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Conversion Status of the University of Missouri-Columbia Research Reactor from Highly-Enriched to Low-Enriched Uranium Fuel

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ABSTRACT

The University of Missouri Research Reactor (MURR®) is one of five U.S. high performance research and test reactors that are actively collaborating with the U.S. National Nuclear Security Administration (NNSA) Office of Material Management and Minimization (M^3) to find a suitable low-enriched uranium (LEU) fuel replacement for the currently required highly-enriched uranium (HEU) fuel. In January 2017, MURR received a new 20-year license for operation with HEU fuel from the U.S. Nuclear Regulatory Commission (NRC). More recently, a Preliminary Safety Analysis Report (PSAR) for a proposed core loaded with U-10Mo monolithic LEU fuel that is currently being tested for qualification has been completed and submitted to the NRC for review. The PSAR was prepared in a format consistent with NUREG-1537 and describes all changes to the fuel element design and core operating conditions due to conversion. Transient accident analyses for postulated positive reactivity insertion accidents (RIAs), loss of coolant accidents (LOCAs), and loss of flow accidents (LOFAs) were completed under conditions established during relicensing of the HEU core and consistent with guidelines in NUREG-1537. The models include both fresh and irradiated fuel assemblies and the associated fresh and irradiated fuel thermo-physical properties, which may affect the severity of the accidents. Also, analyses of accidents with radiological consequences, including the maximum hypothetical accident (MHA), which is a fuel handling accident with LEU fuel, have been revised and are discussed. Detailed analyses at steady-state and accident conditions demonstrate that following conversion with the proposed fuel form and a power uprate there are sufficient safety margins and operational performance is maintained. All accident scenarios demonstrate an acceptable margin to potential fuel damage or acceptable dose consequences in the case of the MHA. The work also included an analysis of thin flat and curved fuel plate stability in the MURR coolant flow environment and an analysis of the beryllium reflector lifetime.