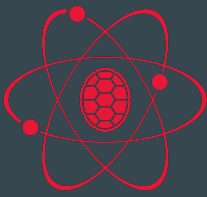


Control Systems Upgrades at the Maryland University Training Reactor



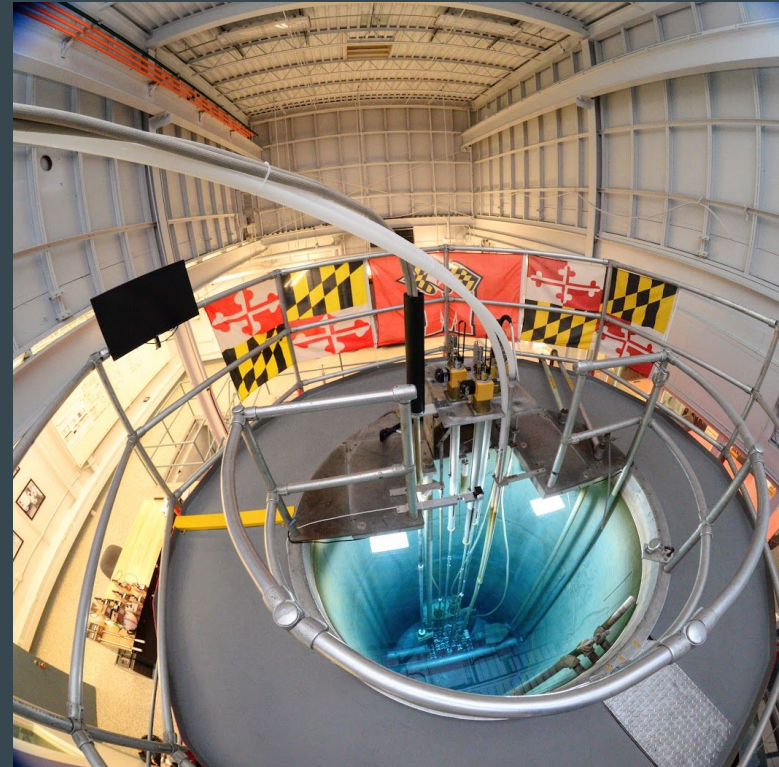
Luke Gilde

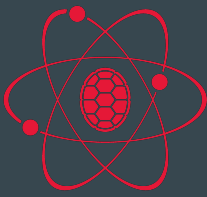
University of Maryland Radiation Facilities



Maryland University Training Reactor

- 250 kW TRIGA Conversion Reactor
 - Built in 1960, converted to TRIGA in 1974
 - Currently limited to about 100 kW
- 5 Experimental Facilities
 - Student Reactor Operator Training
 - University Lab Classes
 - Outreach Activities
 - Neutron Activation Analysis
 - Neutron Detector Testing
 - Neutron Imaging
 - Isotope Production

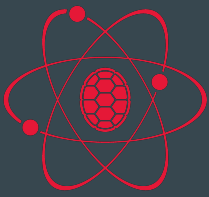




MUTR I&C - 2019

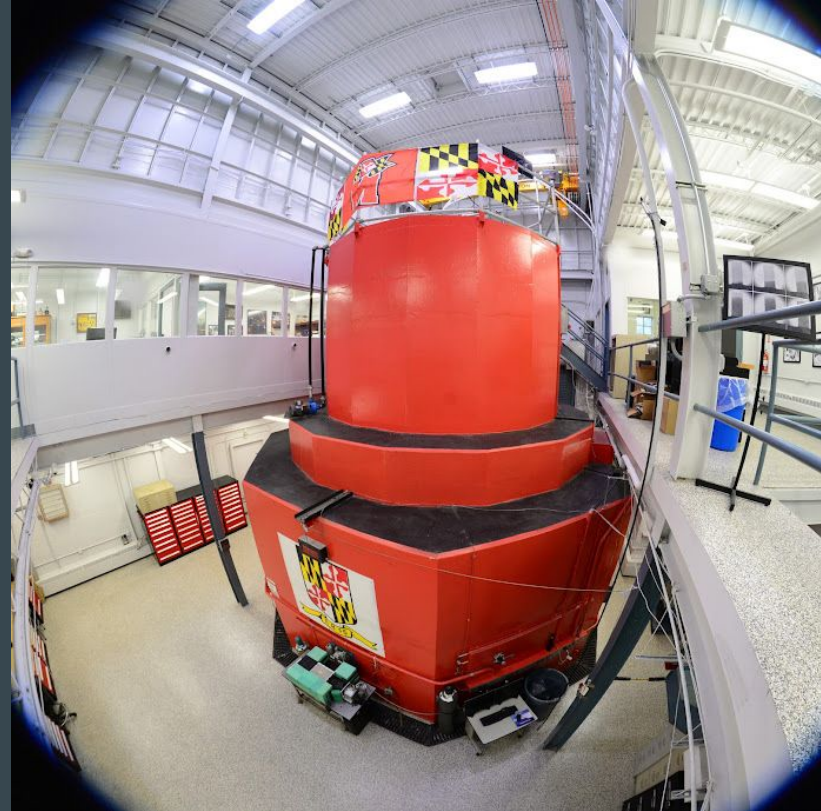
- Paper Chart Recorders
- Wide Range Channel unreliable
- Significant noise on reactor power channels during startup
- Frequent false period trips due to actuating console switches
- Unused instrumentation in console
- Large amounts of wiring abandoned in place

