

The Joint Romania – U.S. Nuclear Forensics Examination of Legacy High Enriched Uranium (HEU) Materials

The Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering (IFIN-HH) in Romania is participating in a joint sample analysis with Lawrence Livermore National Laboratory (LLNL) and Los Alamos National Laboratory (LANL) on a set of legacy high enriched uranium (HEU) materials that have been under safeguards at the IFIN-HH for many decades.

Initiated in 2019 as part of larger collaboration between the U.S. Department of Energy and the Romanian government, this project aims to facilitate a closer cooperation between the U.S. laboratories and IFIN-HH in the field of nuclear forensics, and create opportunities for further projects of mutual interest on both the national and regional levels. The pilot-project titled “Nuclear Forensic Characterization of Legacy Uranium Samples” involves the analysis of a set HEU metal samples with a nominal enrichment of ~93 wt.% U-235, as well the exchange of technical procedures and staff during lab demonstrations and data review meetings. For this project, a total number of five metal samples of interest were selected at IFIN-HH: ten swipe samples (two from each sample) were prepared and shipped to LANL and LLNL, and two solid samples were subsampled and are awaiting the shipment approvals.

A comprehensive nuclear forensics examination of the selected uranium metal samples was completed at IFIN-HH in Romania using a wide range of non-destructive and destructive analysis techniques. Age dating of the samples using gamma spectrometry at IFIN-HH showed a production age of around 1969-1970 for all samples, while the uranium isotope ratio measurements by inductively-coupled plasma mass spectrometry (ICP-MS) indicated a significant difference in the U-236 relative concentration. The U-236 concentration in the samples was confirmed by the U.S. labs through the analysis of the particle swipes provided by IFIN-HH using both secondary ion mass spectrometry analysis (SIMS) of individual particles and digestion and ICP-MS analysis of the entire swipe for each sample. The digestion and ICP-MS analysis of the entire swipe for each sample was also used to determine the radiometric ‘age-dates’ of the samples. The data seemed to indicate a difference in processing history between the samples that resulted in an increased U-236 ratio for a subset of the materials. The preliminary results of this study also showed how different nuclear forensic signatures (e.g., sample age, isotopic and chemical characteristics) and analytical approaches (particle analysis vs. bulk) can provide clues on sample origin and history.

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