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#4-142 Measurement of the Thermal Neutron Fluence Rate in the Instrument Thimble 11 Position in the Advanced Test Reactor Critical

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The Advanced Test Reactor is a highly versatile, pressurized, light water cooled, beryllium moderated test reactor with a nominal power capacity of 250 Megawatts (thermal). Its unique core design utilizes a serpentine clover leaf of 40 fuel elements to create 9 different flux traps. The Advanced Test Reactor Critical is a full-scale replica of the Advanced Test Reactor core but in a pool in lieu of a pressure vessel and usually operates at a power level near 600 Watts. The Advanced Test Reactor Critical is primarily utilized for physics, instrument, and experiment testing prior to being irradiated in the Advanced Test Reactor. Test impacts on core power distribution in the Advanced Test Reactor Critical are utilized to indicate how an experiment will perform during the full irradiation in the Advanced Test Reactor. The cores were designed with space to accommodate 12, dry, in-pile tubes located outside the main reactor tank that are used as instrument thimbles. Eight instrument thimble tubes have been installed in the Advanced Test Reactor Critical, 6 of which hold instrumentation that is essential to operation. Two instrument thimbles are held in reserve if one of main thimbles is compromised. Instrument Thimbles 6 and 11 are often unused and could be made available to researchers and programs during irradiations. Measurements of the neutron fluence rate in Instrument Thimble 11 in the Advanced Test Reactor Critical will be used to assess the position for nuclear instrumentation development, research, and testing. Gold and indium foils, and pure cobalt, nickel, silver and gold wires have been irradiated and measured. These combined experiments established the processes needed to execute experiments in the instrument thimbles, as well as aided in refining the material selections for further dosimetry packages. Fast neutron fluence rates were below the minimum detectable level. The high thermal-neutron ratio in the instrument thimble makes it a good environment to test thermal neutron instrumentation with minimal interference from epithermal and fast neutron interactions. Thermal neutron fluence rates have been calculated using standard methods outlined by the American Society for Testing and Materials International using the measured specific activity of dosimeters after irradiation. Thermal neutron fluence rates between 1.00 x 106 n·cm-2·s-1 and 1.00 x 107 n·cm-2·s-1 have been observed depending on axial dosimeter placement relative to core elevation. It can be difficult, costly and time consuming to get experiments placed into the Advanced Test Reactor. The Advanced Test Reactor Critical can provide a simplified, faster and more affordable way to test new instrumentation, assess design and material performance during irradiation and facilitate further research and development efforts in the nuclear industry.

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