Safeguards in Pyroprocessing: an Integrated Model Development and Measurement Data Analysis

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ABSTRACT:

Different from aqueous-based reprocessing of used nuclear fuels such as Plutonium-Uranium Extraction (PUREX), pyroprocessing is known as 'pipeless processing.' There is no continuous flow of material solution through pipes, and all materials and products are transported by batch operations. Therefore, the current safeguards approach used for PUREX is not applicable for pyroprocessing. Applying safeguards to the pyroprocessing has presented serious challenges due to the lack of well-developed safeguarding fundamental approaches and designs. The overall objective of the proposed research is to develop a comprehensive and effective safeguards approach for a pyroprocessing facility to support safeguards for future U.S. fuel cycles. Here, we focus directly on the special nuclear materials in the electrorefiner (ER) where actinides are separated from fission products through electrochemical process. The research consists of three key components: 1) development of a physics-based model, 2) bench-scaled experimental program performing the electrochemical studies in a controlled environment to obtain results and data sets for model validation, and 3) a system level analysis and assessment of the processing.

The proposed research will take advantage on our previous research on model development and ER operations. The PI has overall responsibility for the timely completion of the project and will coordinate the reach activities. The PI's research team will focus on physics-based model development and system level analysis that aids experimental design, while collaborator's research team will focus on conducting experimental measurements and data analysis for model validation.