NOR in NORM: naturally occurring radionuclides in naturally occurring radioactive materials – characteristics, principles of measurement organization, and interpretation of measurement results

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NORM-related activities encompass a wide range of industries that result in human exposure to radiation and generate substantial solid residues, as well as gaseous and liquid effluents often containing particulate matter. These materials are then subjected to environmental factors and affect various biota. While these residues share similarities with industrial waste, they consistently contain natural radionuclides undergoing radioactive decay, leading to the formation of isotopes of diverse elements and often coexisting with additional contaminants, thereby creating complex exposure scenarios.

Radionuclides from decay series commonly exist together in both NORM and environmental samples, making data analysis more challenging than with artificial radionuclides. Existing regulations mainly target parent radionuclides U-238 and Th-232, omitting U-235, hence overall trend is observed to evaluate activity concentrations of these radionuclides. Under rare secular equilibrium conditions, measuring any single radionuclide can represent the whole series, including parent radionuclides but this is uncommon due to frequent disturbances. Phenomena like leaching, sorption, diffusion, precipitation, emanation etc., as well as human or non-human biota activities can alter mutual radionuclides dependencies determined by the radioactive decay law and affect their final distribution.

When secular equilibrium cannot be assumed, radionuclide-specific analytical techniques must be applied. However, directly measurable naturally occurring radionuclides do not always correspond to those most relevant for NORM characterization from a radiation protection perspective. Therefore, accurate interpretation of results demands thorough evaluation of the NORM source history, composition, and assumptions regarding radioactive equilibrium to ensure meaningful assessment of potential radiation hazards in both occupational and environmental contexts.