

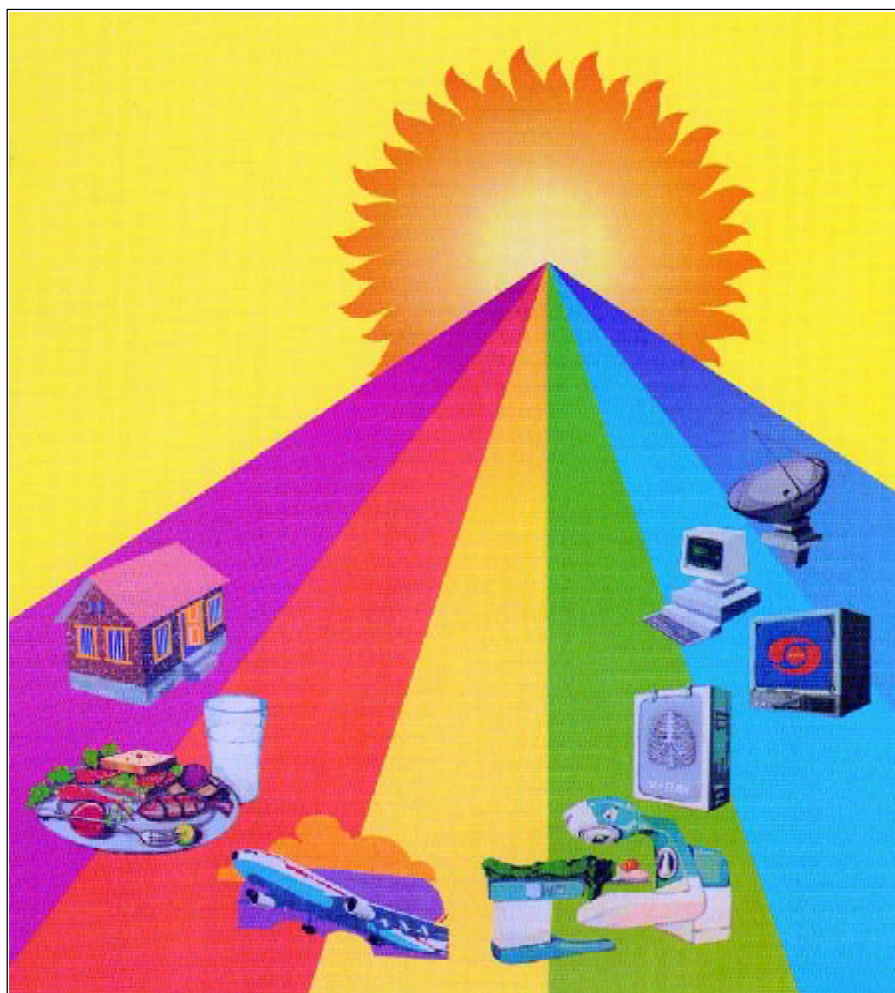
Background Radiation Exposure Levels : Indian Scenario

*T. V. Ramachandran, K. P. Eappen , R.N.Nair, Y. S. Mayya and V.D.Puranik
Environmental Assessment Division, Bhabha Atomic Research Center*

Ever since his existence on the earth, man has been undergoing exposure to radiation emitted by naturally occurring atomic species like uranium, thorium and potassium. He was exposed to radiation only from natural sources until recent times, when the growth of science and technology has created minor but additional sources of exposures, such as X-rays, TV monitors, radioactive releases from nuclear reactor operations and accidents, fallout from weapon tests, exposure due to radioactive waste disposal and other industrial, medical and agricultural uses of radioisotopes. Still, the major contribution to the background radiation exposure arises from the natural sources and the manmade radiation is very small fraction of the existing natural radiation. Natural sources of exposures are due to (a) external source of extra-terrestrial origin (cosmic rays), (b) source of terrestrial origin (radioactive nuclides present in earth's crust, in atmosphere and in building materials), (c) internal source of exposure from naturally occurring radionuclides taken into the body through ingestion of food materials etc., and (d) lung irradiation due to radon and thoron and their daughter products inhaled through air. Some of these exposures are relatively constant and uniform throughout the world. Other exposures vary widely depending on the location and due to elevated levels of naturally occurring radioactive elements like uranium and thorium in specific localized areas. Extent of exposure to natural radiation depends on the occupation, type of dwelling, location of habitation and life style of the population.

