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Tritium Handling and Recovery System for Accelerator Based 14-MeV Neutron Generator

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An accelerator based 14 MeV neutron source is under development to study the fusion neutronics for Indian fusion programs. The neutrons are generated by impinging 10 mA deuterium beam accelerated up to 340 keV energy over a 140 Curie tritium target. Being a system handling tritium-radio-active material, a recovery system is to be designed to minimize airborne tritium effluent releases to well below the permitted limit. In addition, the system should minimize tritium exposure to staff by maintaining low levels of tritium in the Rotating Tritium Target Holder (RTTH). The paper presents the first estimated value of tritium coming out into the exhaust of the accelerator system. A mathematical model is developed to estimate the amount of tritium getting sputtered out of the target. The calculated result is then successfully simulated using SRIM software, and validated using the experimental results available. According to a paper by M.Martone, tritium release from the target at maximum power has been evaluated to be 37 GBq/h experimentally. As per our calculation method and the simulated results, the tritium release is calculated to be 40 GBq/h which is in very close conformance with the claimed value. Based on this primary calculated data a conceptual design of the Tritium Handling and Recovery System (THRS) is also presented. There are a number of technologies available for THR like, metal membrane reactors, cryogenic adsorption on molecular sieve beds, getter beds, cryogenic freezing, high temperature electrolysis, and catalytic oxidation. Today globally, getter bed technology for the tritium separation is in frequent practice. This paper also elaborates the specific selection criteria for development of recovery system. Followed by determining the significance of the selection criteria using the Pairwise comparison (Pugh matrix) approach for weighting the criteria accordingly, and selecting the appropriate technology.

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