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Improving Materials Accountancy for Reprocessing using hiRX

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The High Resolution X-Ray (hiRX) technology has the potential to replace K-Edge and Hybrid K-Edge Densitometry (HKED) for routine accountability measurements in reprocessing. This technology may significantly reduce plutonium measurement uncertainty in a simpler and less costly instrument. X-ray optics are used to generate monochromatic excitation of a sample and selectively collect emitted x-rays of the target elements. The result is a spectrum with a peak specific to one element with negligible background. Modeling was used to examine how safeguards could be improved through the use of hiRX at existing aqueous reprocessing plants. This work utilized the Separation and Safeguards Performance Model (SSPM), developed at Sandia National Laboratories, to examine how reduced measurement uncertainty decreases the overall inventory difference measurement error. Material loss scenarios were also modeled to determine the effect on detection probability for protracted diversion of nuclear material. Current testing of hiRX is being used to inform the modeling effort, but a 0.1% measurement uncertainty for uranium and plutonium concentration is an optimistic goal based on laboratory results. Modeling results showed that a three-fold improvement in the ability to detect a protracted diversion of plutonium may be possible if the 0.1% uncertainty goal can be achieved. The modeling results will be presented along with a discussion of the current experimental campaign results. In addition, a qualitative cost analysis will be presented to compare the use of hiRX with HKED.

Country or International Organization

United States of America

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