

## Abstract

This work proposes the optimum gamma ray shield thickness around the HPLWR high pressure turbine for different occupancy periods in the turbine building. Monte Carlo method was employed in the design process and only radioactive nitrogen-16 was considered as the source of radiation. Five grades of concrete (ordinary, magnetite, heavy magnetite, steel magnetite and barite) were used as shielding materials. The isotope source term in the high pressure turbine was estimated by modeling the HPLWR three pass core in MCNP and tracking the inventory using a simple algorithm. The high pressure turbine was thereafter modeled in MCNP with a concrete shield arrayed in layers around it. The surface flux tally and ICRP74 dose conversion coefficients were employed to estimate the dose profile across the shield. For some shielding materials, exponential functions were fitted on the calculated data to extrapolate dose values beyond the model thickness. The optimum shield thickness was determined by comparing the calculated dose profiles with dose limit proposals in the IAEA standard (NS-G-1.13) on radiation protection considerations during nuclear power plant design. It was observed that with a 120 cm thick heavy concrete shield, the turbine building would be safe for most occupancy periods. However for ordinary concrete the shield would require some extension to guarantee safety. For very long occupancy (more than 10 person hours per week), magnetite shield may also require slight extension. It can therefore be concluded that the shield thickness recommended for BWR turbines (which operate on a direct cycle like HPLWR) could be sufficient for HPLWR if high density concretes are used.