AbstractID: 3779 Title: A reduction in neutron production through the use of a flattening-filter-free accelerator

Purpose
High-energy photon treatments (E > 10-MV) are contaminated by neutrons that are produced in the accelerator head. These neutrons are detrimental as they deliver stray radiation dose to the patient, as well as activating components in the treatment vault, which irradiates the radiation therapist. A reduction in the neutron fluence may be achieved through the removal of the flattening filter.

Methods and Materials
A Varian 2100 accelerator was operated in 18-MV photon mode using the flattening filter and also without the flattening-filter. The neutron fluence was measured with moderated gold foils at several points in the patient plane. Additionally, an 8-field prostate IMRT treatment plan was generated in Eclipse version 6.5 for an anthropomorphic Rando phantom for both the flattening-filter and flattening-filter-free modes.

Results
The neutron fluence per MU was found to be 20% lower in the flattening-filter-free mode. Furthermore, as the flattening-filter-free mode has a higher dose per MU on central axis, an IMRT treatment for a Rando phantom required only 3,724 MU as compared to 10,981 MU for the flattening-filter mode. For the Rando treatment there would be a reduction of over 70% in the number of produced neutrons.

Conclusions
The neutron fluence per MU and per treatment was substantially decreased through the use of a flattening-filter-free accelerator. This corresponds to a reduction in the patient dose from stray neutrons, as well as a reduction in the activation dose to the radiation therapist.

Conflict of Interest
This work was supported in part by a grant from Varian Medical Systems.