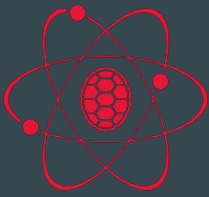


10 Years at the Maryland University Training Reactor: A Retrospective

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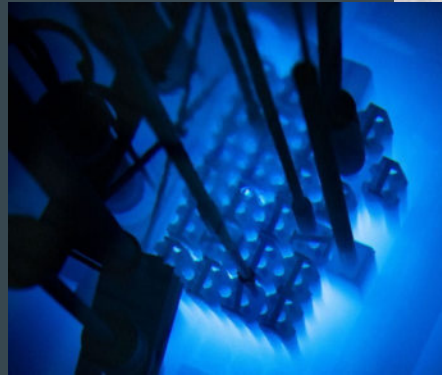
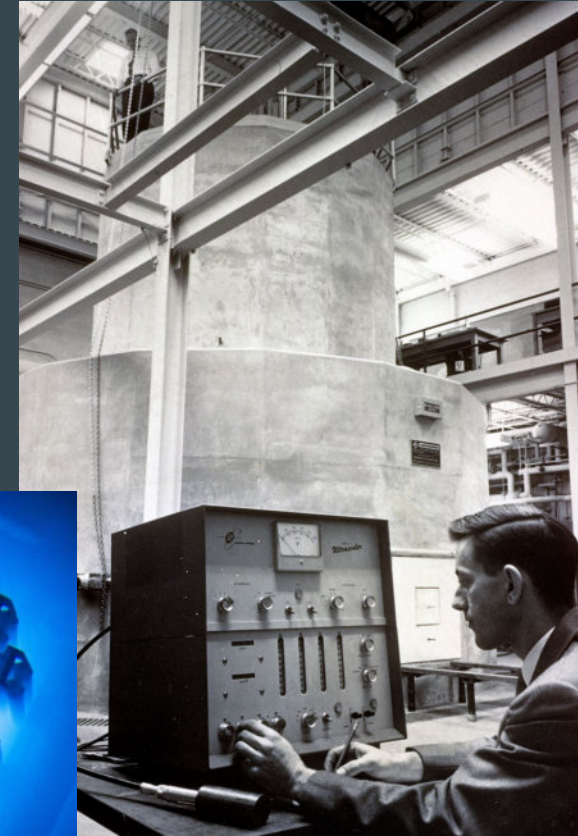
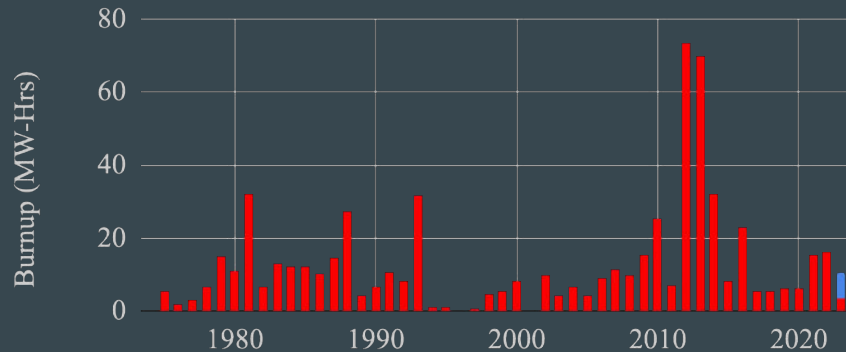
Luke Gilde, Mike Hottinger, Amber Johnson

University of Maryland Radiation Facilities



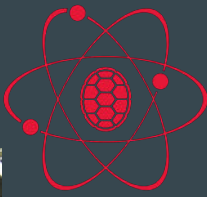
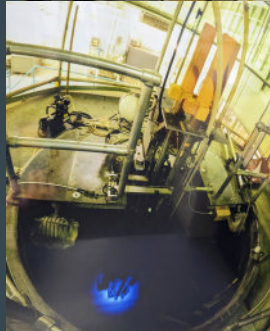
Maryland University Training Reactor

- 250 kW TRIGA Conversion Reactor first achieved criticality in 1974
- UMD Nuclear Engineering program shut down in 2002
 - Reactor now in Materials Science and Engineering
- Reactor has not been heavily utilized
 - Has averaged about 1 full-power hour per week

