การทำนายการสำรวจส่วนประกอบกัมมันตภาพรังสีและรังสีโดยรอบห้องไซโคลตรอนทางการแพทย์ในระหว่างการผลิตเภสัชภัณฑ์รังสีเครื่อง PET

Prediction of Activated Component and Radiation Survey Around Medical Cyclotron Vault During PET Radiopharmaceutical Production

ช่วงเวลาดำเนินการ ปี พ.ศ. 2563

ผู้รับผิดชอบ
ดร. วิทิต ผึ่งกัน ตำแหน่ง รักษาการผู้เชี่ยวชาญเฉพาะด้านการประเมินค่ากัมมันตภาพรังสี
Email: vithit.p@oap.go.th
นายธนพล เดชวิริยะกิจ ตำแหน่ง นักฟิสิกส์รังสีปฏิบัติการ
Email: tanapol.d@oap.go.th

รายละเอียดสรุป

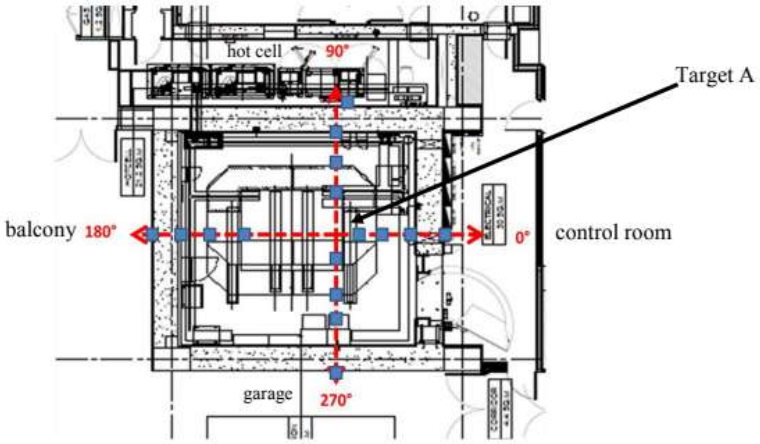
Objectives: A twenty MeV medical cyclotron is used for radiopharmaceutical production. During operation, neutrons were generated. High energy neutrons can penetrate or slow down and activate cyclotron's component to be radionuclide. The cyclotron operators, radiopharmacists and services engineer can be exposed to radiation caused by activated radionuclides. The purposes of this study are to predict radiation and to measure radiation around cyclotron vault for the radiation safety in routine operation.

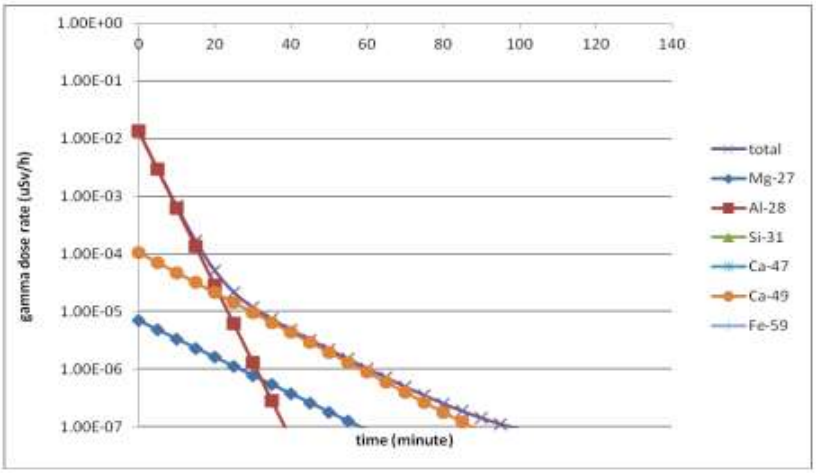
Materials and Methods: The predicted activated component was calculated from neutron flux with activation calculation formula. For inside shielding area, the neutron flux was determined by the gold foil activation method using a HPGe spectrometer for gamma counting. For outside shielding areas, neutrons were measured by CR-39, a solid-state nuclear track detector. Radiation surveillance around cyclotron vault using HDS-101G/GN was done to measure neutron and gamma dose rate.

Results: Prediction of gamma dose rate from activated concrete wall inside cyclotron vault, there are seven radioisotope products including Mg-27, Al-28, Si-31, Ca-45, Ca-47, Ca-49 and Fe-59. In this study, highest gamma dose rate predicted using thermal neutron flux 3.38x102 cm^{-2} s^{-1} /μAh at vault wall was equal to 1.4 x10-2 μSv/h then continue decaying. Radiation surveillance around cyclotron vault highest neutron dose detected was 387 μSv/h/μA on inner vault wall in primary beam direction. For outside cyclotron vault, neutron dose cannot detect compare with that of background. The highest gamma exposure level was found at the electricity room equal to 0.28 μSv/h.

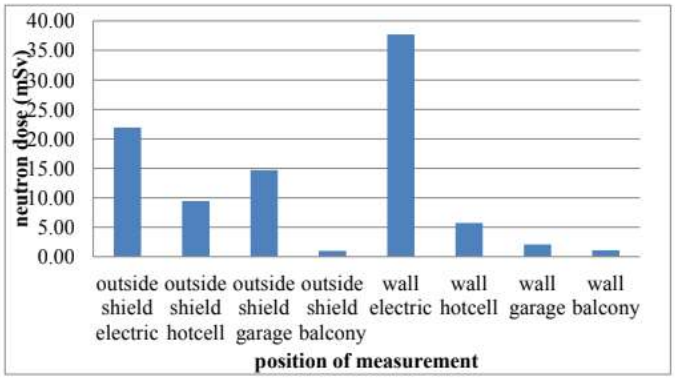
Conclusion and Discussion: Highest gamma dose rate predicted inside cyclotron vault is below

recommended levels of exposure. Due to short live radioisotope, the radiation will be decreased to background level within 90 minutes. Radiation surveillance around cyclotron facility all the values are below recommended levels of exposure. This reflected that the neutron and gamma exposure level around cyclotron vault is safe in routine operation.





Prediction of gamma dose rate using neutron flux measurement at vault wall in primary beam direction (electric room direction) incase of 15 μA and 60 minutes bombarding.



Neutron dose results by CR-39 detector inside cyclotron vault positions.