

UNIT-II

NUCLEAR RADIATION AND ITS EFFECTS ON THE BODY

2.5 PERMISSIBLE EXPOSURES

Permissible exposures" typically refer to the maximum amount of a hazardous substance or environmental factor (like noise, radiation, or chemicals) that a person can be exposed to without experiencing harmful effects. These limits are often set by regulatory bodies to protect workers and the general public from health risks.

Some common contexts include:

➤ **Occupational Safety:**

- **Permissible Exposure Limits (PELs):** Established by OSHA (Occupational Safety and Health Administration) in the U.S., PELs specify the legal limit of exposure to substances like asbestos, lead, or formaldehyde in the workplace.
- **Threshold Limit Values (TLVs):** Suggested by the American Conference of Governmental Industrial Hygienists (ACGIH), these are guidelines for exposure limits but aren't legally enforceable.

➤ **Radiation Exposure:**

- **Annual Dose Limits:** Set by organizations like the Nuclear Regulatory Commission (NRC), defining how much ionizing radiation workers and the public can safely be exposed to over time.

➤ **Noise Exposure:**

- OSHA regulates permissible noise levels in the workplace, often measured in decibels over a certain period, to prevent hearing loss.

➤ **Environmental Exposure:**

- Environmental agencies like the EPA (Environmental Protection Agency) set permissible exposure limits for pollutants in air, water, and soil.

Maximum permissible occupational doses

Maximum permissible occupational doses refer to the highest levels of radiation or hazardous exposure that workers can safely be exposed to over a specific period, as established by regulatory bodies to protect health and safety. These limits vary depending on the type of hazard (e.g., ionizing radiation, chemicals) and are typically based on guidelines from organizations like the **International Commission on Radiological Protection (ICRP)**, the **Occupational Safety and Health Administration (OSHA)**, and the **National Council on Radiation Protection and Measurements (NCRP)**.

For Ionizing Radiation (according to ICRP and NCRP):

1. **Whole Body (Effective Dose Limit):**

- **50 mSv (5 rem)** per year
- **100 mSv (10 rem)** over 5 years (average of 20 mSv/year)

2. **Lens of the Eye:**
 - 150 mSv (15 rem) per year
3. **Skin, Hands, and Feet (Shallow Dose):**
 - 500 mSv (50 rem) per year

For Non-Ionizing Radiation (e.g., Electromagnetic Fields):

Regulations depend on frequency and type of exposure. The **American Conference of Governmental Industrial Hygienists (ACGIH)** and **OSHA** provide specific exposure limits.

For Chemical Exposure:

OSHA sets **Permissible Exposure Limits (PELs)**, while **NIOSH** provides **Recommended Exposure Limits (RELs)**.

- **Time-Weighted Average (TWA):** Average exposure over an 8-hour shift.
- **Short-Term Exposure Limit (STEL):** Max exposure for a 15-minute period.
- **Ceiling Limit:** Should never be exceeded.

LD50 CAUSE OF RADIATION DEATH

The LD₅₀ (Lethal Dose for 50% of the population) refers to the amount of radiation required to cause death in 50% of an exposed population within a specific time frame, usually without medical intervention. For ionizing radiation, the LD₅₀ for humans is roughly 4 to 5 Sieverts (Sv) when exposure occurs over a short period.

Causes of Radiation Death at LD50:

1. Acute Radiation Syndrome (ARS):

Hematopoietic Syndrome: Damage to bone marrow reduces the body's ability to produce blood cells, leading to infections, anemia, and bleeding.

Gastrointestinal Syndrome: Damage to the lining of the intestines causes nausea, vomiting, diarrhea, dehydration, and severe electrolyte imbalance.

Neurovascular Syndrome (at higher doses >10 Sv): Direct damage to the central nervous system can cause confusion, seizures, coma, and rapid death.

2. Cellular Damage:

Radiation causes ionization of molecules within cells, leading to DNA damage.

Cells that divide rapidly (like those in bone marrow, the gastrointestinal tract, and hair follicles) are particularly vulnerable.

3. Immune System Suppression:

The destruction of white blood cells and bone marrow leads to severe

immunosuppression, making infections a major cause of death.

4. Internal Organ Failure:

Severe radiation exposure can cause multi-organ failure due to widespread cellular damage and tissue necrosis.

At doses near the LD_{50} , medical intervention such as antibiotics, blood transfusions, and bone marrow transplants can significantly improve survival rates.