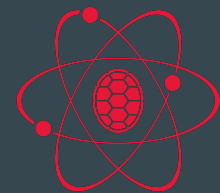




Recent Reactor Upgrades

- Digital Chart Recorders
- High Voltage Power Supplies
- Fission Chamber and Wide Neutron Flux Monitor
- Control Rod Position Indicators
- New Auxiliary Instrumentation
- Cleanup and Restoration

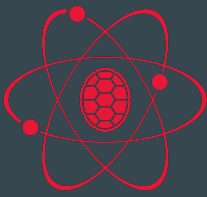




“Modular” Upper Console

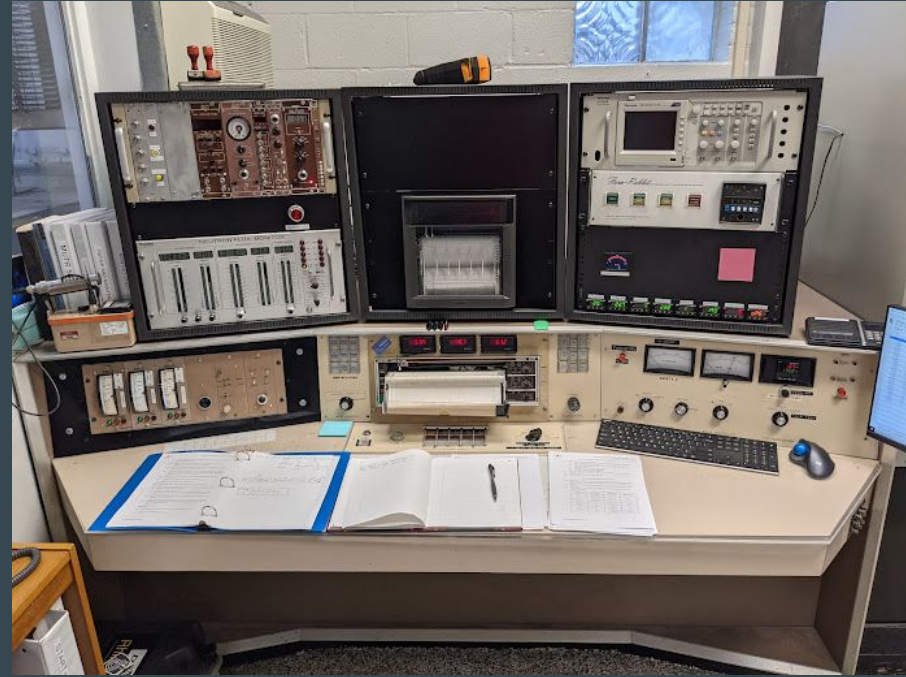
- Replaced homemade Upper Console with 19” Racks
- Racks allow for easy replacement of panels and equipment for upgrades

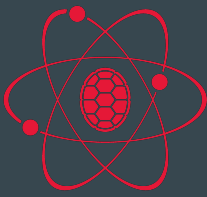




Fission Chamber and Wide Range Neutron Flux Monitor

- New fission chamber and Thermo Fisher TR-10 Neutron Flux Monitor
- Channel provides power and period scrams, count rate interlocks
- Replaced original, 49 year old fission chamber and channel
- Performance was greatly improved

