The RPI
L. David Walthousen Laboratory
Reactor Critical Facility

Dr. Timothy H. Trumbull,
Adjunct Assistant Professor

Rensselaer Polytechnic Institute
Troy, NY
The RPI RCF Offers unique Training and Research Opportunities.

- **Characteristics:**
  - Power: 100 W limit by license, 15 W admin. limit.
  - Negligible burn-up.
  - Very low radiation levels during and after operation.
  - No loose surface contamination areas.

- **Open reactor tank:**
  - Easily accessed for inserting or removing experiments and rearranging fuel.

- **Perimeter control rods:**
  - Minimize flux perturbations within core and allow for flexibility in arranging experiments and fuel pins.

- **Ideal for training and education**
  - Students receive “hands-on” experience in experiment planning, setup, data recording, radiation and criticality safety.

- **Well suited to perform critical benchmark studies**
Facility Description

- Nominal core load of 332 SPERT F-1 Fuel Pins
  - Stainless steel Clad
  - U(4.81%)O$_2$ pellets
- 4 Perimeter Control Rods
  - Stainless Steel clad baskets containing boron-impregnated iron absorber sections
- Detectors and Instrumentation
  - 2 BF$_3$ Detectors
  - 3 Ion chambers in current mode
  - 3 touch-screen plasma displays
  - 3 Core thermocouples
  - Digital rod position indication
- 2 15 kW immersion heaters
Reactor Assembly

Access to fuel pins and core structure provides great flexibility.
Facility Pictures

The fuel vault. RPI maintains an inventory of approx. 600 SPERT fuel pins.

Instructor in the reactor tank setting up an experiment.

View of the control room.
Recent Critical Benchmark Work at the RCF

  - Partial water height exact critical measurement for nominal core configuration.
- Metal-reflected Critical Benchmarks
  - Performed measurements on Zy-slab reflected critical configurations.
  - Examining other reflector materials: SiO$_2$, Pb, Al, Cu, Fe, Concrete.
- Critical benchmarks with BoroBond™
  - Y-12 supplied samples
  - 2”, 4”, and thin wafer reactivity worth experiments performed.
Detailed MCNP Modeling

- BoroBond™ Samples
- Zy Slab Reflectors
- $x$-$y$ planes at core midpoint
- $x$-$z$ plane at $y=0$
Training and Teaching

- Reactor operator training
  - SRO training program at the RCF run by the Operations Supervisor.
- Reactor Lab Course Experiments:
  - BF$_3$ detector response calibration,
  - Inverse subcritical multiplication approach to critical core load,
  - Exact critical control rod bank measurement,
  - Bank and rod worth measurements,
  - Temperature, void, and boron reactivity coefficient measurements,
  - Gamma-ray scanning of fuel pins to determine axial and radial power shapes,
  - Foil activation and analysis.
- Senior design projects
  - Flexibility of RCF allows “custom-tailoring” of experiments to meet specific training or research objectives.
The “Remote Classroom” Concept

- Classroom with 60” plasma display
  - Display core, control room, instrument displays
- Remote classroom via the internet
  - Project views of the control room, core, and instrument displays
- Video of lectures and experiments are uploaded to RPI SharePoint site.
Summary

- RPI Critical Facility is a unique reactor with teaching, training and research opportunities.
- Investing in the “remote classroom” concept
  - Allow students from off campus to view experiments and lectures.
- Well suited to perform water moderated, LEU benchmarks.
  - Flexibility to install reflectors and other experiments in the core or reflector regions.
  - Additional work needed to characterize experimental error for benchmark testing.

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