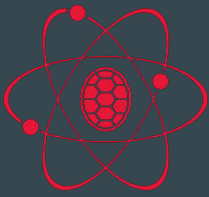


Modern Era

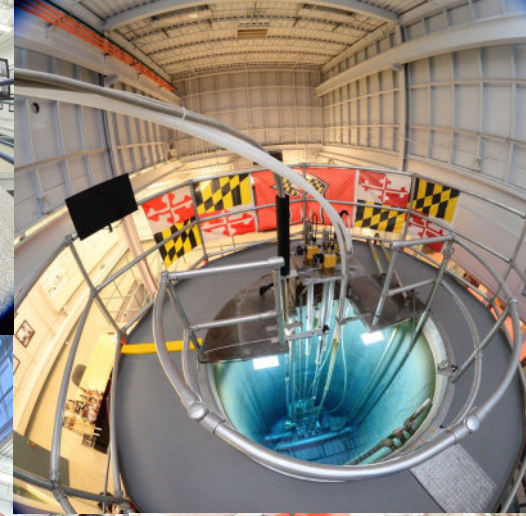
- New Facility Director appointed in 2013
 - Reactor facility was in poor condition at that time
 - Reactor no longer able to reach full power
 - Pressure from university administration to decommission reactor
 - Significant contamination incident in 2010
 - Several NRC violations



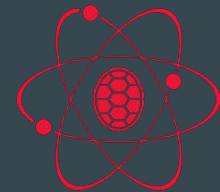
Facility Restoration



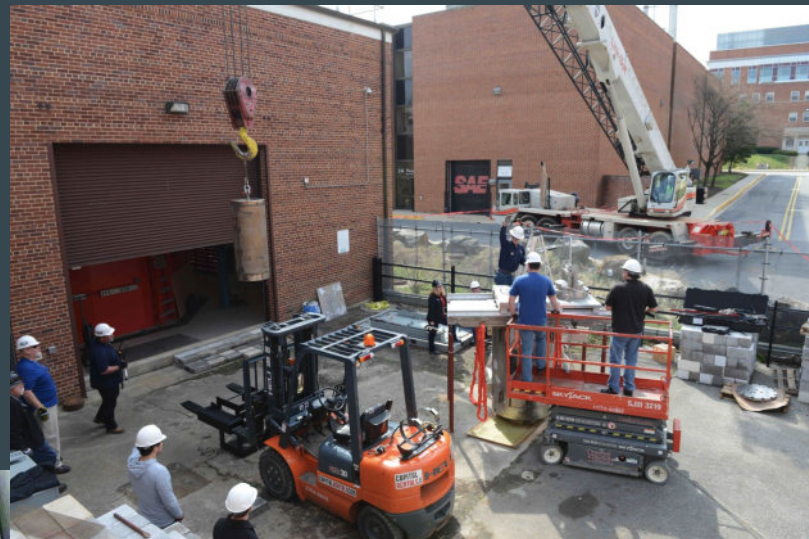
- \$400k investment from the University for improvements
- Facility cleanout and renovations
 - Disposal of legacy radioactive materials
 - Lighting
 - Asbestos remediation
 - Painting
 - Junk removal
 - Furniture
- HVAC Upgrades
- Facility is now provides an inviting environment for research and education



