Abstract

Lead and tungsten are potential alternative materials for shielding reactor ex-core components with high ^{16}N activity when available space limits application of concrete. Since the two materials are vulnerable to photonuclear reactions, the nature and intensity of the secondary radiation resulting from (γ,n) and (n,γ) reactions when ^{16}N decay radiation interact with these materials need to be well known for effective shielding design. In this study the MCNP code was used to calculate the photoneutron and capture gamma-ray spectra in the two materials when irradiated by ^{16}N decay radiation. It was observed that some of the photoneutrons generated in the two materials lie in the low-energy range which is considered optimum for (n,γ) reactions. Lead is more transparent to the photoneutrons when compared to tungsten. The calculations also revealed that the bremsstrahlung generated by the beta spectrum was not sufficient to trigger any additional photoneutrons. Both energetic and less energetic capture gamma-rays are observed when photoneutrons interact with nuclei of the two materials. Depending on the strength of the ^{16}N source term, the secondary radiation could affect the effectiveness of the shield and need to be considered during design.

Keywords

- Photonuclear reactions;
- Radiative capture;
- Lead and tungsten;
- ^{16}N decay radiation;
- Monte Carlo calculation