Radiation and Its Effect To The Environment

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ABSTRACT

Many forms of "radiation" are encountered in the natural environment and are produced by modern technology. Most of them can give both beneficial and harmful effects. Even sunlight, the most essential radiation of all, can be harmful in large amounts. Most public attention is given to the category of radiation known as "ionizing radiation." This radiation can disrupt atoms, creating positive ions and negative electrons, and cause biological harm. Ionizing radiation includes x-rays, gamma rays, alpha particles, beta particles, neutrons, and the varieties of cosmic rays.

Exposure to radiation can cause damage to cells, eventually leading to cancer or other health concerns and also it effects our environment.

Key word: *Ionizing & Non-Ionizing Radiation, radioactivity, Nuclear Reactor.*

1. INTRODUCTION

Radiation is a process in which electromagnetic waves travel through a vacuum or through matter-containing media. Radiation is also a subset of these electromagnetic waves combined with energetic subatomic particles with very high kinetic energies; these are called *ionizing radiation*.

The word arises from the phenomenon of waves *radiating* (i.e., travel outward in all directions) from a source. Radiation expands as it passes through space, and as its energy is conserved (in vacuum), the power of all types of radiation radiating from a point source follows an inverse-square law relating to the distance from its source.

1.1 Inverse-Square Law

It is a physical law stating that a specified physical quantity or intensity is inversely proportional to the square of the distance from the source of that physical quantity. In equation form:

$$\text{Intensity} \propto \frac{1}{\text{distance}^2}$$

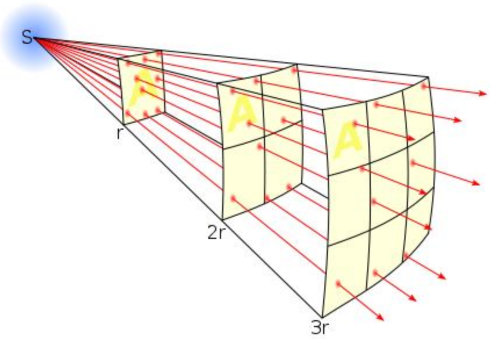

Fig.1.1 Radiation Originating from Point Source

The inverse-square law generally applies when some force, energy is radiated outward from a point source in 3D space. Surface Area of a sphere ($4\pi r^2$) is proportional to the square of the radius, as the emitted radiation gets farther from the source, it

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spreads out over an area that is increasing in proportion to the square of the distance from the source. Hence, the intensity of radiation passing through any unit area is inversely proportional to the square of the distance from the point source.

2.1 Units of Radioactivity and Dose

The original unit for measuring the amount of radioactivity was the *curie* (Ci)—first defined to correspond to one gram of radium-226 and more recently defined as:

1 curie = *3.7* x 10^{10} *radioactive decays per second* [exactly].

In the International System of Units (SI) the becquerel (Bq) has replaced the curie, where

1 becquerel = 1 radioactive decay per second = 2.703 x 10^{-11} *Ci.*

The magnitude of radiation exposures is specified in terms of the *radiation dose.*

3. RADIATION IN OUR ENVIRONMENT

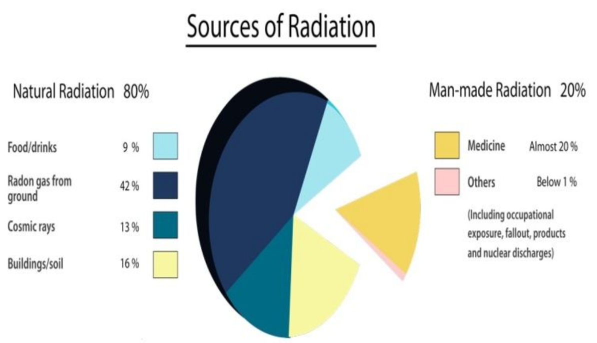

Fig.3: Percentage of Radiation Sources in Environment

There are many sources of radiation some are artificial source and some are man made sources. Nuclear plants and atomic bombs aren't the only sources of radiation. It's all around us, emanating from some common household objects and even the Earth The most common sources are : light-bulb filament, phosphorescent panel (chaotic), a laser beam (coherent).

3.1 Terrestrial Radiation

Radioactive materials are found in Soil, Vegetation, water Low levels of uranium, thorium, and their decay products are found everywhere. Some of these materials are ingested with food and water, while others, such as radon, are inhaled. Locations with higher concentrations of uranium and thorium in their soil have higher dose levels.

The major isotopes for terrestrial radiation are uranium and the decay products of uranium are thorium, radium, and radon.

3.1.1 Radon:

It is one of the leading source of natural radiation and the second leading cause of lung cancer. It is found everywhere usually from soil. The ground that we all walk and build our homes upon contains varying levels of naturally occurring radioactive elements that generates radon gas, which is a major health concern.