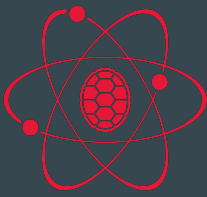




Wide Range Neutron Flux Monitor Installation

- One Time Use Procedure was prepared and approved by RxSC for testing and installing new channel
- Interconnect cable was made to tie new drawer into console with as little disruption as possible
- Several systems tied into wide range channel that were affected by the change
 - Custom signal conditioner for period signal
 - New Ortec 556 HV power supply for CIC
- One 50.59 Review and two 50.59 Screenings

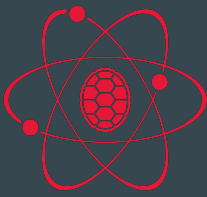




Digital Chart Recorders

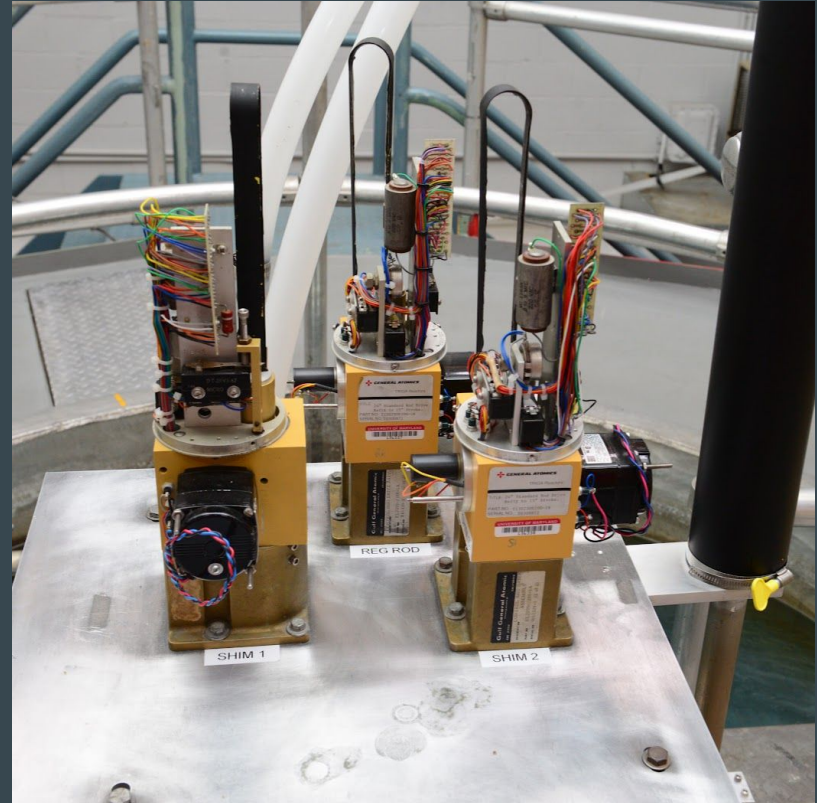
- Yokogawa GX series digital chart recorders
- Nearly all channels recorded now
- Significantly easier to read and review data
- Considering networking recorders for remote access to reactor parameters

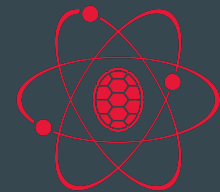




Control Rod Position Indicators

- Control Rod Position Indicators were experiencing significant drift from year to year
- Uncertainty in Rod Worth Curves
- System was returned to its original configuration
- High quality Acopian linear power supply was installed
- New Rod Position displays were installed which can retransmit a 4-20 mA signal for recording



