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Radioisotope Signatures from NPP Power Variations and Their Impact on the CTBTO Verification Regime

Xenon radioisotopes may be a clear signature of nuclear explosions, so that their detection, by the International Monitoring System (IMS) of the CTBTO, is of paramount importance. However, the emission of Xenon radioisotopes also from other sources, challenges the capability of the IMS to identify significant events out of this background, the isotopic composition of the Xenon trace becoming the actual discriminant for detection. Among the main background sources, there are Nuclear Power Plants (NPPs), which may release Xenon radioisotopes during normal operation cycles. Whilst the typical isotopic signatures of NPPs differ from those of a nuclear explosion, some peculiar conditions - for example, a rapid decrease of power - may impact the composition of radioxenon. In such cases, the power variation velocity has a crucial role in determining the amplitude of 135Xe overshooting, in turn implying variations in the isotopic ratios used to discriminate the released sources. In this work, the variation in 135Xe overshooting as a function of the NPP power ramping-down rate, is investigated through a parametric analysis using the SCALE 6.1 ORIGEN-S code, as well as its impact on the discrimination of the related isotopic ratios with respect to the threshold of the corresponding screening flags.

Primary author: OTTAVIANO, Giuseppe (Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA))

Presenter: OTTAVIANO, Giuseppe (Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA))

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