

AbstractID: 4433 Title: Shielding II:Linac Radiation Monitoring and Surveys:  
Instruments and Methods

Regulatory agencies typically require shielding integrity radiation surveys during commissioning of radiation therapy linear accelerators (linacs). While concrete barriers that provide adequate shielding for photons also provide adequate shielding for neutrons, facilities operating at energies above 10 MV shall be checked for neutrons at the door, maze entrance, and any other openings through the shielding. Laminated barriers shall be monitored for neutrons beyond the shielding.

For the primary barrier measurements, the maximum field size is utilized without a phantom in the beam. Gantry angles of 0, 90, 180, 270 degrees as well oblique angles depending upon the shielding configuration are commonly used. Secondary barriers are surveyed with the maximum field size and a phantom in place.

Photon surveys outside the barriers are performed typically with a calibrated ionization chamber which has both rate and integrate modes, at 30 cm from the barrier. Head leakage in the linac room can be established with the use of film wrapped around the linac head and integrating dosimeters.

In this lecture neutron monitoring will be emphasized. Neutron measurements inside the treatment room are fraught with difficulties because of photon interference from the primary and leakage photon beam and the fact that neutron detection is spread over many decades of energy. Thus no single neutron detector can accurately measure neutron fluence or dose equivalent over the entire energy ranges. Additionally neutron detectors can have photon-induced reactions when used in the primary photon beam. Further because therapy linacs are operated in a pulsed mode, the intense photon pulse overwhelms any active detector that detects particles electronically. Thus active detectors such as neutron rem-meters, fluence meters and spectrometers cannot be used inside the treatment rooms except at or near the maze entrance. They can be used outside the shielded treatment room.

Passive monitors with high neutron sensitivity such as moderated activation foils (gold and indium) and threshold activation detectors (phosphorous) can be typically used inside the treatment room and inside the primary beam. Moderated activation foils can also be used inside the treatment room and outside the primary beam. Solid state neutron detectors (SSNTDs) such as CR-39<sup>®</sup> and bubble detectors can be used inside the treatment room, but outside the primary beam. Bubble detectors can also be used for radiation surveys outside the shielded treatment room.

Educational Objectives:

1. Understand how to perform shielding integrity radiation surveys
2. Understand the various neutron monitoring methods and instruments
3. Understand under which conditions these monitors can be used