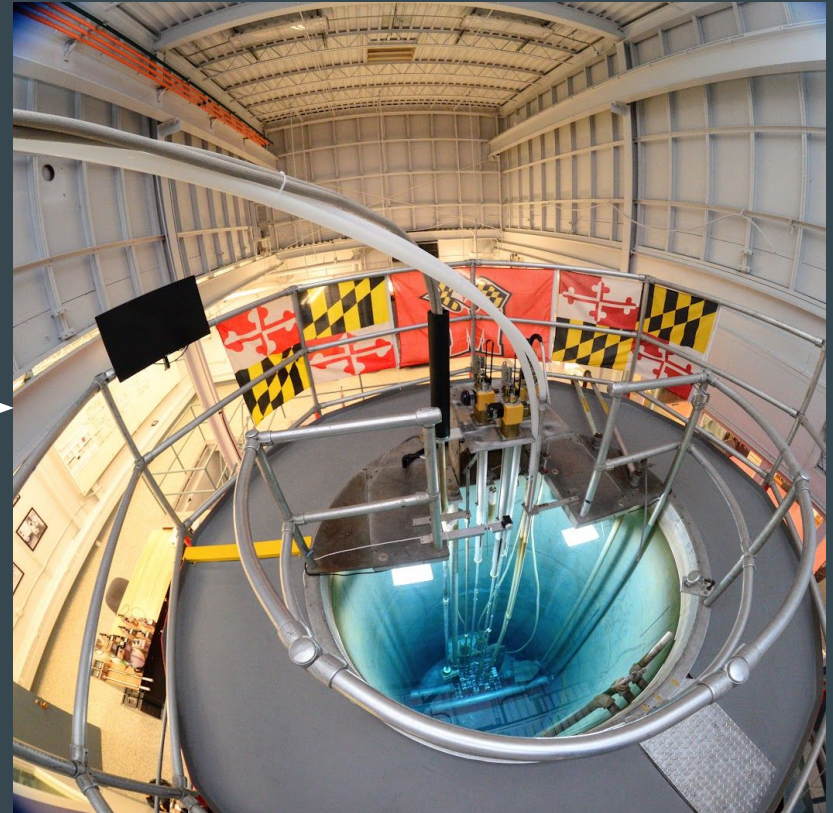
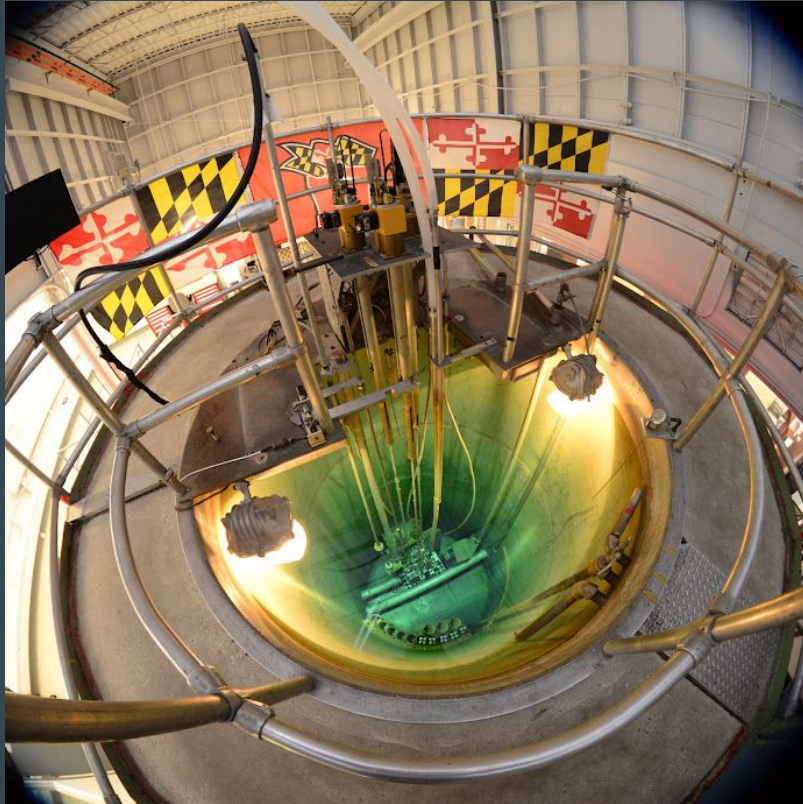
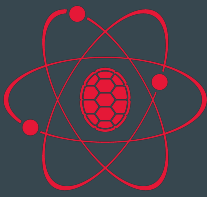


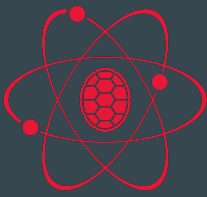
Console Cleanup

- Removed abandoned wires
- Shortened or rerouted wires
- Added labels
- Replaced doors on console



