

**Mining and Milling of Uranium Ore by UCIL at Jaduguda
and its Radiological Impact in the Environment.**

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Summary

Radiation in Jaduguda environment and its effects on population has been the subject matter of several media reports that appeared during the last few years. Concerns were expressed on the impact of UCIL. Operations on the environment. Most of these concerns arise from the lack of even preliminary knowledge about radiation and are abased on misinformation and blown out of proportion to the potential risk.

The objective of this report is to present some basic information on radiation, its sources, biological effects and control of radiation hazards to occupational workers and the general public and surveillance data on various radiation related aspects of UCIL operations and in its immediate environment. The scientific information provided gives the basis for proper evaluation of the radiation levels in the environment and possible public exposures so that the problem of natural radiation in Jaduguda environment could be seen in proper perspective.

Exposure to ionizing radiation from natural sources is a permanent feature of life on earth and organisms including man are subjected to this unavoidable naturally occurring background radiation. The natural exposures to population are mainly depending upon location, altitude, geological feature of the area, dietary habits etc. A wide range of normal exposures are encountered, 1-10 mSv per annum for the world population with an annual average effective dose of 2.4 mSv.

In India, a countrywide survey of radiation levels has been made. It has been observed that radiation levels vary widely, not only from region to region but also locally. This aspect should be considered in evaluating any enhancement in radiation levels and possible impact from technological activities in any area.

Exposure to ionizing radiation causes absorption of energy when it passes through biological tissues and results in two type of effects namely deterministic effects (Sterility, cataract etc) occur at high doses and a threshold exists. For prolonged exposures the threshold is above 100 m Sv per annum. The main stochastic effect is induction of cancer and the risk coefficients per unit of radiation exposure is very small. The international Commission on Radiological Protection (ICRP) has provided standards for protection of man without unduly limiting beneficial uses of radiation. The recommendations of ICRP are adopted by Regulatory bodies all over the world including Atomic Energy Regulatory Board (AERB).

Uranium Corporation of India Ltd (UCIL), set up in 1967 at jaduguda undertakes mining of Uranium ore (0.03-0.06% $U^{3}O^{8}$ from Jaduguda, Bhatin and

Narwapahar mines and processes (about 2090 t/day) it in the mill at jaduguda for recovery of Uranium concentrate in the form of Magnesium – di- uranate (MDU)

A health physics Unit / Environmental Survey Laboratory (HPU/ESL) of BARC is functioning at site from 1965 to provide guidelines for radiation protection, waste management and environmental surveillance. A comprehensive programme for management of wastes from UCIL exists and releases to the environment comply with the guidelines provide by international organizations and as per stipulations of AERB and Pollution Control Board.

The occupational radiation exposures over the years have remained well within the limits prescribed by AERB (30 mSv/y). Maximum numbers of workers were in the exposure range of 5-10 mSv per annum and the annual average dose is around 8 mSv.

The main gaseous waste is the Radon-222, generated in mines and is let out through air exhaust adits at 30m heights. It gets diluted and dispersed in the air. All the liquid effluents containing dissolved radionuclides after preliminary treatment are sent to the Tailings pond along with the solid tailings. Since the solid tailings contain long-lived nuclides like Ra – 226 and Th – 230, it needs long-term management and the practice followed internationally is to contain these in properly engineered retention ponds. Presently 2 ponds are full and the 3rd is in use. Decantation wells are provided in the tailings pond and clear liquids collected through the side channels are clarified and partly reused in the proves and the rest is further treated in an Effluent Treatment Plant (ETP) and then discharged into the local stream.

An extensive environmental monitoring programme is being conducted around UCIL since 1965, Taking into consideration the waste releases and possible pathways of exposure, sampling and analysis of environmental matrices like soil, water (surface and ground) , air , food, items, milk etc are carried out up to 5km radial distance from the Mill. Measurement of terrestrial gamma radiation levels is carried out up to a distance of 25 km from jaduguda. In the Tailings Pond, besides external gamma monitoring, emanation of radon and resuspension of dust from tailings surface are also carried out routinely. On an average about 500 samples and locations are monitored in an year.

Besides natural radionuclides, already present in environmental matrices, the discharges from the UCIL facilities could also contribute to marginal increase in concentration of some of the nuclides in different matrices of the environment and subsequent exposure to the population residing in the close vicinity. These have been evaluated on the basis of monitoring results obtained over the years.

Concentrations of radon in close proximity with UCIL are slightly higher than in areas at distant locations. These higher values ($<3 \text{ Bqm}^{-3}$) reflect the contributions from the operating mines and emanations from the U mineralized zone of jaduguda. Concentrations of radionuclides like Ra-226 and U (Natural) have always been found to be lower than the 'Derived Water Concentrations '(DWC) values stipulated for the public.

An evaluation of the annual radiation exposure to members of the public, especially those residing in villages in close proximity with the Tailings pond,(2km) was made using the monitoring data on external gamma radiation levels, radon concentrations in air, intake of activity through water, food items etc and using appropriate dose conversion factors.

Beyond the fenced area around the Tailings pond, there is no additional external exposure to persons living in the villages. The additional exposure to the population living close by could only be of the order of 0.05 mSv per year from radon arising from UCIL operations. The intake of water from the Gara river and food items from the area contribute nearly 0.1mSv per annum. The annual exposure to the individual members of the population in these villages is estimated to be 1.732-3.14 mSv with a mean of 2.49 mSv per annum. It may be noted that 65% of the world population receive an annual dose of 1-3 mSv per annum.