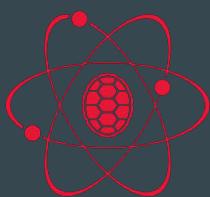


# 10 Years at the Maryland University Training Reactor: A Retrospective

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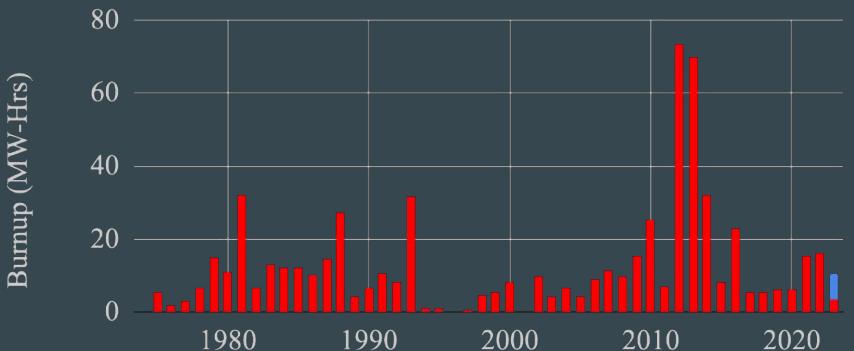
Luke Gilde, Mike Hottinger, Amber Johnson

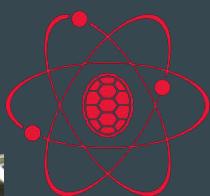
University of Maryland Radiation Facilities



# 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

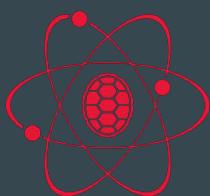




# Modern Era

- 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

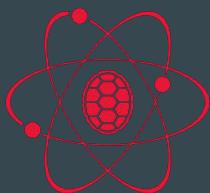




# Facility Restoration

- \$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

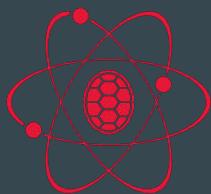




# Fuel

- 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
  - ~  $\frac{1}{2}$  the core raised about  $\frac{3}{4}$ " from the grid plate

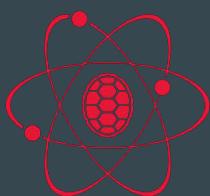




# Fuel

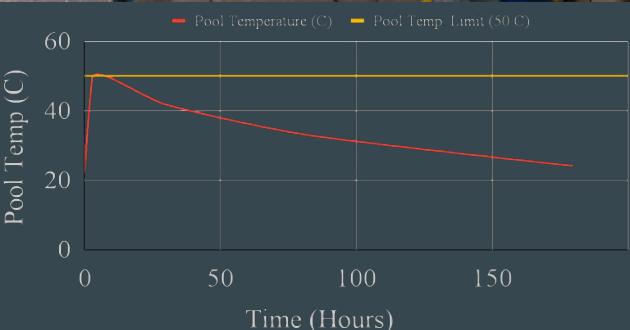
- Fuel licensed for use in 2020
- Assembled “lightly used” fuel into bundles in 2021
- Discovered that additional fuel could not be installed in core
  - Fuel bundles were installed in the wrong orientation
- NEUP Grant for equipment to properly orient fuel bundles in the core was awarded
  - Difficulties 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



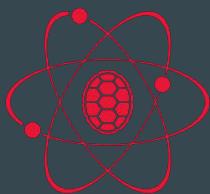


# Instrumentation and Control

- 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!

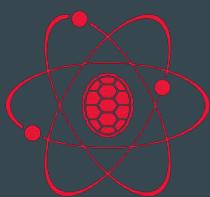


# Experiments



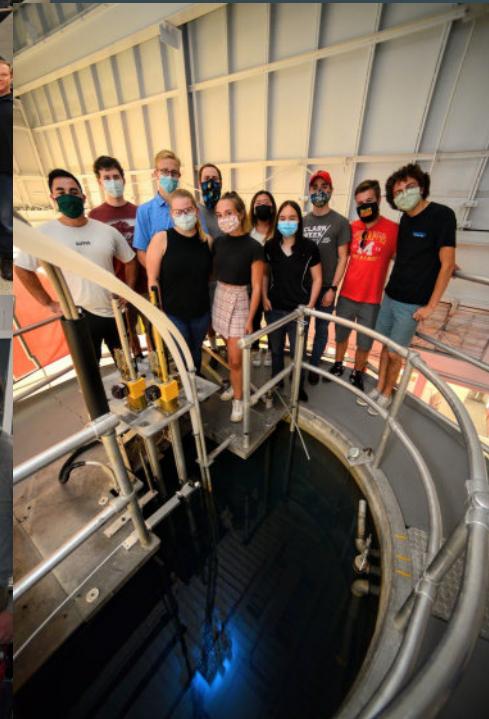
- No graduate students utilizing the reactor since 2015
  - Likely have a graduate student to begin this fall
- Neutron Imaging System donated by NIST installed at the MUTR in 2015
  - Limited capabilities
- Supported AFRRI and NIST during their reactor shutdowns
  - Cell Irradiation experiments for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

