RADIOLOGICAL SAFETY: CONCERNS AND FACTS

Over the last few decades, application of radioactivity and radiation in medical, energy production, industry, agriculture etc for the benefit of mankind is on increase. At the same time, as radiation cannot be seen or felt, there is understandably high level of public concern in any 'Nuclear/Radiation' related news due to the non-availability of credible information to them. While nuclear bombings of Hiroshima and Nagasaki exposed humankind in Japan to dangerous levels of radiation, psychological impact of nuclear accidents at Three Mile Island (TMI), Chernobyl, Fukushima and many radiological emergencies like Goiania, Salvador and the Mayapuri, Delhi etc. was not in proportion to the actual impact on environment or human health. Most of the radiation related news, however small they may be, can lead to misconceptions to the extent that any event immediately are connected with deformed child birth and high cancer incidence. While it is true that there is understandably a high level of public interest in any Nuclear/Radiation related news, but the timely availability of authentic, factual and credible information on the subject is not adequate. It is essential that any possible nuclear / radiation emergency is addressed in rational manner without any preconceived notion / bias.

By living in this world, persons are subjected to radiation exposure due to the natural radioactivity / radiation approximately 2.5mSv (0.0025Sv) in a year. Eating a banana or drinking a glass of milk also leads to the intake of the radioactive Potassium, but nothing happens to persons with these miniscule levels of radiation exposure. Compared to this, if the exposure becomes more than 1000mSv (1Sv) received in a small interval, there is chance of the victim showing nausea and vomiting. If this becomes 4500mSv, there is 50% chance that he may die in 60 days and if the radiation exposure is more than 10000mSv (10Sv) there is only very small chance for the persons survival. Kerala/Tamil Nadu have high radiation background in some area (due to natural thorium) where people are exposed to radiation dose of more than 15mSv (0.015Sv) in a year and in few cases even more than 50mSv/year. It has to be noted that while the annual dose limit for workers in nuclear facility is 30 mSv (as set by AERB), the dose received is much below this limit. The dose seen by the most exposed member of public near the Indian nuclear power plants is 0.05 mSv, which is less than 10% of the dose limit (1 mSv), subscribed by the Atomic Energy Regulatory Board (AERB).

Due to the enhanced safety features incorporated in Indian Nuclear Power plant design and safe operation, there was neither any occasion of high level radioactive release to the environment nor had to worry of any major accidents including threat on them by external event or natural disasters. There is a strong emergency preparedness programme for all the nuclear facilities and also to take care of transportation of nuclear and other radioactive materials. This also includes development of many radiation monitoring systems, software, impact assessment techniques etc. by BARC to respond to nuclear and radiological emergencies. Some of the systems like Aerial Gamma Spectrometry System (AGSS) developed by BARC were used for other countries to respond to radiological emergencies caused by orphan sources based on the request from IAEA.

In March, 2014, during biennial conference of Indian Association for Radiation Protection (IARP), Scientists discussed the same issue of Radiation protection, the effects of radiation and public concerns at length. Shri Bhattacharjee, then member, National Disaster Management Authority, emphasized the need to re-visit the acceptance of 'Linear No Threshold' model (LNT) as there are no scientific evidences supporting the theory. LNT is a dose-response model which is based on the assumption that radiation dose greater than zero will increase the risk of excess cancer in a simple proportional manner. He felt that usage of LNT model for low level exposure currently is creating a concern in public mind because it forces them to believe that even the smallest level of exposure to radiation is dangerous for them even though there is no scientific evidence for health effects for exposures less than 100mSv. Shri S.S. Bajaj, Chairman, AERB dwelt upon the independent regulatory framework of Atomic Energy Regulatory Board and systematic regulatory procedures that are in place for issuance of licences to operate nuclear power plants and other industrial units using radiation and radioisotopes. Dr. K.S. Pradeepkumar, President, IARP mentioned that since we know virtually nothing about the effect of low-intensity radiation, we might at the most agree that the average population dose from manmade radiation should be no greater than that which the population already receives from natural exposures (Cosmic rays, naturally occurring radionuclides like K-40, U-238, Th-232, Po-210 etc..).

