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The assessment of Natural Occurring Radioactive Materials during various stages of the Mining Value Chain

To develop feasible and implementable approaches for proper management of mineral resources containing enhanced concentrates of natural radionuclides, it is critical to assess their behavioral patterns during various stages of the mining value chain. This paper gives an overview of various phases and processes of mineral product development and evaluates the potential radiation exposure levels due to the presence of Naturally Occurring Radioactive Materials. This is achieved through the assessment of mineral features, occupancy factor variation, and exposure pathways. Furthermore, the study demonstrates how physical and chemical mineral features such as the mode of occurrence, grain size, texture and morphology influence the mineral liberation characteristics and release of natural radionuclides during the mining value chain. The information will add value during planning, design and implementation of the effective radiation protection program, specific to the stage of the mining value chain. The exploration stage, which involves locating, sampling, drilling and core logging, is characterized by low to medium radiological exposure levels. During the shaft sinking and mine development, the exposure levels are moderate to high due to blasting, excavation and waste rock stockpiling. The mining phase has the highest radiation exposure levels due to controlled blasting, excavations, rock breaking, primary crushing and waste rock/ore hosting. The processing phase, which involves sorting, crushing, grinding, milling, ore physical separation, extraction and tailings generation, leads to the highest exposure levels. During this phase, particles are liberated and hence easily airborne. The low exposure levels are envisaged during the refining and marketing stages since the mineral product would have been in the required purity.

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