Upgrade of the MIT Research Reactor's Post Irradiation Examination (PIE) Capabilities

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ABSTRACT:

We propose to upgrade the Massachusetts Institute of Technology (MIT) Research Reactor (MITR) post-irradiation examination (PIE) facilities to better complement the irradiation capabilities and broaden our role as a Nuclear Science User Facilities (NSUF) partner. Our eventual goal is to enable the MITR to provide full irradiation and sample analysis capabilities, from the start to the end of NSUF projects. Currently, the irradiation capabilities are strong, while the PIE facilities and equipment are in need of updating and expansion. Under this project, sample sectioning and polishing equipment and optical and electron microscopes will be installed inside the reactor exclusion zone. This will provide for preparation and initial characterization of activated materials at higher levels than is possible in other locations on the MIT campus. Some on-campus capabilities not dedicated for radioactive use have been used for irradiated samples in the past, but the location, ownership and mission of the new equipment will greatly increase maximum activity levels and streamline approvals and procedures. The sample preparation step is often the most difficult to accommodate outside a dedicated radioactive material laboratory, but once prepared samples are available, access is opened to a number of facilities outside the reactor exclusion area and sample size can often be minimized in order to deal with highly activated materials. This critical upgrade is a first step in creating a one-stop solution at the MITR for NSUF and other DOE experiments. No such facility currently exists in the Northeast region. Future planned enhancements to the PIE capability that would directly benefit from this proposed upgrade include mechanical testing equipment and chemical and crystallographic analysis facilities such as X-ray fluorescence (XRF), Raman microscopy and X-ray diffraction (XRD). If planned hot cell expansion and improvement is implemented, this equipment upgrade will also provide an experience base for eventual in-cell installation of critical facilities to further increase the sample activity that can be handled.

The requested upgrades will simultaneously improve NSUF partner access to irradiation/PIE capabilities, increase the attractiveness and viability of neutron irradiation experiments at the MITR, and create a unique educational opportunity for hands-on research training and teaching of radiation materials science with the combined neutron (MITR) and ion beam irradiation facilities available at MIT. Both research and educational opportunities will be made available to the general scientific community, through a combination of NSUF irradiation proposals through the DOE-NE office, interdepartmental collaborations with MIT faculty & staff, and educational partnerships with other universities.