Date of Issue: APRIL 2002	Page 1 of 8

REQUIREMENTS DOCUMENT

No	TITLE	Rev
RD-010	REQUIREMENTS FOR RADIATION DOSE LIMITATION: MINING AND MINERALS PROCESSING	0

CONTENTS PAGE

APPROVED: _____ DATE: 26/4/2002

S VAN DER WOUDE
ACTING CHIEF EXECUTIVE OFFICER

1. RADIATION DOSE LIMITATION

1.1 Radiation doses arising from the normal operation of the facility shall be controlled in order to ensure compliance with the following system of dose limitation:

1.1.1 no practice shall be adopted unless its introduction produces a net positive benefit,

1.1.2 all exposures shall be kept as low as reasonably achievable, economic and social factors being taken into account,

1.1.3 dose limits shall not be exceeded.

1.2 ***The annual effective dose limit for persons designated as occupationally exposed to radiation is 50 mSv. In addition, the annual equivalent dose limit for individual organs and tissues of such persons is 500 mSv except for the lens of the eye, for which the limit is 150 mSv.***

1.3 The annual effective dose limit for visitors to the facility and persons not designated as occupationally exposed to radiation is 1 mSv. In addition, the annual equivalent dose limit for individual organs and tissues of such persons is 10 mSv.

1.4 Formal procedures are to be implemented to ensure that exposures are maintained as low as reasonably achievable which must ensure, as a minimum, that the average annual effective dose to the occupationally exposed workforce does not exceed 10 mSv.

1.5 Women of reproductive capacity shall only be occupationally exposed to radiation under conditions where the equivalent dose to the abdomen is limited to 5 mSv in any period of two consecutive months. Following diagnoses of pregnancy, the total equivalent dose during the remainder of pregnancy shall not exceed 5 mSv.

1.6 ***The annual effective dose limit for members of the public arising from operations at, or effluent discharges from, the facility is 0.25 mSv. This limit shall apply to the critical group of the exposed population.***

1.7 In order to demonstrate compliance with the limits laid down for occupational exposure, summation of external and internal contributions to an individual's radiation dose is required. Such contributions may arise from external beta and gamma radiation sources; radon, thoron and their short lived daughter products; and dusts containing uranium, thorium and their radioactive decay products. For the various modes of exposure appropriate secondary limits are applied, namely: dose equivalent indices for external exposure, annual limits of intake (ALI) for radon, thoron and the long lived alpha emitting nuclides and annual limits of exposure (ALE) for radon and thoron daughter products. Values of the secondary limits corresponding to the primary dose limits are presented in Tables 1,2,3 and 4. Compliance will be demonstrated when the following two conditions are fulfilled:

1.7.1

$$\frac{H_{ID}}{H_{IDL}} + \sum_j \frac{I_j}{ALI_j} \leq 1$$

and

1.7.2

$$\frac{H_{IS}}{H_{ISL}} \leq 1$$

Where:

H_{ID} is the deep dose equivalent index received in the year,

H_{IDL} is the deep dose equivalent index limit,

H_{IS} is the shallow dose equivalent index received in the year,

H_{ISL} is the shallow dose equivalent index limit,

I_j is the annual intake of radionuclide j,

ALI_j is the annual limit of intake for radionuclide j.

The possible components of the summation in condition 1 of paragraph 1.7 for mining and minerals processing are specifically:

$$\frac{H_{ID}}{H_{IDL}} + \frac{I_{RnD}}{a} + \frac{I_{TnD}}{b} + \frac{I_U}{c} + \frac{I_{Th}}{d} + \frac{I_{Uc}}{e} + \frac{I_{Tc}}{f}$$

Where :

I_{RnD} is the annual exposure to radon daughter products,

I_{TnD} is the annual exposure to thoron daughter products,

I_U is the annual intake of uranium ore dust,

I_{Th} is the annual intake of thorium ore dust,

I_{Uc} is the annual intake of uranium concentrate,

I_{Tc} is the annual intake of thorium concentrate,

a is the annual limit of exposure to radon daughter products,

b is the annual limit of exposure to thoron daughter products,

c is the annual limit of intake of uranium ore dust,

d is the annual limit of intake of thorium ore dust,

e is the annual limit of intake of uranium concentrate,

f is the annual limit of intake of thorium concentrate.

TYPE OF LIMIT	QUANTITY	UNIT	DECAY PRODUCTS ^{222}Rn	^{220}Rn
ALI	Potential alpha energy	J	0.02	0.06
ALE	Time integrated potential alpha energy concentration	Jhm^{-3}	0.017	0.050
		WLh	800	2400
DAC	Potential alpha energy concentration	Jm^{-3}	$8.3x10^{-6}$	$2.5x10^{-5}$
		WL	0.4	1.2

TABLE 1: Annual Limits of Intake (ALI), Annual Limits of Exposure (ALE) and Derived Airborne Concentrations (DAC) for ^{222}Rn and ^{220}Rn Short Lived Daughter Products.

TYPE OF LIMIT	UNIT	^{222}Rn	$^{220}Rn+^{216}Po$
ALI	Bq	3.6×10^{8}	6.0×10^{8}
DAC	Bqm^{-3}	1.5×10^{5}	2.5×10^{5}

TABLE 2: Annual Limits of Intake and Derived Airborne Concentrations for ^{222}Rn and ^{220}Rn in the Absence of Decay Products.

TYPE OF LIMIT	UNIT	URANIUM ORE*	URANIUM CONCENTRATE CLASS D	CLASS W	CLASS Y
ALI	Bq	1.7×10^{3}	5.0×10^{4}	2.8×10^{4}	1.5×10^{3}
DAC	Bqm^{-3}	7.3×10^{-1}	2.0×10^{1}	1.2×10^{1}	6.1×10^{-1}

TABLE 3: Annual Limits of Intake and Derived Airborne Concentrations for Uranium Ore and Concentrates.

TYPE OF LIMIT	UNIT	THORIUM ORE*	THORIUM CONCENTRATE CLASS W	CLASS Y
ALI	Bq	2.0×10^{2}	6.3×10^{1}	2.0×10^{2}
DAC	Bqm^{-3}	8.3×10^{-2}	2.6×10^{-2}	8.3×10^{-2}

TABLE 4: Annual Limits of Intake and Derived Airborne Concentrations for Thorium Ore and Concentrates.

* These values are for commonly encountered combinations of radionuclides and their applicability must be validated. Where other combinations arise appropriate values must be derived on the basis set out in ICRP publications 30[1], 32[2] and 47[3].

REFERENCES

1. ICRP Publication 30. Limits of Intakes of Radionuclides by Workers. Annals of the ICRP 2, No. 3/4, 3, Nos. 1-4, 4, No. 3/4 5, Nos. 1-6, 5, No. 2/3, 7, Nos. 1-3, 8, No. 4, Pergamon Press (1979-1982).

2. ICRP Publication 32. Limits for Inhalation of Radon Daughters by Workers. Annals of the ICRP 6, No. 1, Pergamon Press (1982).

3. ICRP Publication 47. Radiation Protection of Workers in Mines. Annals of the ICRP 16, No. 1, Pergamon Press (1986).