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High Temperature Thermal Diffusivity Equipment for Expanding the Scientific Impact of the MIT Reactor

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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 expansion. Under this project, a state-of-the-art Laser Flash Thermal Diffusivity analyzer will be installed inside the reactor restricted area. The specification for this Netzsch unit will allow thermal diffusivity and heat capacity measurements up to 1250°C under controlled atmosphere, including hydrogen mixtures (forming gas). Having a capability for testing in hydrogen environments will enable current and anticipated irradiation studies on metal hydrides and hydride-containing materials. This critical upgrade is a major step in enhancing the ability to support the DOE-NE mission and boost the scientific impact of the MITR for NSUF and other DOE experiments.

The requested upgrade will simultaneously improve NSUF partner access to irradiation/PIE capabilities and increase the attractiveness and viability of neutron irradiation experiments at the MITR. The new capability will allow us to determine thermal conductivity for a range of irradiated nuclear material concepts including hydrogen containing materials, fuel, cladding and moderator concepts at high temperatures. The data generated will be both design-level data for current vendors and be utilized to increase our understanding of neutron-induced thermal diffusivity change in materials and inform and validate high fidelity fuel performance tools (e.g. MOOSE/BISON), supported by the Department of Energy. Moreover, this will be invaluable to enhance our education mission. The facility 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 and staff, and other research partnerships.