Dr. K.B. Sainis, Former Director, Bio Medical Group, Bhabha Atomic Research Centre (BARC) and Dr R. A. Badwe, Director, Tata Memorial Centre (TMC) emphasized the non-existence of radiation related cancer incidences from their studies over a period of two

decades. Dr. Sainis noted that comprehensive data from high background radiation areas of Kerala from a cohort of more than 300,000 persons exposed to high levels of natural radiation did not show any incidence of excess cancer rates over the incidence rates in normal population. These studies lead to non-applicability of LNT theory at least for doses below 100 mSv. Dr. Badwe stated that the cancer incidence rates in normal population are about 40 per 100,000 persons in rural area and about twice of this in urban areas. The extensive studies undertaken by TMC, have also not indicated any additional cancer incidences, attributable to operation of nuclear reactors, around these power plants as compared to those observed in nearest control population.

In a panel discussion in the same conference on the topic of 'Nuclear Power, Radiation Protection and Public Perception' eminent panellists from Nuclear Safety discussed the issue extensively. In response to a question from the delegates, Dr. D.N. Sharma informed that NDMA has formulated a framework for including a subject on Radiation Physics and Radiation Protection in the syllabi of academic Institutions, Colleges, Schools, Civil Services training course and will be implemented by the respective authorities in due course of time, which will help to remove the unjustifiable fear of radiation among the public. Dr. Pradeepkumar and Dr. M.R. Iyer, a former IAEA expert on radiation safety had strongly opined that International Commission on Radiological Protection (ICRP) and United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) should utilise the results of extensive studies on radiation exposure from high background radiation areas on the effects of low level radiation and stop the applicability of Linear No Threshold (LNT) model for exposure to less than 10 mSv. The LNT concept and as also the ALARA (as low as reasonably achievable) have made the members of public more fearful of the otherwise beneficial effects of radiation as claimed by radiation Harmoses. Dr. Pradeepkumar while replying a question, mentioned that every human being due to the inherent natural radionuclide Potassium-40 is exposed to an annual dose of approximately 0.16 mSv (16 mRem). This annual dose if we compare is about 10 times more than that of a member of public generally receives from any operating nuclear power plant at 1.6 km distance. In addition, human body also has other natural radionuclides like U-238 and Po-210, which enter through ingestion route by the consumption of daily foodstuff. Since ICRP and UNSCEAR have already admitted that there are no detected effects of radiation for

exposure of less than 100 mSv, it becomes imperative to consider and implement the non applicability of LNT model.

Further information on the subject is that, In Taiwan, during the 1980s, there were more than 180 buildings constructed with recycled steel contaminated with Cobalt-60. About 10,000 people were affected and lived in these buildings for 10-20 years and the average radiation exposure was 0.4Sv (i.e. 40,000 mrem) per person. The average cancer death per 100,000 persons in Taiwan over this 10-year period was 116 compared to 3.5 persons per 100,000 people for the affected region. In the recent Fukushima accident, as per the UNSCEAR report prepared by International experts, there was no immediate health effect on the public due to radiation. This report also concludes that it is unlikely to be able to attribute any health effects in the future among the general public and the vast majority of workers. The report concluded that the observable health effects from Fukushima accident is from the stresses of evacuation and unwarranted fear of radiation.

Natural background radiation verses cancer mortality rate studies have demonstrated that those living at higher altitudes and getting greater natural background radiation exposures have less cancer mortality rates than those living in lower altitude states. In a comprehensive survey of Kerala population exposed to high-level natural background radiation, approximately 100,000 people lived in areas with high natural radiation from the thorium deposits along coastal areas. In these regions, the environmental exposures in some locations are as high as 70 mSv/year (7Rem/year) and 7.5 times the level seen in their interior areas. Using portable instruments, radiation levels in and outside more than 66,306 houses were measured. Confounding variables such as lifestyle, socio-demographic features, occupation, housing, residence history, tobacco and alcohol were obtained and analyzed. It was found that there was no evidence that cancer occurrence is consistently higher due to increased levels of external gamma-radiation exposure.

Indian Association for Radiation Protection.
10th September 2014.