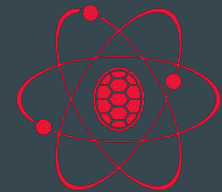
Fuel



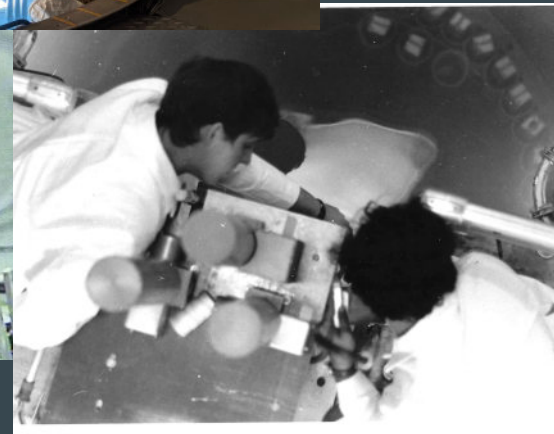
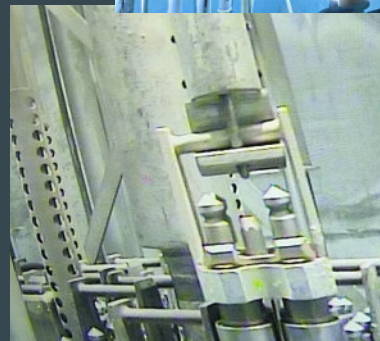
- Reactor can no longer reach 250 kW
- “Lightly Used” fuel delivered from INL in 2017
 - First time used fuel had been returned to a reactor from long-term storage
 - \$4.4 Million dollar project
- Fuel initially only licensed for storage
- Found that fuel bundles were not fully seated in the grid plate
 - $\sim \frac{1}{2}$ the core raised about $\frac{3}{4}$ ” from the grid plate



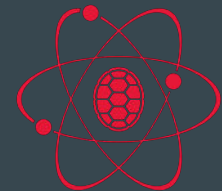
Fuel



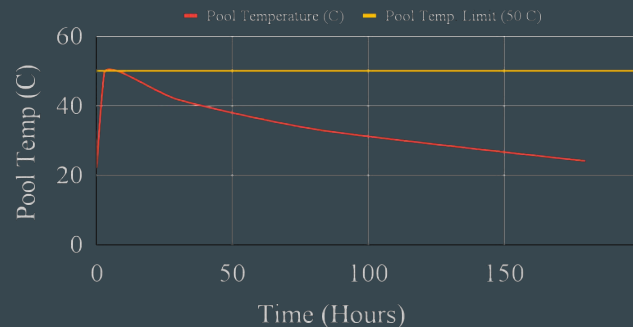
- Fuel licensed for use in 2020
- Assembled “lightly used” fuel into bundles in 2021
- Discovered that additional fuel could not be installed in core
 - Fuel bundles were installed in the wrong orientation
- NEUP Grant for equipment to properly orient fuel bundles in the core was awarded
 - Difficulties in ordering new fuel bundle components due to missing drawings
 - Fuel should be placed in the core later this year



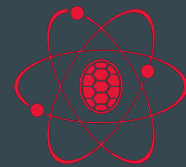
Cooling



- Secondary Cooling System had to be removed from service in 2021
 - Unable to meet license requirements
- Coolant systems have not received significant upgrades or maintenance in ~25 years
- Requested funding to replace entire coolant system outside of the reactor pool
 - Air cooled chiller to supply secondary cooling
 - Should allow for continuous operation at 250 kW



Instrumentation and Control

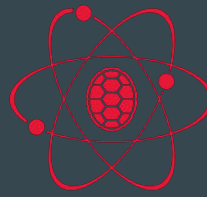
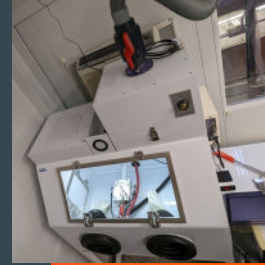


- DOE grant allowed for the purchase of a new fission chamber channel
 - Original channel had become unreliable and caused frequent spurious scrams
- Control Systems upgrades implemented in 2020-2021
- Radiation Area Monitor System replaced under NEUP Grant in 2022
 - Old system caused 29 Unscheduled Shutdowns from January - September 2022
- I&C System now operates reliably!

