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#05-157 Radiation Hardness Test of a Silicon Detector under Radiation Dose Rate of Nuclear Power Plant for In-Containment Coolant Leakage Detection System

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An influence evaluation by background radiation on a silicon detector, which will be used to detect a coolant leakage, and be installed in a containment building of a nuclear power plant, was performed and the result was discussed. The detector that consists of a silicon sensor and preamplifier mounted in a shielding structure which composed of a 5 cm lead cylinder will be installed in an annulus zone that is influenced by background radiation (neutron and gamma ray) from an operation of a nuclear reactor. Absorbed dose rates on a silicon sensor and preamplifier were calculated as 4.17 mGy/hr and 2.1 mGy/hr, respectively, by Monte Carlo N-Particle (MCNP) simulation. Data of background radiation had referred to a Final Safety Analysis Report (FSAR) of a nuclear power plant in the Republic of Korea.
A silicon sensor and preamplifier were irradiated by a 60Co gamma radiation source equipped in a facility of Korea Atomic Energy Research Institute Advanced Radiation Technology Institute (KAERI ARTI) of the Republic of Korea. A 210Po alpha source was used as a check source to evaluate a state of a function of the detector during gamma irradiation. Absorbed dose rates were about 22.92 mGy/hr and 6.6 mGy/hr on silicon sensor and preamplifier, respectively. Before and after gamma irradiation, a counts rate from the check source wasnt changed (from 18.4 cps to 18.4±0.2 cps after irradiation), and any degradations of function also werent observed. Even more harsh condition than calculated dose rates referred by the condition of background radiation of in-containment, the silicon detector maintained the ability of function of charged particles detection. Based on the result, it has been demonstrated that a silicon detector is a suitable detector for detecting charged particles from a leaked coolant even during interfered by the background radiation of a primary system of a nuclear power plant.

Keywords: Silicon detector, Irradiation test, Coolant leakage detection system

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