NUCLEAR REACTOR LABORATORY

The MIT Nuclear Reactor Laboratory (NRL) (*http://nrl.mit.edu*) is an interdepartmental center that operates the 6 MW MIT research reactor (MITR). The NRL has a distinguished history of providing a state-of-the-art neutron source along with a highly efficient, well-organized staff and infrastructure. The facility is used by faculty and students from MIT and other institutions and by researchers in government and industry in a variety of fields. This work exploits the similarity of the MITR in-core irradiation fields to those in commercial power reactors and the ability of neutrons to probe atomic structures, transmute elements for analysis or applications, and produce images complementary to those produced by X-rays. The MITR is integrated into the national research and development program as a partner facility of the Department of Energy's Nuclear Science User Facilities (NSUF).

A wide variety of sample irradiation facilities is available in the MITR, with fast (E>0.1 MeV) and thermal neutron fluxes up to $1.3x10^{14}$ and $5x10^{13}$ n/cm^2-s. These include temperature-controlled in-pile facilities, a neutron diffractometer, pneumatic rabbits for short-term irradiations and neutron activation analysis, and other irradiation and beam ports. A new, large-volume irradiation space is being developed and is scheduled to come online in the next year. This will provide a cubic meter of irradiation volume with a peak total flux of about $2x10^{12}$ n/cm^2-s.

Other experimental facilities and instrumentation include: radiochemistry laboratories, hot cells for dismantling experiments or testing irradiated materials, and radiation detection equipment. A materials characterization laboratory, established in cooperation with the Nuclear Science and Engineering Department, includes sample preparation equipment, optical and scanning electron microscopes, an Instron mechanical test system and other instrumentation. Two new modular hot cells were recently installed and provide additional space for examination of radioactive materials.

Currently, one of the major research areas at the reactor involves in-core irradiations to support materials and fuel development for existing and next generation power reactors. Accident tolerant fuel development for light water reactors and material behavior and tritium transport studies for fluoride-salt-cooled, high-temperature reactors are the subjects of extensive irradiation programs. Other research areas include in-core sensor development and testing, and advanced fuel irradiation testing. The NRL is a major contributor to the US program to convert high performance research and test reactors from high enriched (HEU) to low enriched (LEU) fuel. The Center for Reactor Instrumentation and Sensor Physics is a joint project of the Idaho National Laboratory and the NRL with the overall goal of advancing instrumentation and automation in nuclear systems.

Undergraduates can be involved in the operation of the reactor by completing the reactor operator training program, and earning a Nuclear Reactor Regulatory Commission reactor operator license. They can also participate in reactor research activities through the Undergraduate Research Opportunities Program (UROP) (*https://catalog.mit.edu/mit/undergraduate-education/academic-research-options/undergraduate-research-opportunities-program*) or through special projects or senior theses. In addition, graduate thesis research can be carried out in the various research areas mentioned above.