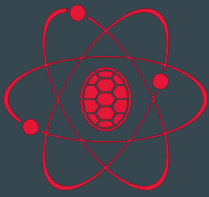


Experiments

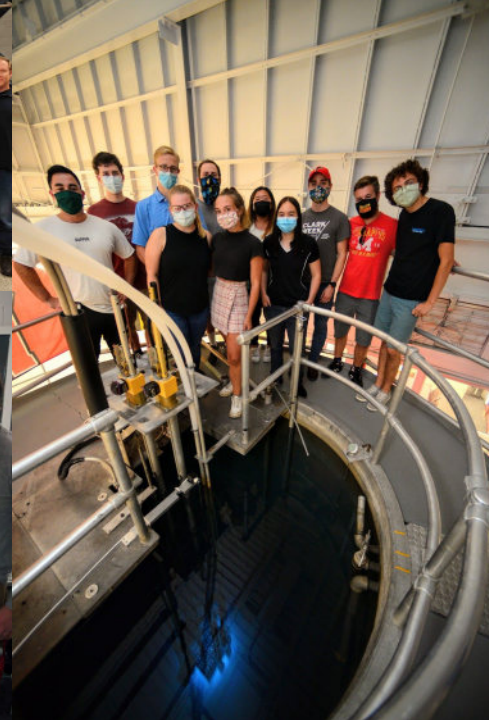
- No graduate students utilizing the reactor since 2015
 - Likely have a graduate student to begin this fall
- Neutron Imaging System donated by NIST installed at the MUTR in 2015
 - Limited capabilities
- Supported AFRRI and NIST during their reactor shutdowns
 - Cell Irradiation experiments for AFRRI
 - NAA and Neutron Detector testing for NIST
- Commercial NAA program started in 2022



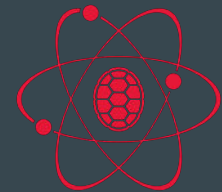
Operator Training



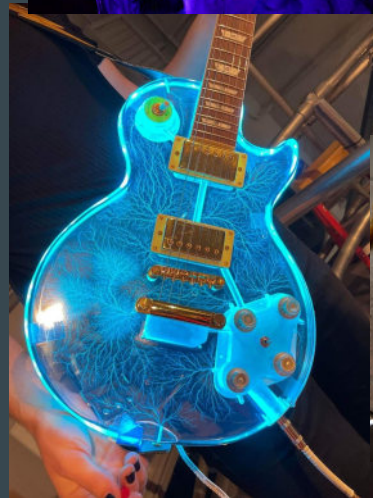
- Reactor Operator Training Program for undergraduate students starts in 2014
 - 2 Semester program open to all students
- First undergraduate Reactor Operators licensed in 2015
- Pandemic interrupted Operator Training Program
 - Only 2 students licensed since 2020
 - Goal of ~5 per year

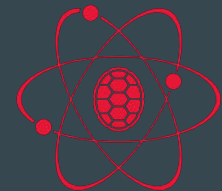


Outreach



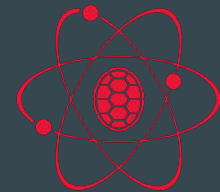
- ~1000 visitors tour the reactor each year
 - Middle school through professionals
 - NRC and other government officials are frequent visitors!
- Facilities are used to support a Reactor and Radiation Measurements class
- Staff participate in local science outreach events
- Made a Lichtenberg Figure electric guitar
 - Has been great for attracting attention
 - Invited to 2 IAEA conferences





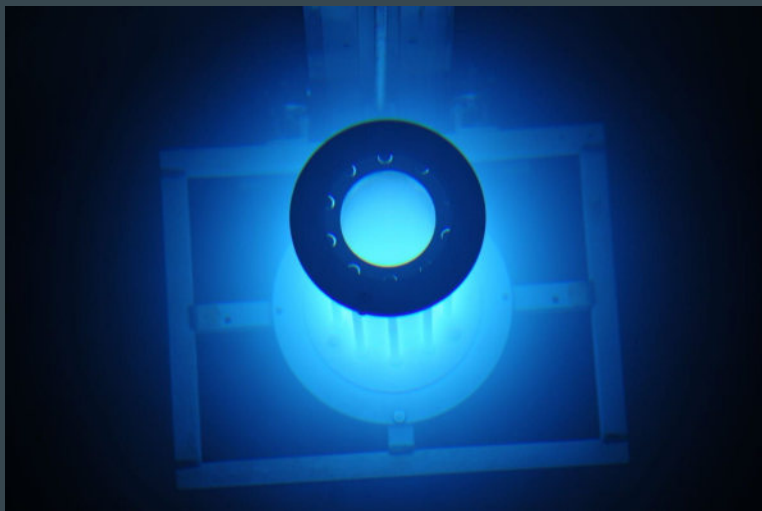
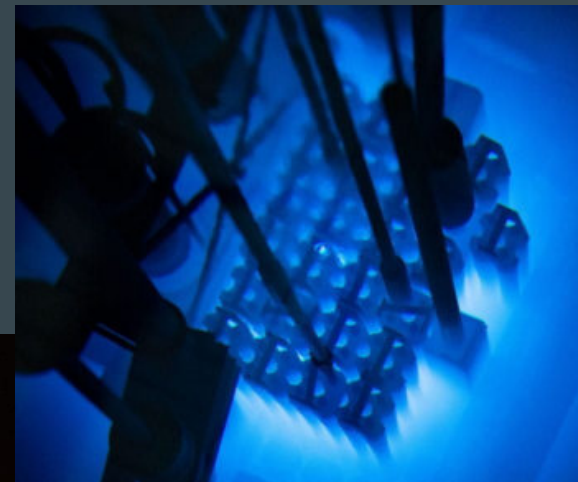
Conclusions

