# Non-Destructive Plutonium Assay in Pyroprocessing Bulk Materials with a 3D Boron-Coated-Straw Detector Array

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**ABSTRACT:**

The once-through fuel cycle adopted in the U.S. does not include reprocessing or recycling of used fuel and leads to inefficient utilization of nuclear fuel, generating a significant volume of high-level waste. Advanced separation technologies have the potential to address these challenges and enable commercially viable reprocessing of used nuclear fuel from the current light-water reactor fleet. Among the most mature of these separation methods is pyroprocessing, which dissolves metal-based spent fuel in a molten-salt bath and minimizes the proliferation risk because it does not produce a pure plutonium stream.

This project aims to further enhance the proliferation resistance of pyroprocessing by accurately assessing plutonium content during the process. The strategy involves developing and demonstrating a novel 3D boron-coated-straw neutron detector array (3D-BCSDA) with high efficiency and spatial resolution. While several destructive assay methods have been developed for nuclear material accountability, an NDA system specific to the assessment of bulk materials, including the ability to withstand harsh pyroprocessing environments and account for the fuel form factor, is not available. We will develop the 3D-BCSDA to fill this technology gap. The 3D-BCSDA will offer exceptional gamma-ray rejection for spent-fuel assay, three-dimensional neutron detection for tomographic sample imaging, and sample-dependent multiplicity assay.

The anticipated innovations are poised to enhance plutonium assay precision by approximately 60% in bulky plutonium-bearing samples in pyroprocessing.