Monitoring radioactive xenon is a critical component of the Comprehensive Nuclear-Test-Ban Treaty (CTBT) verification regime, as radioactive xenon isotopes can provide evidence that helps assess the likelihood of nuclear explosions.Furthermore, the integration of uncertainty estimation, quality control information, and explainable artificial intelligence (XAI) is essential for ensuring that results are scientifically justifiable.Particular focus is placed on convolutional neural networks for recognizing spectral patterns, traditional machine learning algorithms for sample classification, and physics-informed approaches that account for detector characteristics and established statistical principles.This contribution explores the potential applications of machine learning techniques in classifying radioactive xenon gas spectra, detecting anomalies, assessing data quality, and supporting decision-making by expert analysts.However, interpreting xenon measurements remains challenging due to spectral complexity, the limited number of measurements, fluctuating background radiation conditions, and the potential contribution from civilian nuclear activities.Analysis Methods:1.Gamma Spectrometry: This method is used to identify the type and concentration of radioactive isotopes by analyzing the energy emitted via gamma rays.Its advantages include: precise isotope identification, the ability to measure multiple isotopes within a single sample, and high analytical accuracy.Isotopic Ratio Analysis: This is one of the most significant analytical methods used to determine the source of radiation.Artificial intelligence and machine learning offer promising approaches to improve the efficiency and consistency of noble gas data analysis.This includes comparing data with historical records and detecting sudden increases.2.3.

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