revitalized control system

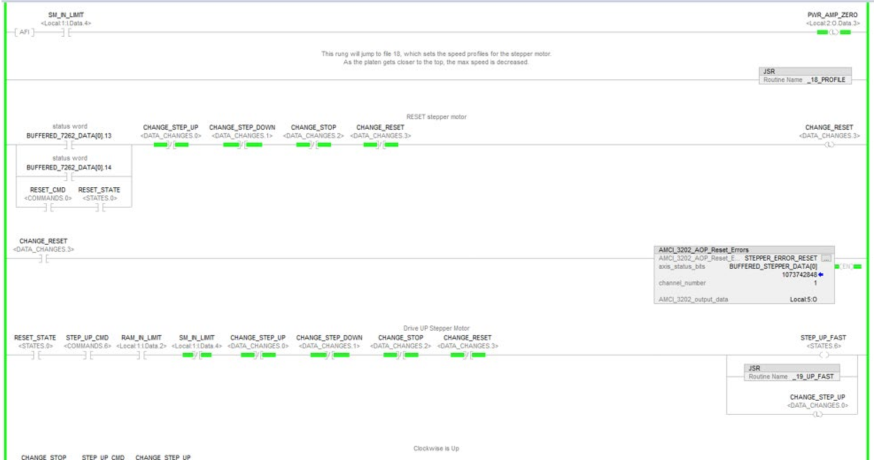
Control System Upgrades



- Hardware
  - New console
  - New monitors
  - New joystick
  - New computers and modules
- Software
  - New HMI
  - New start-up counter program
  - New data collection system (temperature, platen position, etc.)
- All using modern and newly available components
  - No longer tying back to Windows2000

Control System Testing

- Over 4 weeks testing all functionality and ensuring it performed as expected
  - Simple commands are not so simple in Studio 5000
  - Studio 5000 for the control system is a unique art (ladder logic is non-intuitive)
  - Extensive changes to the communication protocols for the joystick, stepper motor, etc.
- Extensive test plan to ensure all design requirements were met
  - Mirrored the original NCERC Start-Up test plan



Performing TEX-CI with the Upgraded Control System

- TEX-CI was the *first* experiment using the upgraded control system
- TEX-CI was an ideal first experiment to meet
  - Scheduled and all paperwork approved
  - Similar to previous experiments
  - Relatively simple to build

TEX-CI Selected Configurations

- Three configurations carried forward from five in CED-3a
- Varied Poly thickness and salt plate thickness
- Configuration 1: 8 Layer Standard
  - Jemima Plate; 1.5 in. HDPE; 1/4 in. Salt Plate
- Configuration 2: 8 Layer Sandwich
  - Unit: Jemima Plate; 3/4 in. HDPE; 1/4 in. Salt Plate; 3/4 in. HDPE plate
- Configuration 3: 18 Layer Standard
  - Unit: Jemima Plate; 3/16 in. Salt Plate

TEX-CI Measurements

Extensive Characterization of All New Components and the Full Systems

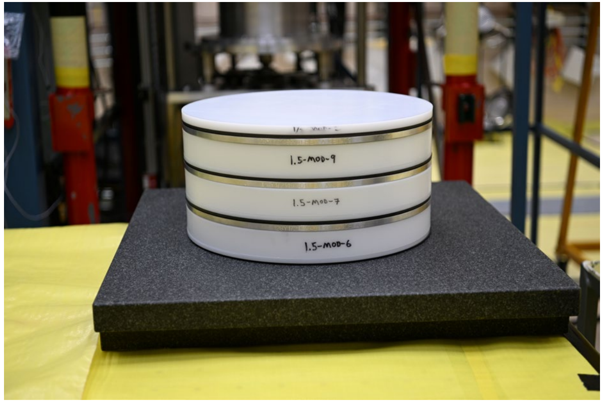
- Tools used: CMM, Micrometer, Various Calipers, Scales
  - All individual components
- Stack Height Measurements, on Comet and on the Granite Surface Plate

