§2. Measurement of Natural Background Radiation in LHD Building

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The natural background radiation was measured by means of high pure germanium semiconductor detector (HPGe detector) for gamma spectrometry in the LHD building. The In-situ measurements have been conducted at 40 points in 2007-2008.

The crystal of HPGe detector has a cylindrical shape, 57mm in diameter and 57mm in length (ORTEC GMX35P4). The detector has a cryostat because the crystal should be cooled in liquid nitrogen temperature when it is operated. The detector was operated with a gamma-ray spectrometry system, EG&G ORTEC Nomad plus. High voltage is applied to the detector in 4200V negative. The HPGe detector can obtain the data of gamma-ray spectrum.

The detector was placed regularly at the point 1 meter above the floor and 1 meter apart from the wall. The counting time was set as one hour. Figure 1 shows an example of gamma-ray spectrum. There are two large peaks at 1461keV and 2614keV. These peaks are the signals from gamma-rays due to K-40 and Tl-208 (Th-series), respectively. The other peaks are come from nucleus of Uranium-series or Thorium-series. Soil and rock and concrete contain naturally these radioactive nucleus of U-series, Th-series and K-40.

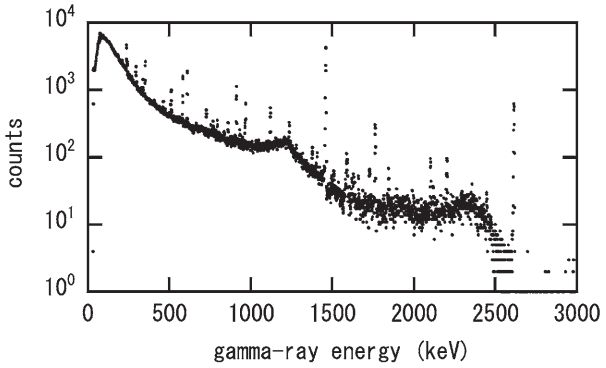

Fig. 1 An example of gamma-ray spectrum from In-situ measurement.

The dose rate was evaluated from the data of gamma-spectrum by a software program for analysis, WInSitu.EXE version 1.3, SEIKO EG&G. The contents of dose rate due to U-series, Th-series and K-40 were obtained by this analysis. However, the dose rate due to cosmic ray is not included because the energy range was upto 4MeV. Figure 2 shows the dose rates in the LHD Lab. The average of dose rate was about 100nGy/h at almost all measurement points. The LHD Lab is framed in by thick concrete walls. The gamma-rays from radioactive nucleus in these thick concrete walls and floor contribute to the high dose rate. The dose rate on A-stage near the LHD has a value of about 40 nGy/h. This is because the gamma-rays from walls and floor have been shielded by the stage and the LHD. The dose rate at east of the LHD Lab ' LHD Lab_E' was lower than other points. This is also because the shield by the LHD.

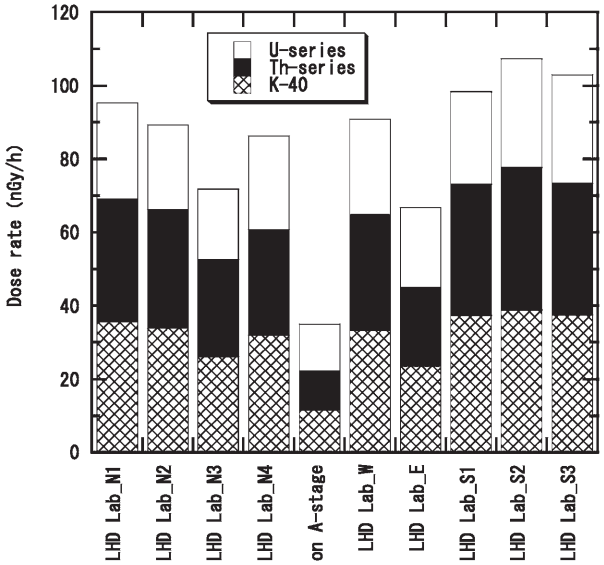

Fig. 2 Dose rate in LHD Lab.

Figure 3 shows the dose rate in the room of Freight Deck and Heating Power Equipment. These dose rates were lower than those at the LHD Lab. This is because these rooms were faced only on the south side to the thick concrete wall. The measurement point of 'Heating P.E._S4' shows lower dose rate than S1-S3 because this is located at the south-east of the room where the point is more distant from thick concrete wall. The points of 'Freight Deck_N and _M' has about 20 nGy/h for dose rate. This may be caused by the shielding with the thick steel plate covering with the floor.

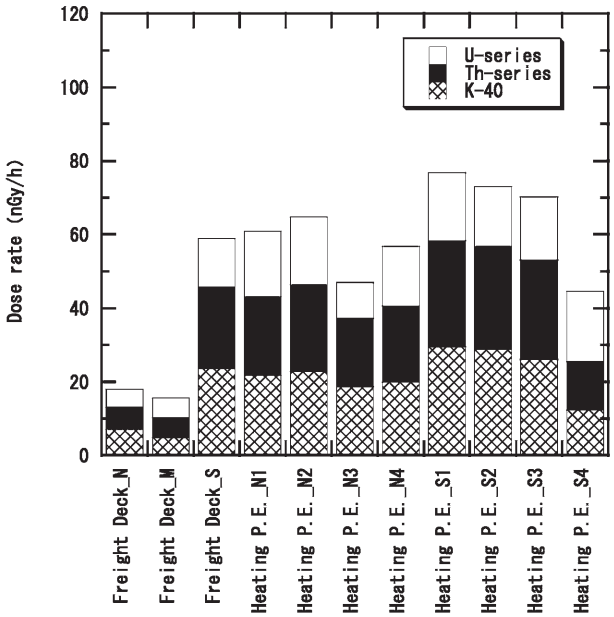

Fig. 3 Dose rate in LHD building.