- University investment and support has allowed the facility to remain operational and grow
- Support from the DOE has been essential in almost all of the recent improvements to the reactor program
 - \$5.1 million in DOE support since 2016
 - Additional \$1.5 million requested for cooling system
 - Ideas for ~\$1.5 million in I&C upgrades and ~\$1 million in experimental facilities over the next 10 years
 - Replacements for aging neutron power channels and CRDMs
 - Neutron Imaging Facility and Neutron Diffractometer

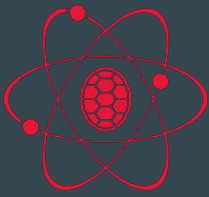


University of Maryland Radiation Facilities

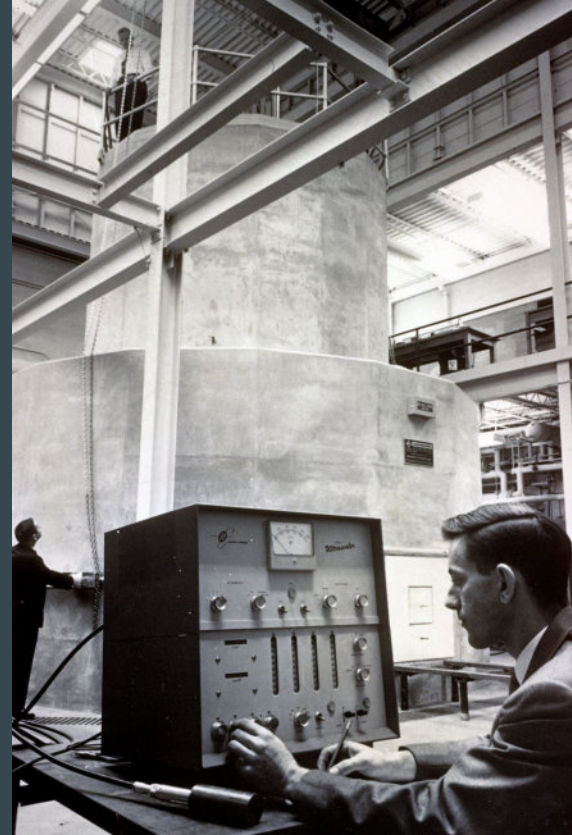
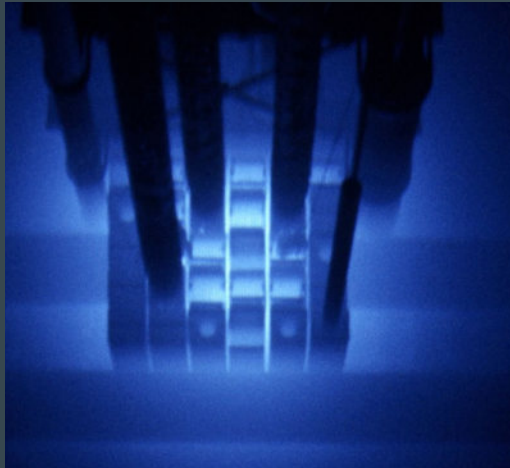
- 250 kW TRIGA Reactor
- Panoramic Co-60 Irradiator
- 5 MeV Electron Linac
- Associated Support Facilities