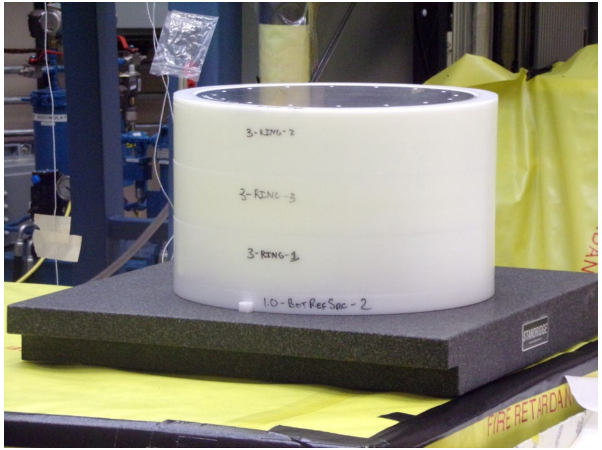
Excellent Demonstration of New Camera System

Experiment Results

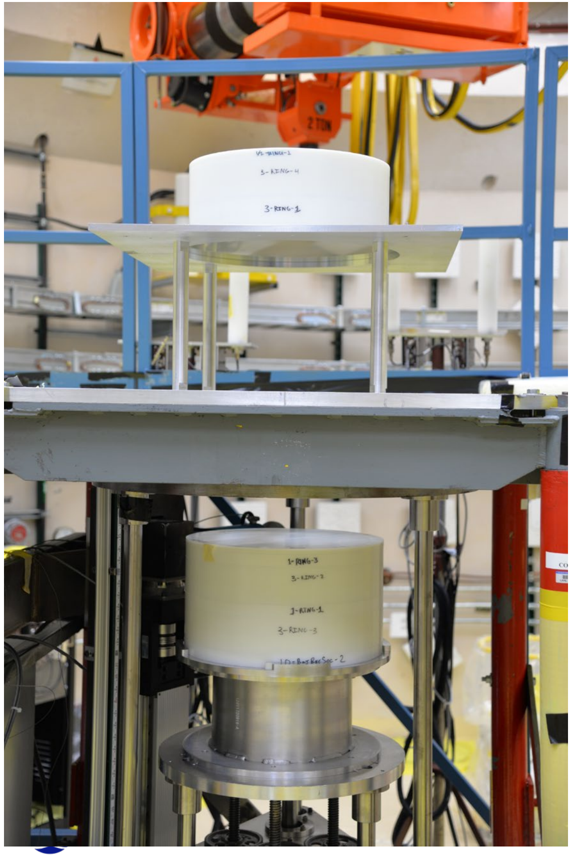
Configuration	HEU Mass (kg)	Measured Reactor Period (seconds)	Associated Excess Reactivity (cents)
8-Layer Standard	48.6	206	5.4
8-Layer Sandwich	48.6	119	8.6
18-Layer Standard	110.3	47.7	16.3

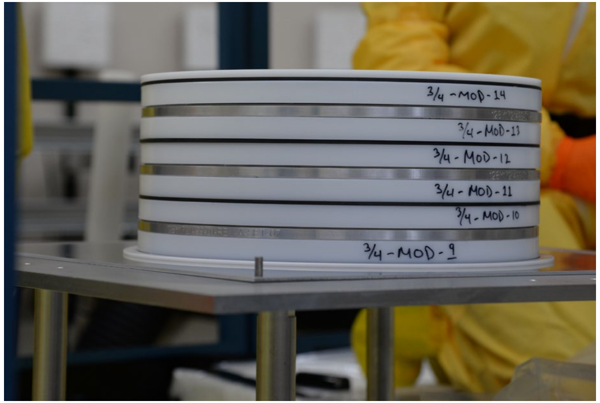
8-Layer Standard Configuration Highlights

