

Assessment of Radiological Impact of Mining and Processing Low Grade Uranium Ores on the Environment and Monitoring Strategies.

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Low grades of uranium ores are mined by underground and opencast methods in many countries for several decades. Environmental considerations have assumed increasing importance during the recent times. Uranium mining results in generation of large quantities of waste rocks, sub-ores and mill tailings with low radioactive content. These, in turn, result in emanation and atmospheric dispersal of radon and its progeny in the vicinity of the mines and the tailings facilities. Ventilation exhaust air from the underground mines also release radon and low concentrations of long-lived radioactive dust in to the environment. Mine water, runoff water from ore and waste rock stockpiles and that from the tailings facility even after treatment have the potential to carry small amounts of radioactivity in to the nearby aquatic system. Assessment of radiological impact of the operations on the environment is, therefore, important before undertaking mining and processing of uranium ores. Regulatory bodies require these assessments to be made and have issued guidelines.

With the exception of a few mines in some countries, most uranium ores mined in different countries have average grades between <0.05 to 0.3 % U_3O_8 . This paper aims to evaluate the radiological impact of mining and processing of an ore with average grade of 0.1 % U_3O_8 , so that for a particular grade of ore the values may be scaled appropriately. The waste rocks, ore heaps and tailing piles have the potential of low level gamma radiation exposure only in the immediate vicinity. Radon emanating from these materials has the potential to disperse in the atmosphere but is likely to get diluted to natural background levels with in short distances. The regulatory requirements, preoperational impact assessment and monitoring strategies such as baseline surveys, in-operation monitoring of gamma radiation, radon and its progeny and natural radioactivity in aquatic systems are discussed. The estimates made are compared with available data from some mining sites in different countries including India. The estimates indicate that radiological impact of mining and processing low grade uranium ores is only marginal and confined to immediate vicinity of the operations. For example, radon emanation rate from the tailings emerging from an ore containing 0.1 % U_3O_8 is estimated at $5.8 \text{ Bq.m}^{-2}.\text{s}^{-1}$. This is reasonably comparable to the radon emanation rate of $1.3 \text{ Bq.m}^{-2}.\text{s}^{-1}$ from Olympic Dam tailings emerging from an ore of 0.08 % U_3O_8 and $1.53 \text{ Bq.m}^{-2}.\text{s}^{-1}$ reported for Indian uranium tailings emerging from ores below 0.07 % U_3O_8 . The difference may be due to varying moisture content of the tailings. An area source of 10^5 m^2 is unlikely to contribute more than 0.3 Bq.m^{-3} at 1 km to the natural background radon concentration of 10-15 Bq.m^{-3} .