

Nuclear Radiation

What is Radiation?

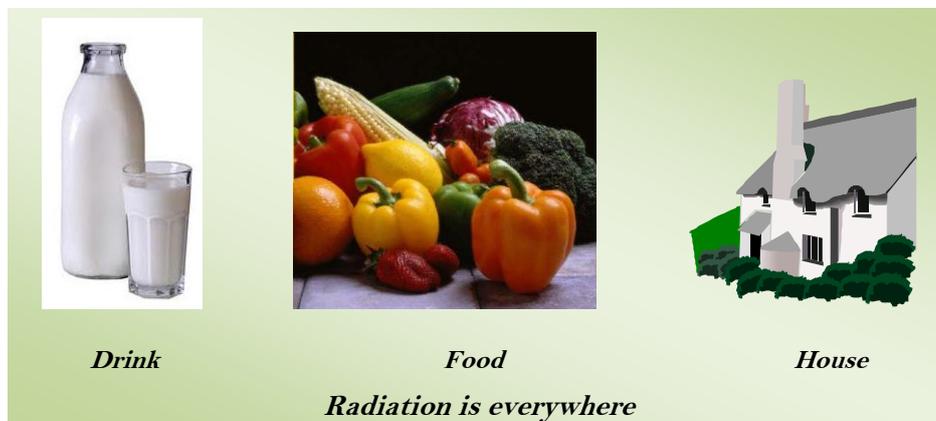
Radiation is a form of energy like heat or light, emitted through space and matter. Radiation has been broadly classified into two types such as non-ionizing radiation (Radio waves, Micro waves, light, and heat) and ionizing radiation (Alpha, Beta, Gamma, X-ray, Neutron). Ionizing radiations cannot be detected by any of our five senses (cannot be seen, cannot be smelled, cannot be tasted, cannot be felt, cannot be heard). However, ionizing radiations can be detected by using specialized instruments.

Radiation – Our constant companion

Application of radiation has played a significant role in improving the quality of life of human being since we learnt the use of artificial radiation. Sad memories of the use of nuclear weapons dropped on Hiroshima and Nagasaki, and the wide publicity given to the reactor accidents at Three Mile Island (TMI) in USA, Chernobyl in erstwhile USSR and Fukushima in Japan have strongly influenced the public perception.

Since the formation of Universe, radiation has been an integral part of Nature. We live in a naturally radioactive world. We are exposed to radiation from Sun and outer space, radioactive materials present in the earth, radioactive gases in the house we live in, buildings where we work, food we eat & air we breathe. Even our own bodies contain naturally occurring radioactive elements. The human environment has always been radioactive and accounts for up to 85% of the annual human radiation dose.

Potassium-40 is one of the naturally occurring radionuclide present in human body. Radon is a gas produced by the decay of Radium. Since Radon is a gas, it can accumulate in homes which give continuous exposure to the public. Accumulation of Radon is dependent upon home location as well as building methods



Radiation arising from human activities typically accounts for up to 15% of the public's exposure every year. This radiation is no different from natural radiation except that it can be controlled. X-rays and other medical procedures account for most exposure from this

quarter. Less than 1% of exposure is due to the fallout from past testing of nuclear weapons or the generation of electricity in nuclear, as well as coal and geothermal power plants.

Why Nuclear Energy is necessary?

Nuclear energy is the world's largest source of emission-free energy. Nuclear power plants produce no controlled air pollutants, such as sulphur and particulates, or greenhouse gases. The use of nuclear energy in place of other energy sources helps to keep the air clean, preserve the Earth's climate, avoid ground-level ozone formation and prevent acid rain. Of all energy sources, nuclear energy has perhaps the lowest impact on the environment, including water, land, habitat, species, and air resources. Nuclear energy is the most eco-efficient of all energy sources because it produces the most electricity relative to its environmental impact.

Energy Efficiency of different fuel

1kg Wood	=	1 KWe
1kg Coal	=	3 KWe
1kg Oil	=	4 KWe
1kg Uranium	=	35,00,000 KWe

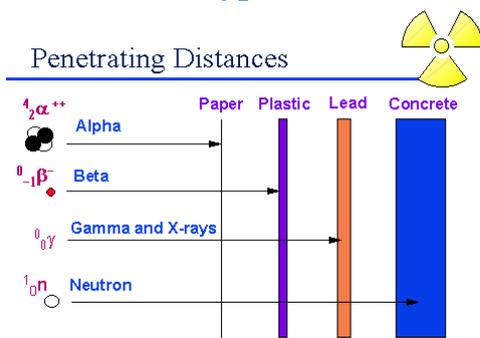
Kakrapar Atomic Power Station (KAPS)

Kakrapar Atomic Power Station (KAPS) site is located in Mandavi Taluka in Surat district. It is situated on the southern bank of Moticher Lake, which is about 85 km by road from Surat city, southern region of Gujarat State. At present two Pressurised Heavy Water Reactors (PHWRs) having capacity of 220 MWe each are operating and two more units (PHWRs) of 700 MWe each are under construction which is expected to be in commercial operation by December 2015. A 16 km radius around the site is considered as the Emergency Planning Zone (EPZ).

