A Shutter Assembly Design for a Reactor Based Boron Neutron Capture Therapy Facility

Plans are under development to modify the Tower Shielding Reactor at the Oak Ridge National Laboratory into a neutron source for clinical BNCT. Because the treatment field is generated by a reactor, a shutter must be designed to turn the beam on and off. In this work, a mixed neutron/photon shutter and mechanical assembly were designed that minimize the treatment SSD.

The combined neutron and gamma dose rate must be reduced to acceptable limits between treatments, but the thickness of the shutter is limited due to the treatment SSD. Photon and neutron shielding calculations were performed using discrete-ordinates radiation transport codes. A compact laminated shield composed of tungsten and borated polyethylene was designed that minimizes both occupational expose and treatment SSD.

In order to further minimize the SSD, the shutter was positioned above the neutron filter in a vertical shutter/filter assembly. By using this configuration, the space between the reactor and the patient is always occupied by either the shutter or filter. Two steel crossbars were used to support the shutter in the beam off position. When the shutter is lowered into closed position, the crossbars support the shutter section of the assembly, even in case of accidental hydraulics failure. Because the weight of the shutter is supported by the crossbars, the neutron filter can be separated from the assembly and easily replaced with other filters.