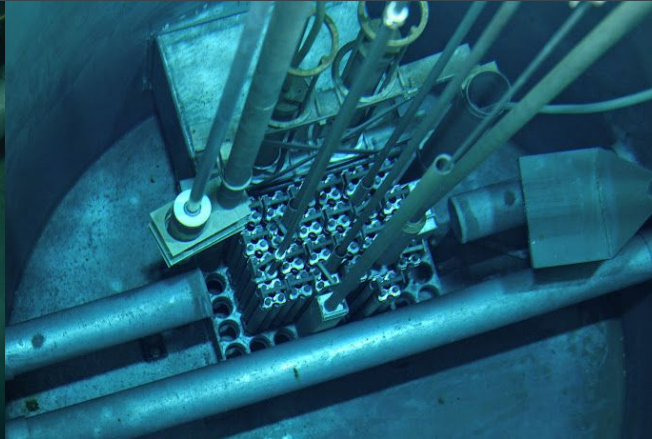
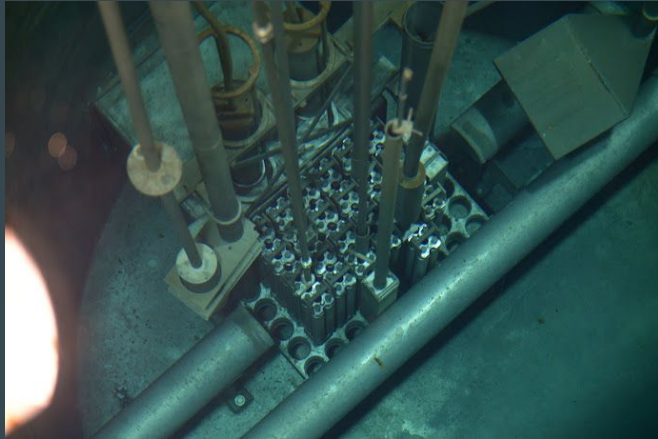
Cleanup and Painting of Reactor Top

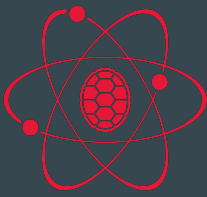




Reactor Pool Vacuuming

- Reactor Pool was vacuumed for the first time in approximately 30 years
- Off the shelf pool vacuum
- Procedure was performed with minimal contamination

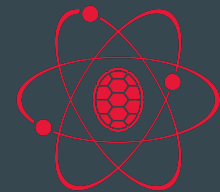




Lessons Learned

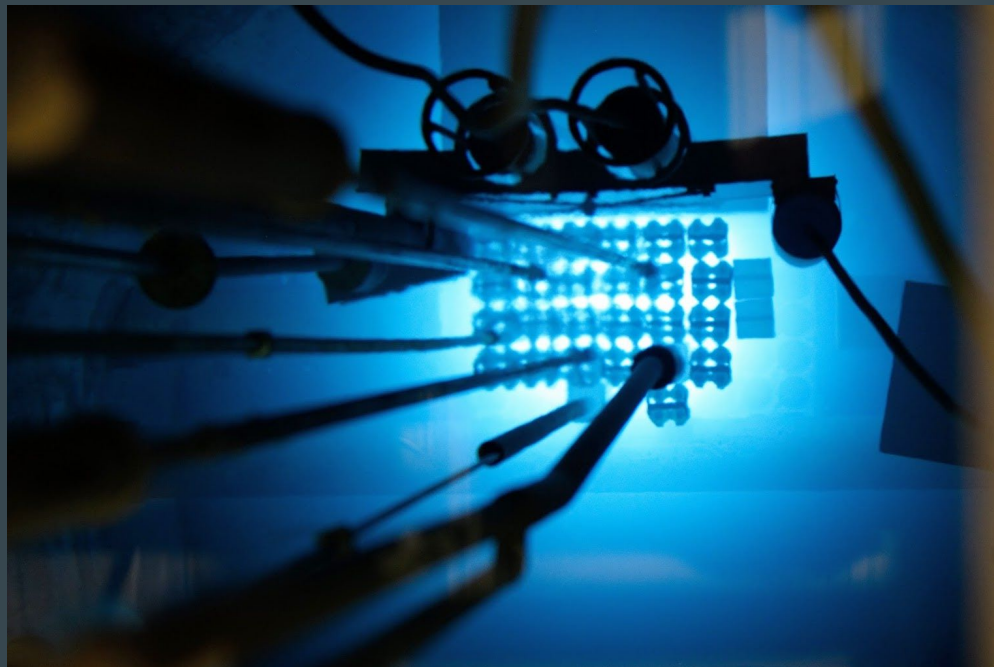
- Use of off the shelf components
 - Increased reliability and easy of replacement
- Modular component
 - Ease of replacement and upgrades
- Signal Conditioners
 - Reduced noise from AC current pickup
- Maintaining good documentation
- Have long term plans for upgrades
 - Provide consistency on updated parts