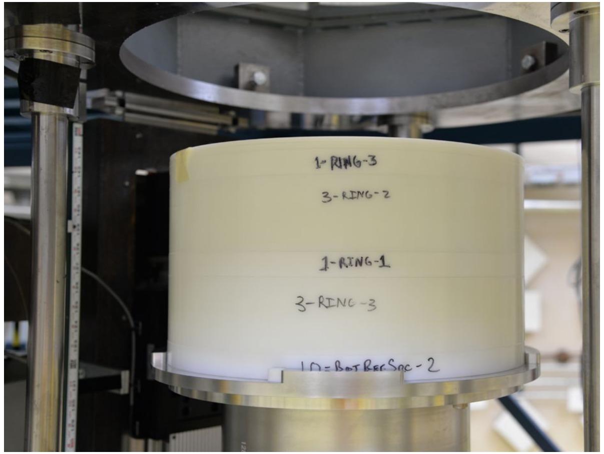


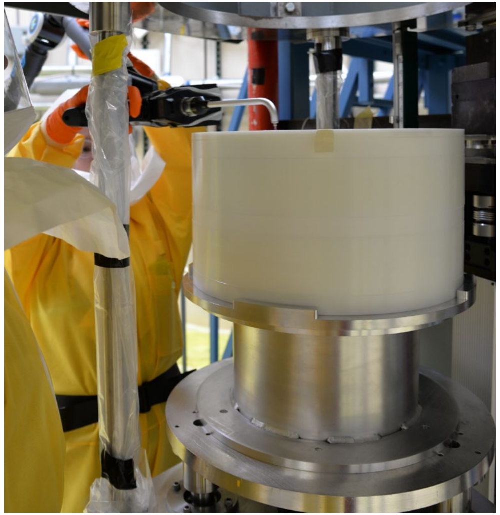


8-Layer Sandwich Configuration Highlights

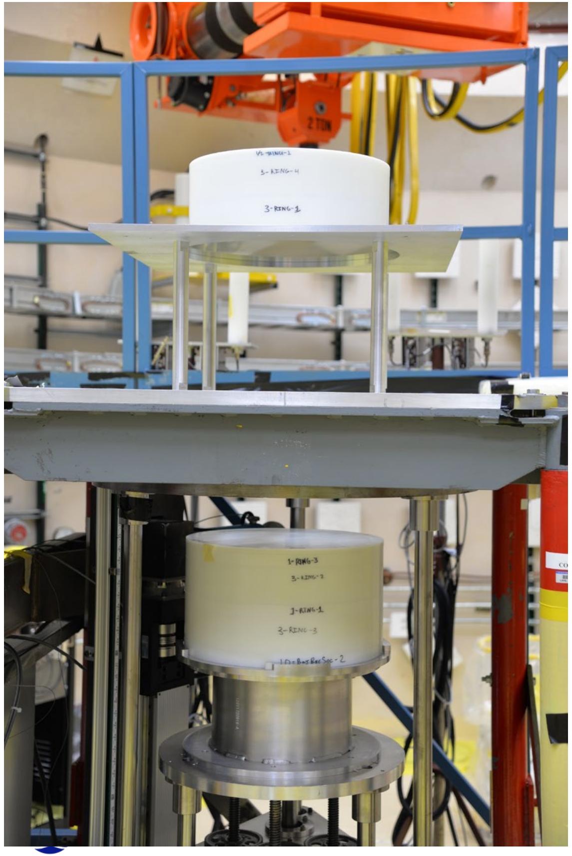


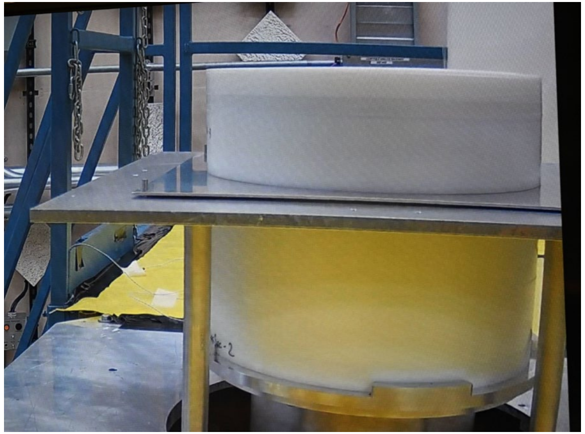






18-Layer Standard Configuration Highlights





Summary

- New NCERC control system is operational in Control Room 2
- TEX-Cl completed using new Comet control system
- Three configurations measured
- LLNL evaluating the experiment for inclusion in ICSBEP
- Complementary to Chlorine Worth Study with Pu, which was published in ICSBEP as PU-MET-THERM-005

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NUCLEAR CRITICALITY SAFETY PROGRAM

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