CONCLUSIONS

Effective half-life of tritium for subjects in coastal region of India is found to be in the range of world average and is average 8.19d which is slightly higher than Indian reference man and lower than ICRP reference man. The distribution of biological half-life of tritium is observed to be log-normal. The biological half-life of tritium reduces by half in the summer as compared with the winter.

Gamma-ray and fast neutron shielding effectiveness of different types and different places of soils have been studied. It is found to be that the buildup factors for the soil samples are dependent on photon energy and penetration depths. Mass attenuation coefficients of soils are found of same order in the Compton scattering region. We have found that the clay loam soil is a good radiation shielding material for gamma-rays and sandy loam for fast neutrons.

Gamma-ray and fast neutron shielding effectiveness of fly-ash have been studied and compared with mud and common brick materials. The exposure buildup factors for all fly-ash are found to be similar and almost independent of silicon concentration; any fly-ash may be considered as representative sample. Shielding effectiveness of the fly-ash for gamma-rays is lower than that of mud and common brick materials. Fly-ash sample with low-Z elements and high density shows large fast neutron removal cross-section. Therefore, it is concluded that low-Z element and high density contribute a vital role in fast neutron shielding properties.

Gamma-ray and fast neutron shielding effectiveness of normal and heavy concretes have been studied. Steel-Magnetite is found to be the most appropriate concrete for gamma-rays and fast neutrons shielding in reactors. Simulations on attenuation coefficients for the normal and heavy concretes are found to be in good agreement with theoretical XCOM and experimental values. Chemical composition dependency of buildup factors for concretes is established using mixture dependency. The air-kermas are found to be dependent on the elemental compositions of the concretes. The pair production is dominant interaction process above 3 MeV energy of photons which can be explained by the chemical compositions.

Gamma-ray and fast neutron shielding effectiveness of some alloys have been studied. Linear attenuation coefficients of alloys are found to be independent on iron contents. Cupero-Nickel is found to be the most appropriate shielding material for gamma-rays and SS-316 for fast neutrons.

Gamma-ray and fast neutron shielding effectiveness for oxide dispersion-strengthened (ODS) steels have been computed. The ODS steels having largest iron and copper contents offer better gamma-rays shielding effectiveness whereas copper-based ODS steel offer superior fast neutrons shielding. We have also found that high-Z elements also contribute in fast neutron shielding.

Gamma-ray exposure buildup factors and macroscopic effective removal cross-section for fast neutron for bismuth borosilicate glasses have been evaluated. The exposure buildup factors are found to be dependent on photon energy, penetration and molar concentration of bismuth oxide. The borosilicate glass with the largest bismuth content is found to be the superior shielding for gamma-rays and fast neutrons. The bismuth borosilicate glass with the
highest bismuth content shows the largest macroscopic effective removal cross-section for fast neutrons.

Gamma-ray and fast neutron shielding effectiveness of lead and nickel oxide borate glasses have been investigated. Effective atomic numbers and electron densities for lead oxide borate glass are found to be the largest in photoelectric absorption region. Macroscopic effective removal cross-section for fast neutrons is found to be the highest for borated glass which is free from lead and nickel oxides; inclusion of lead and nickel oxides in glass matrix modifies the buildup factors.

Gamma-ray and fast neutron shielding effectiveness of silicate and borate heavy metal oxide glasses have also been investigated. The bismuth silicate glass is found to be the superior shielding glass for gamma-rays and fast neutrons and is appropriate for replacement of lead based glasses. The fast neutron shielding effectiveness of the HMO glasses is found lesser than ordinary concrete.

Effective atomic weight and gamma-ray interaction parameters for hydride and borohydrirde metals have been investigated. It is found that the effective atomic weight and effective atomic number can be calculated using macroscopic effective removal cross-section in the neutron energy range 2–12 MeV. Exposure buildup factors for hydride and borohydrirde metals show sharp peaks in low-energy due to absorption edges of high-Z elements.

Gamma-ray shielding effectiveness of some spin ice compounds has been studied. Effective atomic numbers are approximately constant in intermediate energy region due Compton scattering process. The well type structures of effective atomic numbers are observed in the photon energy range 30–60 keV due to K-shell electron involvement. Dy2Sn2O7 and Ho2Sn2O7 are found to be suitable materials for gamma-rays shielding.