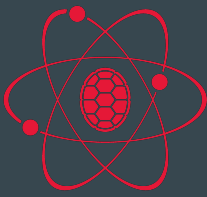




Questions?

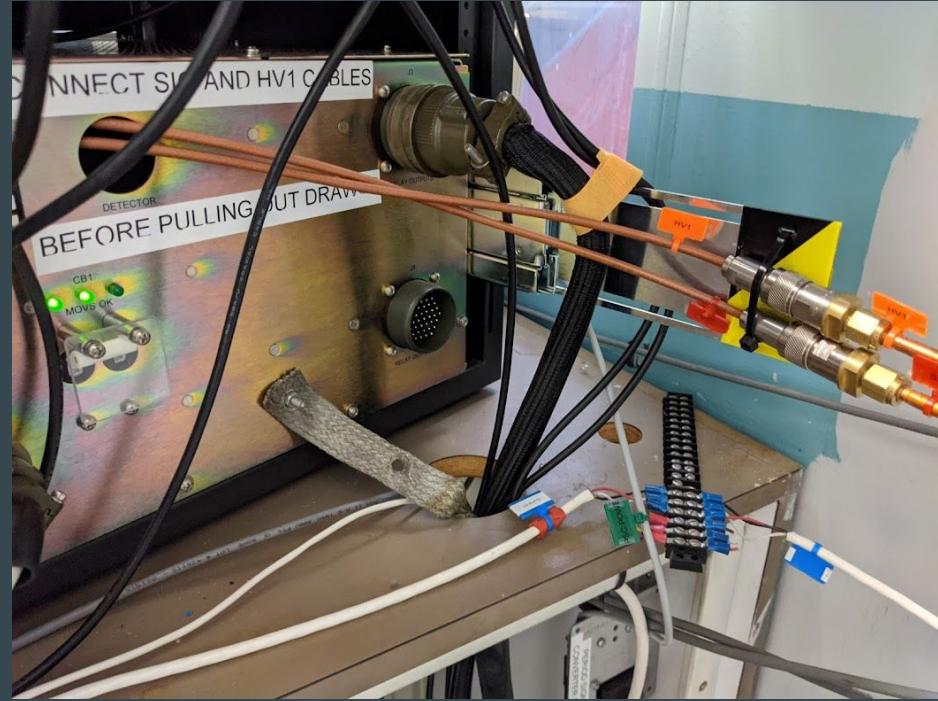
- Thanks to:
 - Steve Smith, Oregon State University
 - Jonathan Wallick, USGS
 - Sam MacDavid, NIST
 - Brian J. Schmoke, Penn State
 - Tim Koeth, UMD

