RADIATION POLLUTION [NUCLEAR HAZARDS]

Radioactive contamination is defined as the deposition or introduction of radioactive substances into the environment, where their presence is unintended, or the levels of radioactivity are undesirable. Such type of pollution is harmful to life due to the emission of ionizing radiation. This type of radiation is potent enough to cause damage to tissues and DNA in genes.

Sources/Causes of Nuclear Hazards:

Radioactivity can occur in one of two ways:

- Naturally occurring radioactivity
- Man-made radioactivity

Natural and man-made sources of nuclear hazards are briefly described below:

(A) Natural Radioactive Sources

Natural radioactivity, as the name suggests, occurs naturally in our environment. Some radioactive elements such as uranium and thorium are present in rocks and soil. Interestingly, humans and all other living organisms contain nuclides such as carbon-14, which are created by cosmic rays.

(i) **Cosmic Radiation** It is a stream of ionising radiation that enters the earth's atmosphere from outer space. The intensity of cosmic rays in the biosphere is low. Therefore, they are not a health hazard. However, cosmic rays are a major hazard in space.

(ii) **Terrestrial Radiation** It is long-wave electromagnetic radiation emitted by naturally radioactive materials on the earth including radon, uranium and thorium.

Humans have been exposed to low levels of radiation from these natural sources for thousands of years. But it is the man-made sources which are posing a threat to mankind.

(B) Artificial (or Man-Made) Radioactive Sources

Man-made radioactivity is the result of nuclear weapon discharge or a nuclear reactor containment breach. In such scenarios, all living organisms in the vicinity of the nuclear event will become contaminated by fission products and remnants of nuclear fuel. This can be in the form of radioactive dust or even particles that are found on various surfaces.

These sources of radioactivity are waste materials that contain radioactive nuclei produced during the

(i) mining and processing of radioactive ores,
(ii) use of radioactive materials in nuclear weapons,
(iii) use of radioactive isotopes in medical, research and industrial applications, and
(iv) use of radioactive materials in nuclear power plants.

Radioactive materials are composed of unstable atoms. *Radioactivity* is a process by which an unstable atom emits radiation until it becomes stable. Radiation cannot be detected by

sight, smell, etc., but it has harmful effects on humans. The longer a person is exposed to radiation, the greater the risk.

Effects of Nuclear Hazards

The effects of nuclear hazards may be somatic or genetic.

(i) Somatic Effects Somatic Effects of nuclear radiation appear in the exposed person. The quantity of radiation that leads to the absorption of 100 erg per gram of the absorbing material is known as Radiation Absorbed Dose (RAD).

When an individual receives an acute dose (typically ≥ 10 RAD) in a short period of time, prompt somatic effects occurs.

For example, a dose of 400 RAD to the scalp results in temporary hair loss which occurs about three weeks after exposure. New hair is expected to grow within two months after the dose although the colour and texture may be different.

When an individual receives a small dose, *delayed somatic effects* are observed years after irradiation, for example, development of cataracts and cancer.

(ii) Genetic (or Heritable) Effects These effects appear as abnormalities in the future generations of the exposed person as a result of radiation damage to the reproductive cells.

Control Measures of Nuclear Hazards

Nuclear hazards can be controlled by practicing the following measures:

(i) Nuclear power plants should be located far from populated areas and should be provided with a suitable radiation-absorption zone around them to minimize the escape of radiation.

(ii) Safety measures should be enforced strictly to avoid nuclear accidents and occupational exposure.

(iii) Waste disposal must be effective, careful and efficient,

(iv) The following should be totally stopped:
Leakages from nuclear reactors, careless handling, transport and use of radioactive fuels and/or radioactive isotopes.

(v) Nuclear wastes have to be properly disposed off.

High-Level Wastes (HLW) like spent nuclear fuel has a very high radioactivity per unit volume. These are very dangerous. These wastes must be contained either by converting them into inert solids (ceramics) and then burying deep into earth or storing in deep salt mines.

Filters, reactor components, etc., are *Medium-Level Wastes* (MLW). These are solidified and mixed with concrete in steel drums before being buried in deep mines or below the sea bed in concentrate chambers.

Solids or liquids contaminated with traces of radioactivity are *Low-Level Wastes* (LLW). They are disposed of in steel drums in concrete-lined trenches in designated sites. After the disposal of nuclear waste, drilling activity must be prevented in and around the disposal site, and radioactivity must be monitored periodically around the disposal sites.