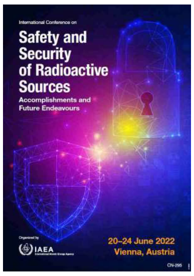

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SAFETY AND ANALYSIS OF 18 MeV PHOTONS ACTIVATED RADIOISOTOPES IN SIEMENS ONCOR IMPRESSION 3D LINAC DECOMISIONING EXPERENCE AT KLAIPEDA UNIVERSITY HOSPITAL

Tuesday, 21 June 2022 16:00 (15 minutes)

Nowadays radioactive sources are one of the most used technique to destroy tumor cells in patient by megavoltage or kilovoltage photon beam. Klaipeda university hospital in Lithuania uses sealed 60Co source of ionizing radiation and a linear accelerator (linacs) in its activities. In this field radiation protection and physical security plays a very important role in safety of ionizing radiation sources. The main goal is to ensure that ionizing radiation sources are secured and used safely to provide an appropriate level of protection for people, animals and the environment against the harmful effects of radiation exposure. The consequences of incidents with radioactive sources can be severe.
However, high-energy photons (>8 MeV –10 MeV) generated by a linear accelerator may induce photonuclear reactions and activate linac‘s parts. Materials activated in a linac can cause issues to arise during decommissioning of the machine as workers or additional dose to staff may be exposed to radiation from the activation products. Activation products are subject of radiological regulation which means that activated linac‘s parts must be disposed in accordance with national standards after decommissioning of the equipment.
This research aims to quantify the amount of neutron activation induced radioactivity in the components of an 18 MeV Siemens Oncor Impresion 3D medical linac head, disscus decommissioning experience and assessed the adequacy of the quality of security measures. The activated isotopes were identified and their activities determined.
Before the linac decomissiong main objects were:
1. Preparing final decommissioning plan of the facility which is activating with sources of ionizing radiation according national legislation,
2. Supplement radiation protection programme and physical security description.
3. Review assessment of the quality and effectiveness of the measures to ensure the physical security system
Dismantling work was carried out by engineers, which had electronic digital individual dosimeters. Radiation background was measured continously in the working area 0,15 μsv/h. Linac head parts ware measured with dose rate meter. According meter data, activated linac parts was vacuum window of the accelerating waveguide, bending magnet core, x-ray target and the flattening filter. A maximum gamma dose rate of 6.1 μsv/h and 2,58 μsv/h beta dose rate were measured 5 cm distance.
To ensure safety and security activated linac parts were placed in several a steel box, marked with a sign of ionizing radiation and temporary storage in the department specific room with a security alarm, video surveillance system and limited access. Dose rate measurements were performed on storage-assisted radioactive packages.
A Canberra falcon 5000 high purity portable germanium (HPGe) detector was used to detect gamma rays emitted from the activated isotopes. Gamma spectroscopic analysis was undertaken using Genie2k software. Data analysis showed a wide spectrum of radioisotopes. 57Co, 54Mn, 58Co, 60Co, 51Cr, 196Au, 181W , 124Sb radioisotopes activity were higest. Results are shown in Figure 1, Figure 2 and Table 1, Table 2.
Finally the radioactive materials were transported to Ignalina Nuclear Power Plant for radioactive waste management.

Figure 1. Radioisotopes spectrum of bending magnet core

Figure 2. Radioisotopes spectrum of accelerating wave-guide vacuum window, x-ray target and the flattening filter

Table 1. Radioisotopes activity results of bending magnet core
Radioisotope Activity, MBq Uncertainty, MBq

Table 2. Radioisotopes activity results of accelerating wave-guide vacuum window, x-ray target and the flattening filter

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