Nature of Hazard

Radioactive materials are produced in the operation of nuclear power reactors. Release of these materials is very low during normal operation. Release of these materials is likely to be higher during accidental conditions and the chance of such releases is very low. Release of radioactive materials into the atmosphere can cause contamination of the public, the water, the crops and the feed, domestic animals and wildlife that will be consumed, the livestock and milk or milk products that people consume; and the areas that people occupy (i.e. where they work, live, play, etc.).

Radiation & Types



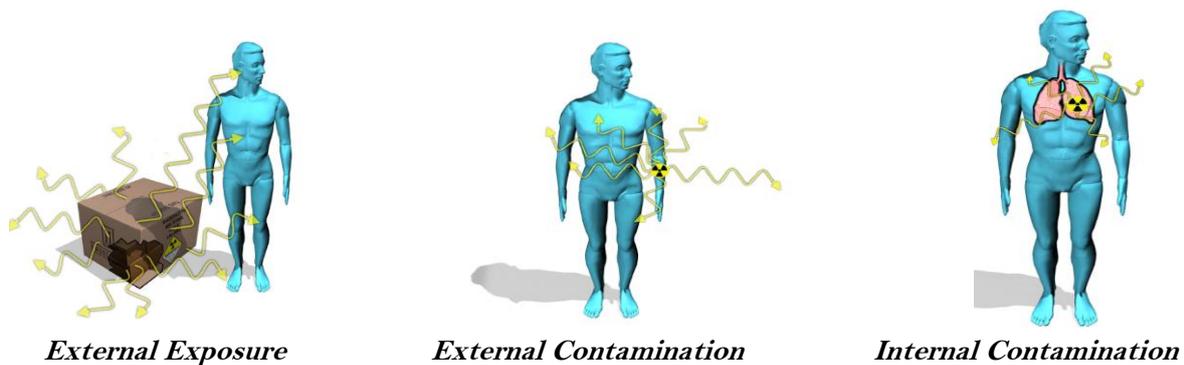
Energy emitted from a radioactive atom/source is known as **radiation**. The three main types of ionizing radiations emitted by radioactive substances are alpha (α), beta (β) rays and photons (x-ray and gamma (γ) rays). There is yet another type of radiation, known as neutron radiation, which is emitted during a nuclear fission process.

Radiation Exposure Vs Contamination

Contamination of an individual is possible if the radioactive material is present on the surface of the body / taken inside the body.

External exposure may be due to direct irradiation from a sealed source or due to contamination, i.e. airborne radionuclide deposited onto the ground or onto clothing and skin. **Internal exposure** may result from the inhalation of radioactive material in air, the ingestion of contaminated food or water, or contamination of an open wound.

When a person is **exposed** to radiation, it penetrates the body. The extent of penetration depends on the type of the radiation. For example, when a person has an X-ray, he or she is exposed to radiation.



A person exposed to radiation is not necessarily contaminated with radioactive material. For a person to be contaminated, radioactive material must be on or inside of his or her body. A contaminated person is exposed to radiation released by the radioactive material on or inside the body. An uncontaminated person can be exposed by being too close to radioactive material or a contaminated person, place, or thing.

Limiting exposure

There are four ways in which people are protected from identified radiation sources:



Limiting time – limit total exposure by limiting time spent in a radiation environment.



Distance – Increase distance from point of source. The intensity of radiation decreases with distance from its source. If we double the distance, the dose rate is a fourth.



Shielding – Barriers of lead, concrete or water give good protection from high levels of penetrating radiation such as gamma rays.

In contaminated areas, protective clothing helps to prevent external body contamination and appropriate respiratory protection helps to prevent internal contamination. Eating, drinking and smoking should be forbidden in contaminated areas.



Containment - Highly radioactive materials are confined and kept out of the workplace and environment. Nuclear reactors operate within closed systems with multiple barriers which keep the radioactive materials contained.

Effects of radiation

The effect of ionizing radiation on human tissue can be divided into two types: Deterministic effects and Stochastic effects. Deterministic effects occur only when threshold of exposure has been exceeded.

The nuclear power plants are designed and operated such that under any circumstances, exposure will always be much less than the threshold values. Some of the symptoms of radiation sickness due to the exposure above threshold value are skin burns, nausea, vomiting, and diarrhea.

There is some probability for occurrence of stochastic effects even in low doses (Eg: Cancer). There is very low probability for occurrence of stochastic effects as the quantity of radioactive materials released/dispersed into the environment during operation is well below the authorized limits.

Do's & don't for general public during radiation emergencies

- You must be aware of nuclear radiation hazard. You must take part in all the awareness activities being carried out by GSDMA, KAPS, NDRF and other Government & Non-Government agencies. Discuss on Nuclear radiation safety among children and family members, to reduce their fear of radiation.
- After hearing the emergency announcement, the members of public are requested to remain inside their houses or nearby buildings closing the windows and keeping wet handkerchiefs over their nose. Follow further instructions.
- **Turn on local radio/ TV channels** for advice from District Emergency Operation Centre/health authorities.
- **Obey any instruction of the District authorities** who will be doing their best to ensure the safety of you, your family and society as a whole and also try to save the property and the environment.
- If in the open, cover your face with a wet handkerchief, towel, dhoti or sari. Quickly move inside the nearest safe building and **change your clothes**.
- Cover all food, water and consume only such covered items.
- **Do not panic.**
- **Do not believe in rumours** and do not spread rumours.