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The Rapid Radionuclide Isotopic Ratio Determination Technique to Assess Nuclear Event Debris

Radionuclide detection is a further step to complement any abnormal event data recorded by seismic, hydro acoustic and infrasound station network prior asking for the approval of the On-Site Inspection (OSI). Radionuclides can travel away from a source of event for thousands of kilometres under favourable meteorological conditions and still can be detected. In this work a rapid comprehensive method that optimises man-work hours, materials and activities such as a rapid radiochemical radionuclide separation, gamma- and mass-spectrometry measurement techniques combined together for radionuclide determination and source assessment is demonstrated. Gamma spectrometric measurements were performed with the state-of-the-art "Ortec" alpha spectrometer and gamma spectra were recorded by SILENA gamma-spectrometric system with a HPGe coaxial detector. Radionuclide isotopic ratios were measured by a sector field mass spectrometer combined with a high sensitivity APEX sample introduction system. It is demonstrated how an environmental sample analysis could be performed within 72 hours from arriving to the analytical laboratory. Elevated 137Cs/239,240Pu, 238Pu/239,240Pu, 240Pu/239Pu isotopic "finger print" values reliably reveal a nuclear event and assess its source by fusing these values with atmospheric transport modelling. What is more, analysis of soil profiles in depth clearly distinct the new nuclear event debris from the previous ones.

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