University of Maryland Reactor

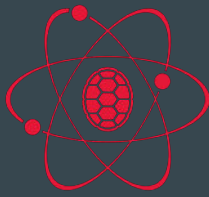
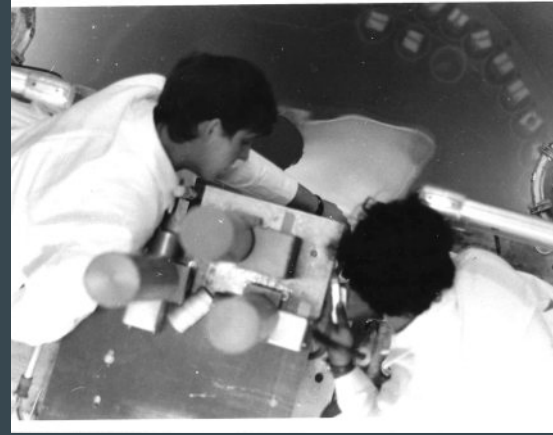


- Construction began on June 29th, 1960
 - Reactor was designed and built by Allis-Chalmers
 - Initial criticality achieved 111 days later
- 10 kW MTR reactor using HEU fuel
- 14 PhD or MS theses by 1966

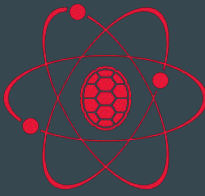


Maryland University Training Reactor

- In 1969 planning began to upgrade the reactor
- UMD was one of the first institutions to recognize that HEU would face additional restrictions in the future
 - Decision was made to convert the reactor to a 250 kW LEU TRIGA
- New control system was installed in 1971
- Core conversion and power uprate completed by 1974



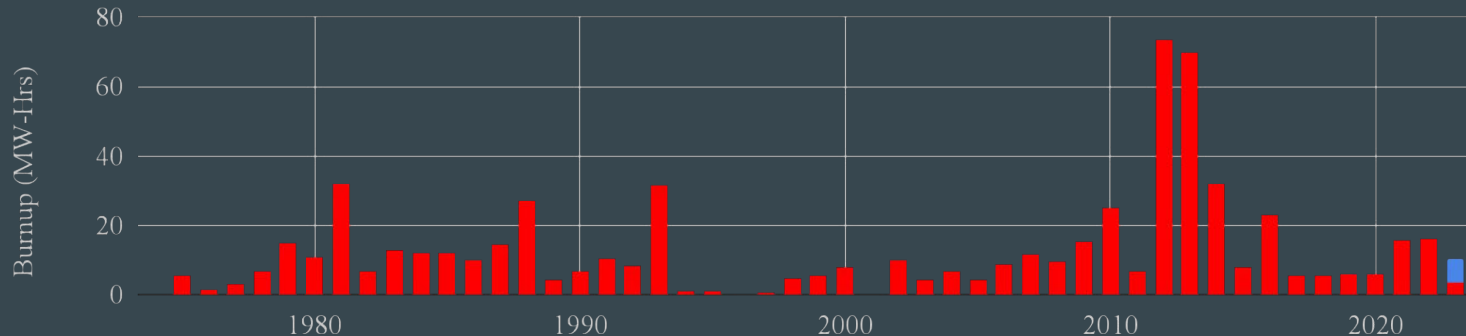
Continued Operations



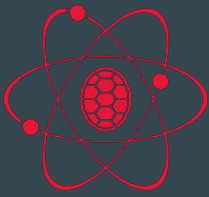
- Reactor Relicensed from 1980-1984
- Minor control system and cooling upgrades in the 1990s
- Reactor license expired again in 2000
- Nuclear Engineering program was dissolved in 2002 leaving the Radiation Facilities in the Materials Science & Engineering Department



Above, campus nuclear reactor director R.L. Belcher sits by the control console. Right, reactor control rods reach through water pool to control the eerily glowing campus reactor during a recent run.



Licensing



- License renewal took nearly 17 years
 - Issued in December 2016
 - Relicensing needed to be completed to allow for the receipt of additional fuel
 - Fuel was licensed only for storage and not use
- Submitted an LAR to allow additional fuel to be added to the core in 2018
 - Modeling performed by Oregon State University
 - No in-house modeling capability
- Additional fuel licensed to be added to core in 2020