Gamma-ray shielding effectiveness of some boron containing materials such as B2Al2O3, B3C, B10H14 and ferro-boron has been studied. The ferro-boron is found to be the superior material for gamma-rays shielding.

Gamma-ray and fast neutron shielding effectiveness of non-centrosymmetric, iron-based and oxide-based superconductors have been studied. It is found that non-centrosymmetric and oxide-based superconductors are superior materials for gamma-rays shielding.

Gamma-ray and fast neutron shielding effectiveness of some building materials have been studied. The requirement of shielding thickness of glass, marble, fly-ash, cement, limestone and plaster of paris are found to be comparable with ordinary concrete. Limestone and plaster of paris demonstrate superior shielding properties for gamma-rays and neutrons, respectively.

Photon buildup factors for Optically Stimulated Luminescence (OSL) dosimeters have been computed. Effective atomic numbers for OSL dosimeters have also been calculate and compared with human body tissue and phantoms. The BeO is found to be most suitable OSL dosimeter. Air-kerma is found to be independent upon chemical compositions for high energies of photons.
Photon buildup factors for sixteen gel dosimeters have been investigated. The water and PMMA phantom equivalence of the gel dosimeters are evaluated using EABF; large difference is noted for photon energy below 1 MeV.

Photon build-up factors for solid state nuclear track detectors have been studied. Significant variations in build-up factors are observed. The build-up factors are strongly dependent on photon energy, penetration depths and chemical compositions. The build-up factors are found to be the lowest for glass phosphate and the highest for CR-39 in small penetration depths for low photon energies.

Photon buildup for some sulphate based thermoluminescent dosimeters has been investigated. The buildup factors have been studied as a function of photon energy, penetration depth and chemical compositions. The effective atomic numbers for MgSO₄ are nearer to cortical bone and hence it may be considered dose monitoring.

Gamma-ray interaction properties for some gases have been studied. Each gas has shown constant effective atomic numbers for photon energy in the region 0.10 to 10 MeV; effective atomic numbers are far away from ICRU tissues. However, effective atomic numbers for carbon dioxide are close to ICRU tissues. The single value effective atomic number of carbon dioxide from XmuDat program is found comparable with ICRU tissues.

Effective atomic numbers, air-kermas and energy-absorption buildup factors for some biological samples have been computed. It is observed that the buildup factors and air-kermas are dependent upon effective atomic numbers and chemical compositions. The buildup factors, effective atomic numbers and air-kermas of calcium carbonate and lithium carbonate are found to be in good agreement with cortical bone and fat, respectively.

Gamma-ray interaction parameters for plastics and polymers have been investigated. The effective atomic numbers are calculated by direct method, interpolation method, software Auto-Zeff and XMuDat program. A large difference in effective atomic numbers is observed in photoelectric region when calculated by the direct and interpolation method. It is to be noted that the effective atomic numbers calculated by direct method and interpolation method are in very good agreement for intermediate energy region.

The direct method, interpolation method, software Auto-Zeff, and XMuDat program have also been used to determine the effective atomic numbers for some low-Z materials. It is found that the effective atomic numbers can be calculated using the direct method, the interpolation method and software Auto-Zeff in Compton scattering region. The effective atomic numbers of low-Z material calculated by the direct method are comparable with human body tissues in the Compton scattering region.

Effective atomic numbers for some tissue substitutes have been calculated using software Auto-Zeff, direct method, interpolation method and power law method. It is found that the effective atomic numbers computed by software Auto-Zeff, direct method and interpolation method are in good agreement in the intermediate energy region. A large difference in effective atomic numbers is observed in photoelectric and pair-production regions using these methods. Effective atomic numbers computed by power law method are found to be close to direct method in photoelectric absorption region.
Effective atomic numbers for organic compounds have been computed by software Auto-$Z_{eff}$, direct method, interpolation method, ratio method and XmuDat program. The effective atomic numbers calculated using the XMuDat program and the power law method are very close to each other.

Photon interaction parameters for alcohols have been studied and compared with experimental values. It is found that suitable for phantom as well as human organ tissues.