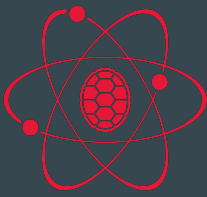




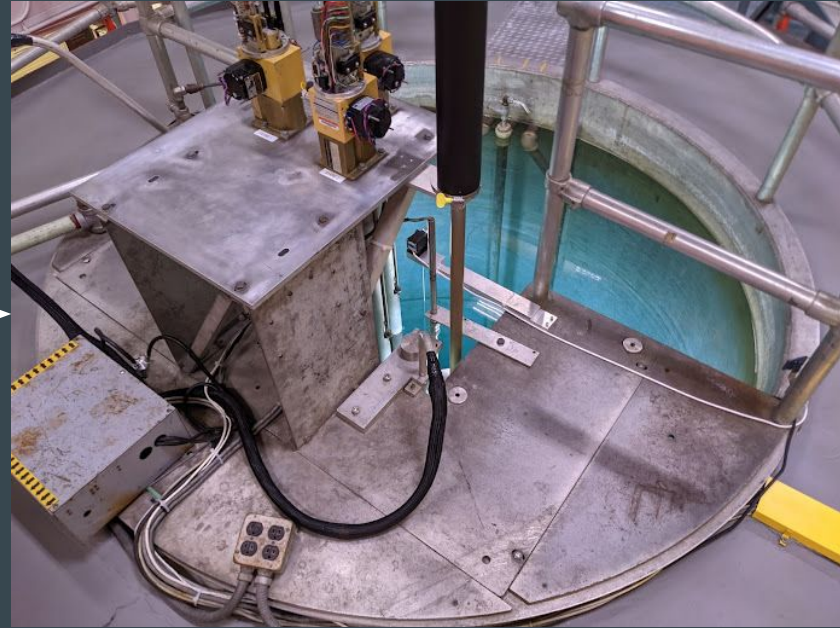
TR-10 Installation Issues

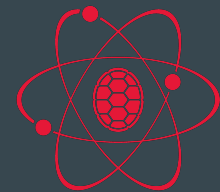
- Lack of HV Scram Test
 - Installed switch to cut off HV
- Insufficient contacts for interlocks
 - Significant delay for troubleshooting
- Detector positioning
 - Original mount did not allow detector close enough to core
- Cable fatigue
 - Stress on cable causes noise





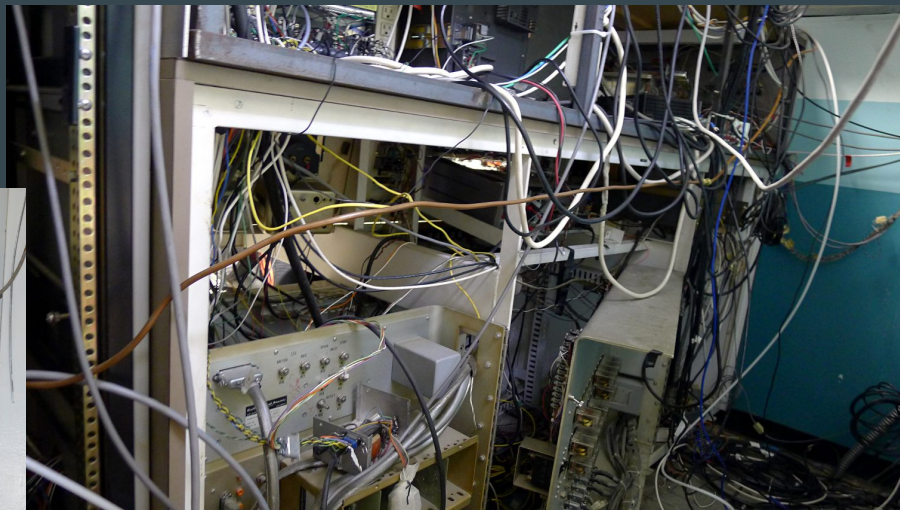
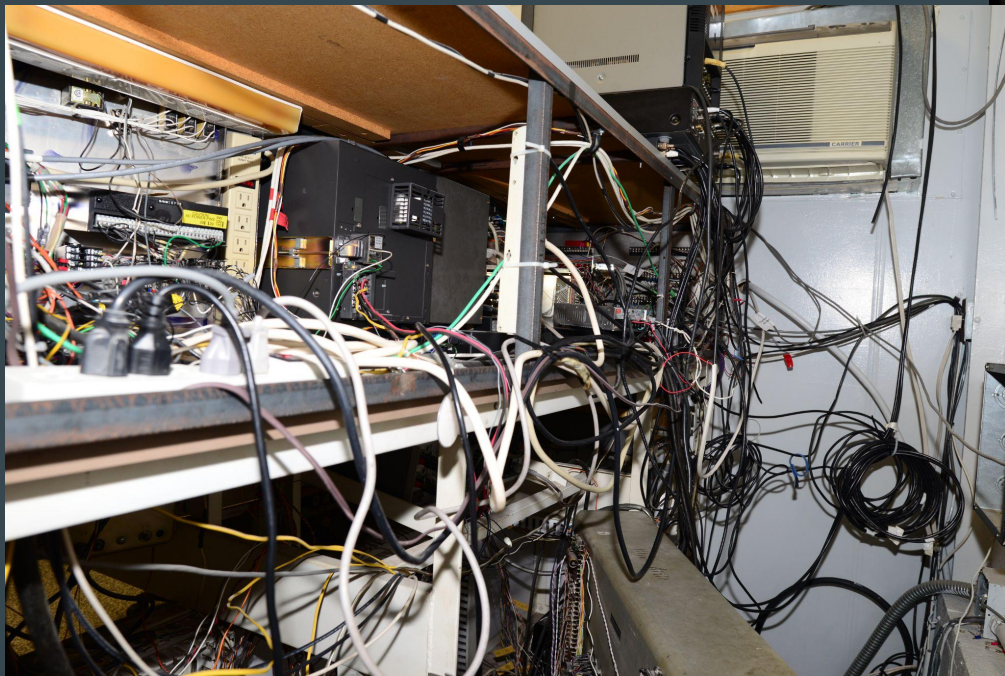
Cleanup and Painting of Reactor Top



