Corrosion Assessment of Candidate Materials for the SHINE Subcritical Assembly Vessel and Components

S. J. Pawel¹, K. J. Leonard¹, Z. M. Burns¹, J. K. Thomson¹, E. N. Van Abel², and C. D. Bryan¹

¹Oak Ridge National Laboratory, Oak Ridge, TN 37831
²SHINE Medical Technologies, Monona, WI 53713

ABSTRACT

Laboratory corrosion testing of candidate alloys—including Zr-4 and Zr-2.5Nb representing the target solution vessel, and 316L, 2304, 304L, and 17-4 PH stainless steels representing process piping and balance-of-plant components—is underway in support of the proposed SHINE process to produce ⁹⁹Mo from low-enriched uranium. The testing utilizes depleted uranyl sulfate in various concentrations and incorporates a range of temperatures, excess sulfuric acid concentrations, and iodine additions. Testing has included static immersion of coupons (fully immersed and in vapor), galvanic tests featuring couples between a stainless steel and a zirconium-based alloy, U-bends (fully immersed and in vapor), slow-strain rate exposures, and electrochemical polarization as a function of rotating disk speed. Preliminary testing has also included encapsulated exposures in a spent fuel pool to generate active gamma-radiolysis conditions. Results to date indicate the candidate alloys are quite resistant to general and localized corrosion under a wide range of exposure conditions.

This research was sponsored by the US Department of Energy National Nuclear Security Administration under the Global Threat Reduction Initiative to support promising technologies for the production of ⁹⁹Mo.