# Estimation of Radiation Safety of MCNP Calculation for Container Inspection with Neutron Generator

**Gil-Ho Jeon, Dong-Kwyn Shin**

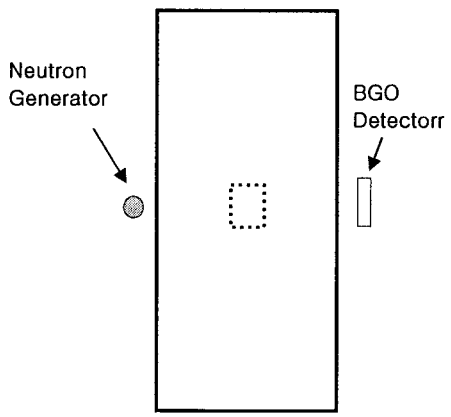
Hanmac Radiation Co.,Ltd. 303 songjunB/D 1182 dunsan1dong seogu Daejon S.Korea

hanmac03@empal.com

In comparison with x-ray radiography, the neutron radiography has so many advantages such as testing the explosive materials or the nuclear materials. However, neutron radiography facility has disadvantage not to be portable. Recently, the function of neutron generator has been up graded to high flux (~$10^{10}$ n/cm$^2$-sec) up to perform the neutron radiography level. The neutron generator produces the fast neutrons by the D-T nuclear reaction, $D + T \rightarrow {}^4He + n\,(14.1\ MeV)$. Currently many companies and the laboratories are interested in developing the portable NRF(neutron radiography facility).

Most of export and import packages are moved by container. We calculated the radiation safety for the equivalent doses when a neutron generator is applied a container which contained the explosive materials.

This report shows the gamma energy spectrum, and equivalent dose calculated by MCNP simulation after fast neutrons pass through the empty container wall. We have assumed a simplified system such as Fig. 1. We chose one model of neutron generator (neutron flux = $1\times10^{10}$ n/cm$^2$-sec) called the "ING-031" developed by VNIIA, Russia. The neutron generator is covered by 1mm thickness of carbon steel. We assumed that the thickness of a container is 3mm of steel as usual.




| Subject | Content |
|---|---|
| Size of container | 242 × 242 × 610 cm |
| Thickness of container | 3 mm |
| Neutron flux | 1 × $10^{10}$ n/cm$^2$-sec |
| NG - container | 30 cm |
| Remark | Neutron generator is covered by 1mm steel |

Fig.1 Simplified system for testing of container and its functions

Calculation result of the surface equivalent dose after container shows 15732 ± 9% mSv/hr and its gamma energy spectrum is shown in Fig. 2.

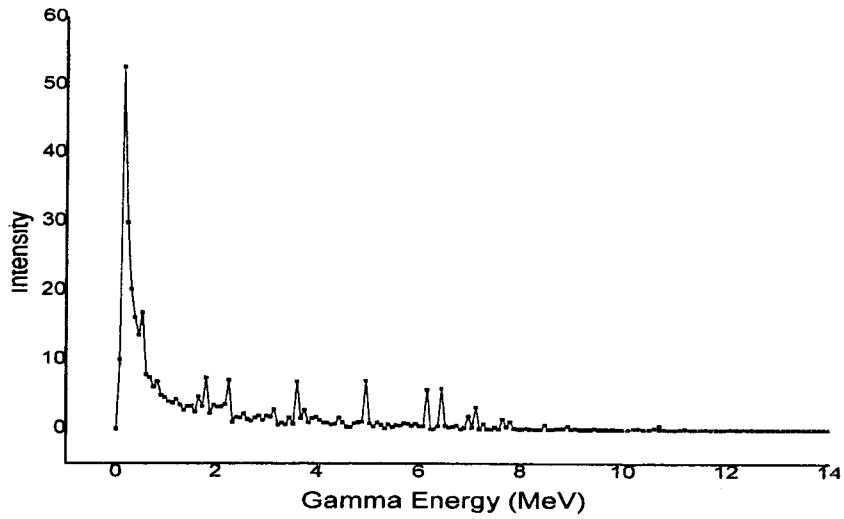



Fig. 2. Gamma Energy Spectrum after container

Most of surface equivalent dose is governed by neutron, as neutron easily passes through 0.3mm thickness steel. The equivalent dose of 15732 ± 9% mSv/hr is too high to compare 25 mSv/hr recommended.

This MCNP calculation data for neutron generator may help to understand the radiation protection for experimental setting of neutron generator in future. We are studying the shielding effect of the radiation protection from searching container by neutron generator.

References

1. MCNPX Version 2.4.0 (2002)
2. Proceeding of the International Scientific and Technical Conference, (2004)