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NG09 And CTBT On-Site Inspection Noble Gas Sampling and Analysis Requirements

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A provision of the Comprehensive Test Ban Treaty (CTBT) allows on-site inspections (OSIs) of suspect nuclear sites to determine if the occurrence of a detected event is nuclear in origin. For an underground nuclear explosion (UNE), the potential success of an OSI depends significantly on the containment scenario of the alleged event as well as the application of air and soil-gas radionuclide sampling techniques in a manner that takes into account both the suspect site geology and the gas transport physics. UNE scenarios may be broadly divided into categories involving the level of containment. The simplest to detect is a UNE that vents a significant portion of its radionuclide inventory and is readily detectable at distance by the International Monitoring System (IMS). The most well contained subsurface events will only be detectable during an OSI. In such cases, 37 Ar and radioactive xenon cavity gases may reach the surface through either "micro-seepage" or the barometric pumping process and only the careful siting of sampling locations, timing of sampling and application of the most site-appropriate atmospheric and soil-gas capturing methods will result in a confirmatory signal.

The OSI noble gas field tests NG09 was recently held in Stupava, Slovakia to consider, in addition to other field sampling and analysis techniques, drilling and subsurface noble gas extraction methods that might be applied during an OSI. One of the experiments focused on challenges to soil-gas sampling near the soil-atmosphere interface. During withdrawal of soil gas from shallow, subsurface sample points, atmospheric dilution of the sample and the potential for introduction of unwanted atmospheric gases were considered. Tests were designed to evaluate surface infiltration and the ability of inflatable well-packers to seal out atmospheric gases during sample acquisition. We discuss these tests along with some model-based predictions regarding infiltration under different near-surface hydrologic conditions. We also consider how naturally occurring as well as introduced (e.g. SF6) soil-gas tracers might be used to guard against the possibility of atmospheric contamination of soil gases while sampling during an actual OSI.

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