3.2 Cosmic (Space) Radiation

Space is full of different types of radiations, such charged particles and gamma rays. Earth contains atmosphere that absorb and filter the radiations, which protects us from high doses of cosmic radiation,but still some radiations pass through it.The dose of cosmic radiation received depends on the altitude of the area in which one live. Since air is thinner at higher elevations, less cosmic radiation is filtered out than it is a t lower altitudes with thicker air.

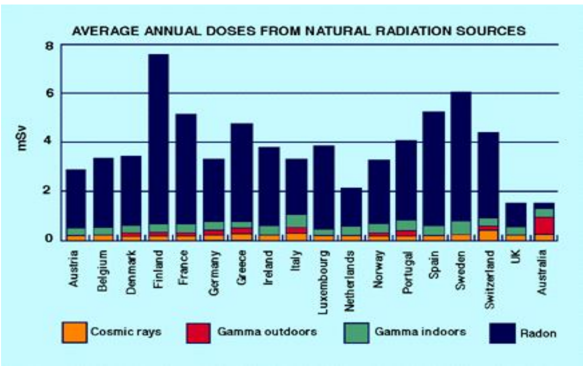

Fig 3.2 : Graph Showing Annual Doses from Radiation to Various Countries

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3.3 Internal Radiation

In addition to the cosmic and terrestrial sources, all people also have radioactive potassium- 40, carbon-14, lead-210, and other isotopes inside their bodies from birth and their doses levels also vary.

3.4 Man Made Radiation Sources

Public are exposed to direct radiation in medical procedures, such as diagnostic X- rays, nuclear medicine, and radiation therapy. Some of the major isotopes would be I-131, Tc-99m, Co-60, Ir-192, Cs-137 etc.

Public are also exposed to radiation from consumer products, such as tobacco (thorium), building materials, combustible fuels (gas, coal, etc.), ophthalmic glass, televisions, luminous watches and dials (tritium), airport X-ray systems, smoke detectors (americium), road construction materials, electron tubes, fluorescent lamp starters, lantern mantles (thorium), etc.

Public are also exposed to radiation from the nuclear fuel cycle, which includes mining and milling of uranium to the production of power at a nuclear plant.

4. RADIATION RISKS

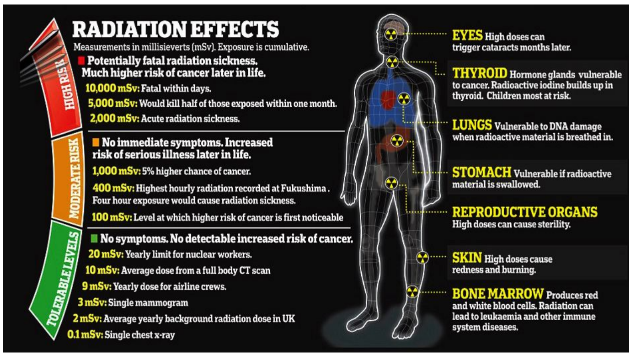

Fig.4: Radiation Level and its Effect on Human Body

Radiation can damage living tissue by changing cell structure and damaging DNA. The amount of damage depends upon the type of radiation, its energy and the amount of radiation absorbed. Most cellular damage is repaired,some cells, however, may not recover as well as others and could become cancerous. Radiation also can kill cells.

The exposure to radiation causes cancer. Recent Radiation Hazard are the atomic bombs attack at Hiroshima and Nagasaki, Japan, at the end of World War II. Other studies of radiation industry workers and studies of people receiving large doses of medical radiation also have been an important source of knowledge.

Radiation damages genetic material in reproductive cells that causes genetic mutations, which could be passed on to future generations. Exposing a developing embryo or fetus to radiation can increase the risk of birth defects.

On exposing to large amount of radiation all at one time could become sick or even die within hours or days. This level of exposure would be rare and can happen only in extreme situations, such as a serious nuclear accident or a nuclear attack.

5. CONTROLLING RADIATION USE

5.1. States/Organization

States regulate the use of x-ray machines. Some also are responsible for regulating other sources of radiation within the state on behalf of federal agencies such as the NRC.

5.1.1 U.S. Environmental Protection Agency (EPA):

EPA issues standards and guidelines to limit human exposure to radiation. EPA works directly with the public and industry, the states, and other government agencies to inform people about radiation's risks and to promote actions that reduce human exposure. EPA measures environmental levels of radiation and assesses radiation's effects on people and the environment.

5.1.2 U.S. Nuclear Regulatory Commission (NRC):

NRC develops regulations based on EPA's standards for protecting the public from radiation.

