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Advanced Technical Approaches to Detect and Discern TENORM in Commercial Transportation

Non-nuclear industries like oil and natural gas production and processing, industrial coal combustion facilities, metal mining and processing, phosphate fertilizer and elemental phosphate production, scrap metal processing (Smelting) generate alarming quantities of TENORM by producing concentrated activities of NORM or by moving the radioactive materials where they potentially cause more human exposure. The existence of TENORM causes an increased risk for human exposure to radioactivity. Workers in TENORM-producing industries may be occupationally exposed to ionizing radiation. TENORM industries may release significant amounts of radioactive material into the environment resulting in the potential for widespread exposure to ionizing radiation.

Illicit trafficking of radioactive materials across the borders of countries is an international problem and currently being dealt with by establishing networks of sensitive radiation detection systems in the form of Radiation Portal Monitors (RPM) at airport, national borders, highways and ports of entry. The RPMS serve two major purposes: the reliable detection and identification of threat materials and the rapid characterization of non-threat materials comprised of NORMs and TENORMs and legitimate radioactive materials in streams of commerce. Without proper adjudication the RPMs will create nuisance false alarms.

This article discusses advancement in spectroscopic analysis techniques and applications to examine gamma energy spectra collected by the RPMs. It discusses the methods to reduce noise and variance at different steps in data acquisition and analysis in the process of detecting the threat materials with low thresholds but without triggering on TENORMs. The practical applications of wavelet transform of gamma ray energy spectra will be explained. The success of reduction of dimensionality by principal component analysis (PCA) will be discussed within the framework of multichannel analysis spectroscopic data. The application of Detector Response Function (DRF) in the Gamma Detector Response and Analysis Software (GADRAS) software package developed at Sandia National Laboratory will be used to show how small amount of threat materials masked by TENORM can be detected. The sensitivity to initial input parameters to GADRAS will be highlighted.

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