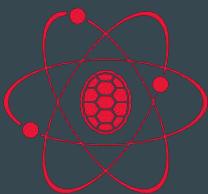




# Operator Training

- 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

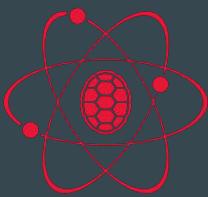




# Outreach

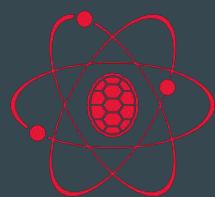
- ~1000 visitors tour the reactor each year
  - Middle school through professionals
  - NRC and other government officials are frequent visitors!
- Facilities are used to support a Reactor and Radiation Measurements class
- Staff participate in local science outreach events
- Made a Lichtenberg Figure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





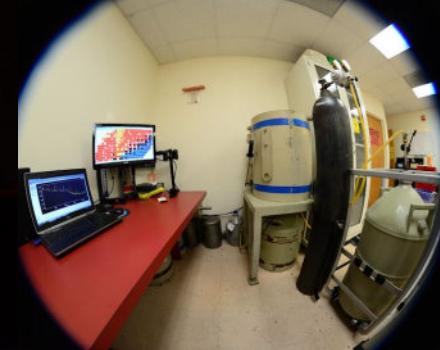
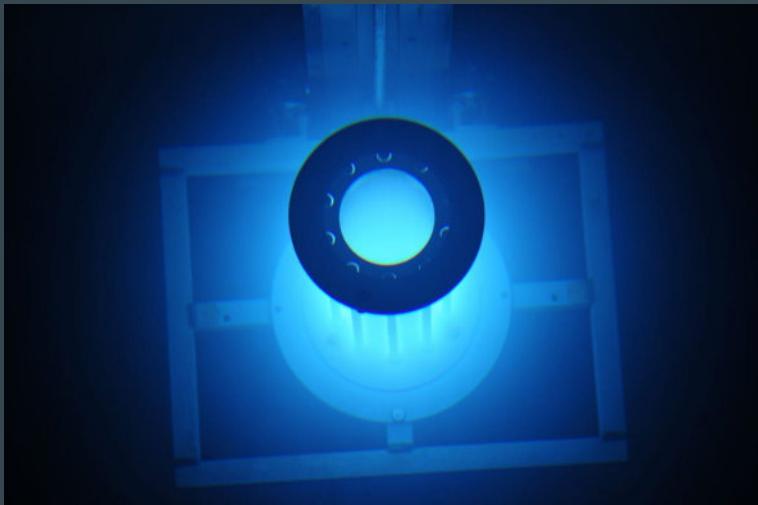
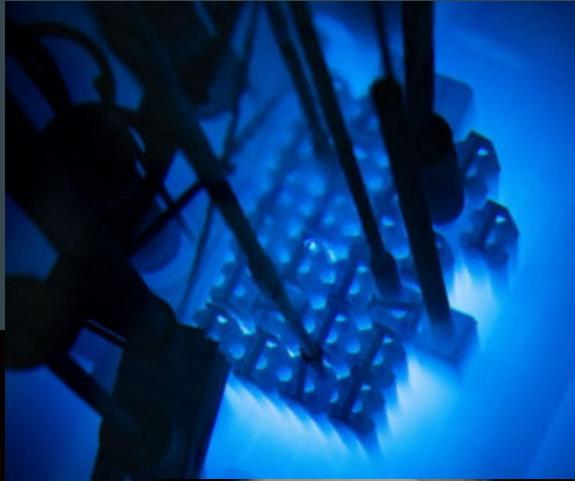
# Conclusions

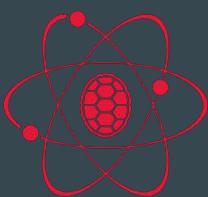
- University investment and support has allowed the facility to remain operational and grow
- Support from the DOE has been essential in almost all of the recent improvements to the reactor program
  - \$5.1 million in DOE support since 2016
    - Additional \$1.5 million requested for cooling system
    - 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

