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University Research Reactor Upgrades Infrastructure Support for the MIT Research Reactor's Normal and Emergency Electrical Power Supply Systems

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ABSTRACT

Objective: The objective of this proposal is to improve reactor safety, operational reliability, and emergency preparedness by replacing the existing emergency electrical power battery system with updated technology and equipment, and by updating the two existing reactor motor control centers (MCCs) that provide normal electrical power to the reactor's main cooling pumps, building isolation equipment, instrumentation, and other necessary operational and safety equipment.

Description: Funds of $537,818 are requested to procure (a) a replacement reactor emergency power system that includes two 30-cell battery banks, three 10-kVA static inverters, an automatic transfer switch, manual selector switches, a battery charger, a battery monitoring system, and other necessary support hardware; and (b) replacements for the two existing reactor motor control centers that provide normal electrical power for reactor operation and experiments. The new emergency battery system will have a total of 60 cells of low-maintenance lead-acid batteries for a nominal 120-volt DC 840 amp-hour rating, capable of providing more than eight hours of emergency electrical backup power for reactor cooling and control room monitoring of the reactor in a shutdown condition during a total loss of off-site power. The static inverters will convert the DC battery power to 120-volt/208-volt, three-phase AC power for this purpose, and the battery monitoring system will continuously assess the condition of each cell. There will be a 5-kVA mock load for the inverter output to allow off-line testing. The existing battery cells are at the end of their 20-year expected life. The motor-generator and supporting equipment are based on 1940s technology and have been in service for 60+ years. As for the reactor motor control centers, they have also been in service for 60+ years, and multiple breakers have had cable-insulation embrittlement and overheating problems that led to reactor shutdowns. These aging components also increase the risk of arc faults when personnel interact with the equipment, thereby increasing the risk of severe personnel injury. The replacement equipment will modernize electrical power infrastructure for the reactor, improving operational reliability, emergency preparedness, and personnel safety.

Relevance and Outcomes: The MIT Reactor Technical Specifications require an emergency electrical power system capable of operation for at least one hour following loss of normal electrical power to the facility. Startup of the emergency power system and transfer of all loads is required to be automatic. The existing battery cells were procured about 20 years ago and were rated for eight hours of continuous operation. They have aged and can currently provide only about two hours of emergency power. An NRC-initiated post-Fukushima evaluation of the MIT Reactor a few years ago considered the eight-hour rating an important factor when coming to the conclusion that the reactor was resilient against loss of off-site power. The proposed equipment will restore the capability for at least eight hours of post-shutdown emergency power supply, enhancing emergency preparedness of the reactor facility.

Normal off-site electrical power to the reactor comes from an on-site 13.8-kV substation. It is then stepped down to 480 volts to provide power to the two existing reactor MCCs as well as to other non-reactor loads. The local electric company services the substation and the main step-down transformer, but none of the reactor electrical equipment downstream. As a result, the two reactor MCCs are antiquated, with parts no longer available. The proposed upgrade will improve equipment reliability and enhance personnel electrical safety by using components that meet modern standards.