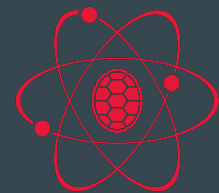


University of Maryland Radiation Facilities

- Rabbit

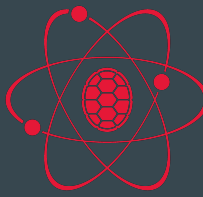
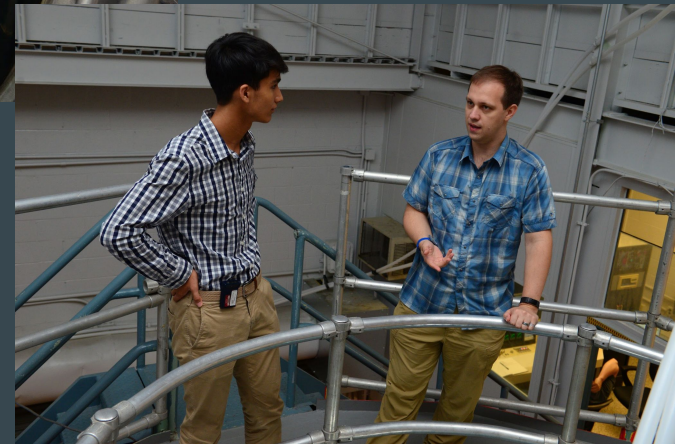
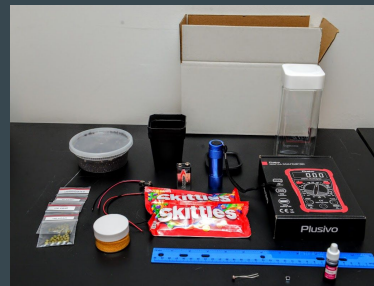
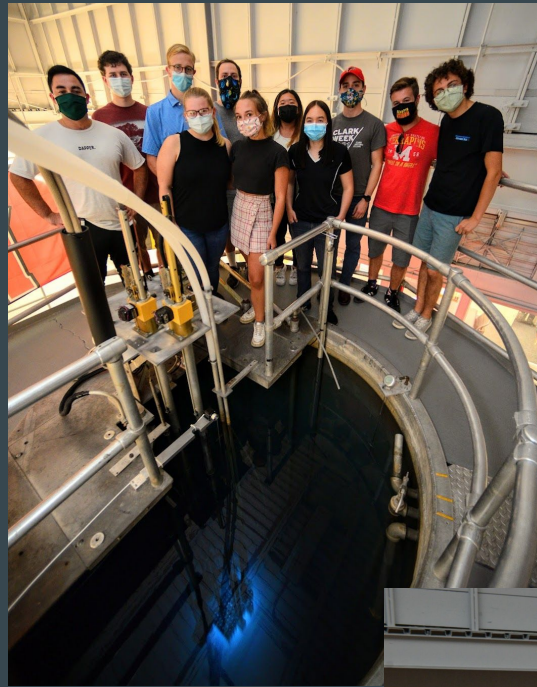


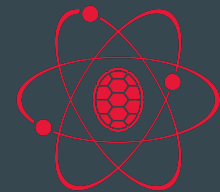
Reactor Console Upgrades



Reactor Use

- NAA
- Neutron Detector development
- Medical Isotope production testing
- 11 students in RO training
- EMNE432: Reactor and Radiation Measurements
- Virtual Science Labs and tours





University of Maryland Radiation Facilities

- 250 kW TRIGA Reactor
- Panoramic Co-60 Irradiator
- 5 MeV Electron Linac
- Associated Support Facilities

