AbstractID: 12751 Title: Neutron-induced electronic failures around a high-energy linear accelerator

Purpose: After a new in-vault CT-on-rails system repeatedly malfunctioned following use of a high-energy radiotherapy beam, we investigated the presence and impact of neutron radiation on this electronic system, as well as potential neutron shielding and neutron evaluation options. **Methods:** We first determined the CT scanner's failure rate as a function of the number of 18 MV monitor units (MUs) delivered. We then reexamined the failure rate with both 2.7-cm-thick and 7.6-cm-thick borated polyethylene (BPE) covering the linac head for neutron shielding. To further examine shielding options, as well as to explore which neutrons were relevant to the scanner failure, Monte Carlo was used to calculate the neutron fluence and spectrum in the bore of the CT scanner. Simulations included BPE covering the CT scanner itself as well as covering the linac head. **Results:** We found that the CT scanner had a 57% chance of failure after the delivery of 200 MUs. While the addition of neutron shielding to the accelerator head reduced this risk of failure, the benefit was minimal and even 7.6 cm of BPE was still associated with a 29% chance of failure after the delivery of 200 MU. This shielding benefit was achieved regardless of whether the linac head or CT scanner was shielded. Additionally, it was determined that fast neutrons were primarily responsible for the electronic failures. **Conclusions:** As illustrated by the CT-on-rails system in the current study, physicists should be aware that electronic systems may be highly sensitive to neutron radiation. Physicists should therefore monitor electronic systems that have not been evaluated for potential neutron sensitivity. This is particularly relevant as electronics are increasingly common in the therapy vault and may exhibit increased sensitivity in newer electronic systems.