Natural radiation exposure is of importance because it accounts for the largest contribution to the collective dose to the world population from all sources. Cosmic ray radiation consists of 85 % protons, 14 % alpha particles and about 1 % nuclei of atomic number between 4 and 26. These particles are highly penetrating and have extremely high energy. Cosmogenic radionuclides like ^3H , ^7Be , ^{14}C and ^{22}Na , produced by cosmic ray interaction of the heavy charged particles coming from outer space, with the atmosphere, contribute to the natural radiation exposures as internal expo-

sure through inhalation. Annual effective doses from cosmic ray radiation around the world are estimated to range between 0.26 to 2.00 mSv/y. Radionuclides existed on the earth's crust since its formation are referred to as primordial radionuclides. Main primordial nuclides which are of importance are ^{40}K , ^{87}Rb and the isotopes of ^{238}U and ^{232}Th present in rocks and soil give rise to external as well as inhalation and ingestion exposures. Levels of terrestrial radiation differ from place to place around the world, as the concentrations of these nuclides



Sources of Radiation : Natural and Man Made

in earth's crust vary considerably.

A countrywide survey of outdoor natural gamma radiation in India using thermoluminescent dosimeter has yielded a national average value of 0.734 mSv/y as external terrestrial gamma background radiation consisting cosmic ray (0.355 mSv/y) and terrestrial component (0.379 mSv/y). Since the dose rate from cosmic rays increases with altitude, in high altitude places like Gulmarg in India, the annual effective dose to residents is about 830µSv. Out of the terrestrial component, 48.7 % is from ⁴⁰K and the rest from thorium (33.6 %) and uranium series (17.7 %) to the Indian population. Internal exposures arise from the ingestion of primordial radionuclides and potassium, through dietary intake. Total dose received through ingestion pathway of dietary intake of long-lived radionuclides of ²³⁸U and ²³²Th series as well as ⁴⁰K to Indian population works out to be 0.315 mSv/y as against 0.310 mSv/y

estimated globally. Effective dose contribution from cosmogenic radionuclides through internal exposure is estimated to be as 0.015 mSv/y. Internal exposure via inhalation arises from inhalation of radon and thoron, rare gases formed in the decay chain of ²³⁸U and ²³²Th series. Typical worldwide outdoor levels of radon and thoron are estimated to be about 10 Bq.m⁻³; while those of indoor radon and thoron are 40 and 10 Bq. m⁻³ respectively giving a total inhalation dose rate of 1.275 mSv/y. A countrywide survey of indoor radon and thoron using solid state nuclear track detector based radon-thoron dosimeters has yielded a national average value of 1.235 mSv/y for the inhalation dose due to radon, thoron and their progenies(both indoor and outdoor).

Total annual effective doses from natural radiation sources to the Indian population residing in normal background areas work out to be 2.299

mSv/y and can be compared to the reported global value of 2.455 mSv/y (Table 1). We all are in the midst of a radiation environment, however low it may be, and exposure from natural sources altogether cannot be avoidable. All what is needed and is possible is to be conscious of this fact with a constant endeavor to control the radiation component due to radon, thoron and their progenies to levels as low as is reasonably achievable.

Trainee Workshop on Radiation Emergency Preparedness for Medical Officers

The XIV Training Workshop on Planning, Preparedness and Response to Radiation Emergencies for Medical Officers was held under the aegis of Local Working Committee for Radiation Emergency Medical Response (REMR) of BARC, at Atomic Energy Regulatory Board (AERB), Mumbai during September 28 – October 2004. It was inaugurated by Prof. S.P. Sukhatme, Chairman, AERB.

The training workshop comprehensively covered all the topics pertaining radiation injuries/emergencies/accidents including assessment of psychological impact of radiation accidents and an overview of overall preparedness in dealing with medical management of radiation emergencies as it exists in different units of DAE. A series of lectures were delivered by faculty members drawn from AERB, BARC and DAE, and practical demonstrations were arranged on methods

Table 1: Estimated Annual Effective dose (mSv/y) and percentage contribution (%) from different natural sources to Indian population and its comparison with global value reported by UNSCEAR, 2000.

Sources of Radiation	India		World	
	(mSv/y)	(%)	(mSv/y)	(%)
External Exposure:				
1) Cosmic radiation	0.355	15.4	0.380	15.5
2) Terrestrial	0.379	16.5	0.480	19.6
Internal Exposure:				
1) Cosmogenic nuclide (inhalation)	0.015	0.65	0.010	0.41
2) Radon and thoron (inhalation)	1.235	53.7	1.275	51.9
3) Terrestrial (ingestion)	0.315	13.7	0.310	12.6
Total	2.299	100.0	2.455	100.0