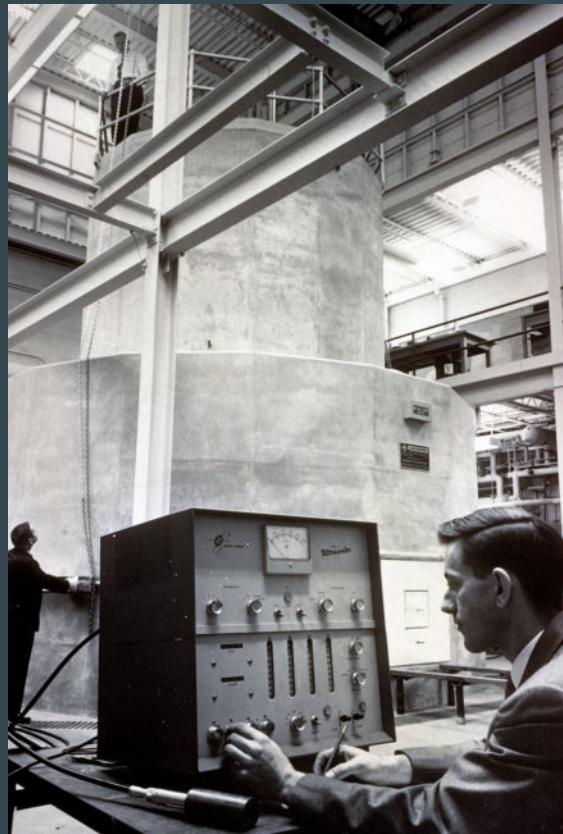
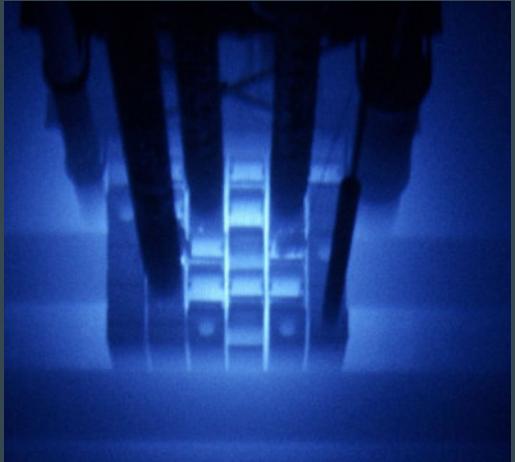
- 250 kW TRIGA Reactor
- Panoramic Co-60 Irradiator
- 5 MeV Electron Linac
- Associated Support Facilities

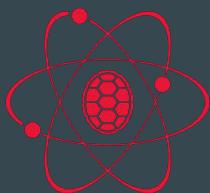




# University of Maryland Reactor

- 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



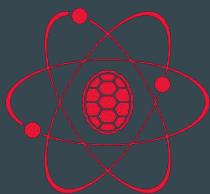


# Maryland University Training Reactor

- 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



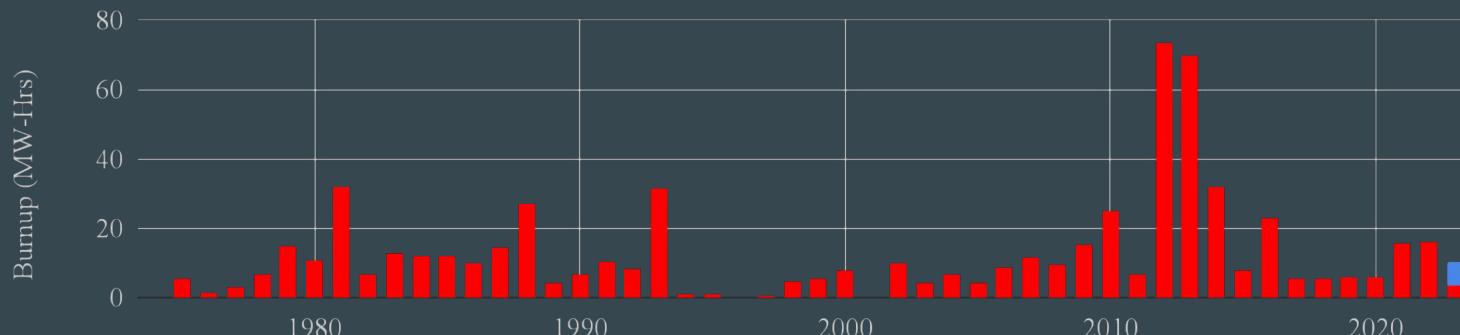
# Continued Operations



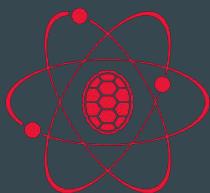
- Reactor Relicensed from 1980-1984
- Minor control system and cooling upgrades in the 1990s
- Reactor license expired again in 2000
- Nuclear Engineering program was dissolved in 2002 leaving the Radiation Facilities in the Materials Science & Engineering Department



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