NRC regulates the civilian uses of nuclear materials in the United States by licensing facilities that possess, use or dispose of nuclear materials establishing standards and inspecting licensed facilities. NRC regulates nuclear power plants and other users of nuclear materials, including hospitals, educational institutions, research institutions, and industrial equipment such as gauges and testing equipment.

5.1.3 U.S. Department of Homeland Security (DHS) :

DHS has the primary responsibility for ensuring that emergency response professionals are prepared to respond to a terrorist attack, natural disaster or other large-scale emergency. DHS coordinates the comprehensive federal response to any large-scale crisis and mounts a recovery effort. Additionally, DHS educates citizens about preparing themselves, their families, and their homes for major emergencies.

5.1.4 U.S. Department of Health and Human Services (HHS) :

The HHS Food and Drug Administration's (FDA) Center for Devices and Radiological Health establishes safety standards for x-ray machines and other radiation-producing devices.

5.1.5 U.S. Department of Energy (DOE) :

DOE is responsible for the development of the disposal system for spent nuclear fuel from the nation's civilian nuclear power plants. This activity is fully funded by a tax paid by the users of nuclear-generated electricity. DOE is also responsible for the management and disposal of nuclear waste and other radioactive materials associated with nuclear weapons production at federally owned facilities. DOE is cooperating with state governments and private industry in working to clean up its present and former nuclear sites. DOE provides technical advice and assistance to states and the private sector in the management and disposal of low-level radioactive waste.

5.1.6 U.S. Department of Defense (DOD) :

While the DOE is responsible for the safe handling of radioactive material at defense production facilities, the DOD is responsible for the safe handling and storage of nuclear weapons in its custody and for other military uses of nuclear energy.

5.1.7 U.S. Department of Transportation (DOT):

The DOT, in cooperation with the NRC and the states, governs the packaging and transport of radioactive materials. The DOT also regulates carriers of radioactive materials.

5.1.8 Occupational Safety and Health Administration (OSHA) :

OSHA, a division of the U.S. Department of Labor, develops and enforces radiation protection regulations to protect workers not covered by other agencies.

5.1.9 Department of Atomic Energy (DAE), Govt. of India :

The Department of Atomic Energy, Government of India has clarified that recent reports published by certain sections of media about the 'adverse radiation effects' of operations of Uranium Corporation of India Ltd. (UCIL) in Jaduguda, East Singhbhum district of Jharkhand are speculative, misleading and are not based on scientific facts. This clarification also applies on similar reports appeared earlier in print as well as electronic media attributing various ailments of the people living in Jaduguda region to the operations of UCIL.

Uranium Corporation of India Ltd. (UCIL) is a responsible organization, under the Department of Atomic Energy (DAE), Government of India, and is well aware of its responsibility towards the workers, members of the public and the environment.

5.1.10 Australian Safeguards and Non-Proliferation Office (ASNO) :

The Australian Safeguards and Non-Proliferation Office is responsible for nuclear safeguards, nuclear

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security and the physical protection of nuclear facilities. ASNO is responsible for ensuring that nuclear materials and nuclear items - facilities, equipment, technology and nuclear-related materials - are appropriately regulated and accounted for. ASNO is responsible for ensuring Australia's commitments under the NPT, CPPNM and the various bilateral safeguards agreements (covering supply of uranium and other issues) are met, particularly that nuclear activities are conducted for exclusively peaceful purposes).

5.1.11 Canadian Nuclear Safety Commission (CNSC) :

Formerly the Atomic Energy Control Board (AECB), the Canadian Nuclear Safety Commission can best be described as the watchdog over almost all activities in Canada involving nuclear energy and materials. The website includes FAQs on the Canadian Nuclear Safety and Control Act.

5.1.12 Nuclear Regulatory Authority, Japan (NRA):

The Nuclear Regulation Authority came into being against the backdrop of badly damaged public trust in the nation's nuclear safety regulation and administration. Keeping this in mind, we must ensure that the NRA carries out its responsibility and meets the expectations of the people to the fullest, in adopting and applying strictest regulations.

6.CONCLUSION

Risks to health associated with ionising radiation have been overestimated by a wide margin. Now conclusion has been reached at the point to bringing together three sources of scientific information: firstly a century of clinical experience of radiotherapy; secondly the current knowledge of radiobiology based on laboratory studies; thirdly the analysis of the long-term health records of large populations of people exposed to radiation, either as a single (acute) dose or as a continuing (chronic) one. The result is that new safety levels for human radiation exposures are suggested: 100 millisievert in a single dose; 100 millisievert in total in any month; 5,000 millisievert as a total whole-of-life exposure. These figures are conservative, and may be debatable within factors of two, but not ten.

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