Identification of parameters for evaluating swipe samples in nuclear safeguards

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The International Atomic Energy Agency (IAEA) implemented the environmental sampling to improve the effectiveness and efficiency of nuclear safeguards. The purpose of environmental sampling is to detect undeclared nuclear activities at declared and non-declared sites of member states. As a member state of the IAEA, Korea Institute of Nuclear non-proliferation and Control (KINAC) of the Republic of Korea (ROK) has been operating the same program. The environmental sampling program of the ROK follows the four process: 1) Collection of swipe samples, 2) Screening the collected samples to select effective samples, 3) Analyzing the particles of the effective samples, 4) Evaluating the particle analysis results. KINAC conducted the screening of swipe samples using the X-ray fluorescence (XRF) and High Resolution Gamma Spectroscopy (HRGS). It also conducted the particle analysis using the large geometry secondary ion mass spectroscopy (LG-SIMS). However, KINAC has not established the quantitative criteria for the screening and particle analysis yet. We identified parameters to establish the criteria to operate entire environmental sampling program successfully. We classified the target swipe samples into four groups, based on the process and facility characteristics, and selected parameters to evaluate each group: 1) Non-irradiated for screening, 2) Irradiated for screening, 3) Non-irradiated   for particle analysis, 4) Irradiated for particle analysis. The parameter for the first group was the net count of nuclear material (uranium) based on measurement results. The parameters for the second group were the gamma peaks (796 keV (^{134}Cs), 662 keV (^{137}Cs), 1274 keV (^{154}Eu), ...) based on simulation results. The parameter for the third group was the isotopic ratio database of uranium in each facility based on measurement results. The parameters for the last group were the estimated isotopic ratio of uranium and transuranic elements in each facility based on simulation results using the irradiation history. Once the evaluation criteria are established using the identified parameters, the ROK can operate the entire environmental sampling program successfully.