New Core-Moderator Assembly and Neutron Beam Ports Development and Installation at the Radiation Science and Engineering Center

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Collaborators: NA

Program: Major Reactor Infrastructure

ABSTRACT:

The Penn State Breazeale Reactor (PSBR), which first went critical in 1955, is the nation's longest continuously operating university research reactor. The Nuclear Regulatory Commission renewed PSBR license for an additional 20 years in November 2009. An upgrade in reactor power and a change in fuel type from MTR to TRIGA made in1965 left only one of seven existing beam ports aligned with the centerline of the reactor core. The others are significantly below the TRIGA core centerline. This inherent design issue has greatly limited the utilization of the neutron beam capabilities of the Radiation Science and Engineering Center (RSEC). A significant redesign of the core-moderator/beam port is needed to make full use of the PSBR's capabilities and the establishment of state-of-the-art neutron beam facilities.

In this application, we propose to build, and install a new core-moderator assembly, reactor core upper and lower grid plates, safety plates, a new reactor tower structure and five new neutron beam ports at the PSBR. The proposed major reactor upgrade will substantially improve and expand the research, teaching, and training capabilities of the PSBR. After the installation of new beam ports and the reconstruction of the biological shield, the front face of the reactor pool will be reinforced and relined. This will prevent reoccurrence of the pinhole pool water leak that we experienced several years ago from this area. These improvements will increase reactor safety and operational efficiency. The designs of all of the components of this project were already completed. An application will be submitted to the NRC for 10CFR50.59 review of the project as soon as funding is approved. Through careful planning and parallel scheduling of work, we estimate that total reactor down time will be less than three months. Assuming that the NRC approval is received within one year, the entire project will be completed within two years. After NRC approval, the existing neutron beam tubes will be removed by cutting a section of the existing biological shield wall. The new reactor structure and core-moderator assembly and beam tubes will be placed and the biological shield will be restored during the first half of the second year. Reactor pool restoration and testing will be completed and the reactor will return to regular operation during the second half of the second year.

The proposed new beam ports will be geometrically aligned with the core-moderator assembly for optimal neutron output at experimental positions. Six new neutron beam techniques will be implemented. These techniques will support the existing and future nuclear energy-related research and development at Penn State. The majority of equipment to implement these techniques is already available at the RSEC. The RSEC improved some of its facilities with a combination of internal and external resources during the last several years. With the approval of the Penn State Board of Trustees a $4.6M renovation of the RSEC building that houses the PSBR was completed last year. The University administration continues to display strong support for the RSEC. Since 2003 over $9M in physical improvements to the RSEC were completed mainly utilizing PSU funds. The proposed addition to the existing RSEC capabilities will expose students to a range of important applications. Both undergraduate and graduate students will be educated in utilizations of neutron beam techniques via cutting edge and innovative applications. We anticipate that eight new graduate student research assistants will be employed at the new facility. The total cost of the project is $1,362,253, which includes construction and installation of equipment as well as site restorations after the installations are completed. The proposed budget is based on firm vendor quotes provided after careful evaluation of the scope of the project and does not include any personnel costs and indirect university costs, which will be provided by PSU. In the event there are any cost overruns the RSEC is committed to covering them so that the project will be completed. The PI will be responsible for the implementation of this project. He has over 28 years of experience in nuclear analytical methods, the development of neutron beam facilities, and nuclear instrumentation.