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generation low-power HPGe gamma-ray spectrometer to improve IMS particulate radionuclide station reliability

LLNL developed a low-power and long-lifetime solution to improve reliability of high-purity germanium-based (HPGe) gamma-ray detectors in International Monitoring System (IMS) particulate radionuclide stations. HPGe is a semiconductor that must be operated under high vacuum at cryogenic temperatures (77 - 100 K) for energy-resolution analysis of gamma-rays emitted by radionuclides. The challenge is that HPGe detectors often fail after a station power outage because, with the return of power/cooling, impurities condense on the semiconductor surface inside the vacuum cryostat. One solution is to not let the detector warm up during power failures, however, existing HPGe detectors require too much power. LLNL has developed a high-efficiency (140%) HPGe detector which requires as little as 12-20 W cooling and could replace the higher-power-requiring detector component in IMS stations. The LLNL system requires only 10-25% of the power of current mechanically-cooled HPGe of similar size and could be kept cold via a small solar cell and battery, thereby improving the likelihood the IMS station will fully recover with restoration of power. Engineered for space applications and environments, this poster will discuss the current state of the HPGe systems, the operational characteristics, and possible application to the IMS.

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