Small Commercial Dosimeters for Cosmic Ray Measurements Onboard Aircraft

T.Nakamura[1], M.Takada[2], T.Nunomiya[3], Y.Uchihori[2], L.G.I.Bennett[4], A.R.Green[4] and B.J.Lewis[4]

[1] *Tohoku University, Sendai, Japan*

[2] *National Institute of Radiological Sciences, Chiba 263-8555, Japan*

[3] *Fuji Electric System Co. Ltd., Tokyo Japan*

[4] *Royal Military College of Canada, Kingston, Canada*

Cosmic radiation at altitude has been measured by using the large instruments, the HAWK based on a 5 inch TEPC and an ion chamber plus a SWENDI, an extended rem counter, by RMC. It is hard to measure the cosmic radiation onboard aircraft. Small detectors with a long battery life have an advantage in that they are easier to carry onboard aircraft.

To verify the possibility of using small dosimeters to measure cosmic radiation, two small commercial dosimeters, NRF20 and DIS100, were used on the outbound flight from Toronto to Singapore via Vancouver and Seoul. The NRF20 and the DIS100 are based on the Si detector and the direct ion storage technology, respectively. Both dosimeters are as small and light as a mobile phone. The NRF20 and the DIS100 work for 2 months and for 2 weeks with a battery, respectively, and can record the dose rate every 10 minutes. The aircraft travelled three different cut-off rigidity areas. Because the dose rate and particle fraction at high altitudes varied greatly with the cut-off rigidity, on these three different cut-off rigidity flights, the possibility of using these small dosimeters for cosmic radiation measurement has been determined.

These detectors were compared to other detectors, LIULIN, FH41B and an ion chamber, and three predictive codes, PCAIRE, EPCARD and CARI. From the LIULIN and the FH41B measurement, the dose equivalent was obtained by using the ICRP60 Q(L) relationship and the cut-off rigidity correlation, respectively. Both techniques were developed by the Royal Military College. The PCAIRE, EPCARD and CARI are based on a semi-empirical model, the FLUKA Monte Carlo calculation and a theoretical model, LUIN, respectively.

No correction factors were used for the dosimeters' results. For the non-neutron radiation measurement, the two dosimeters agreed with the ion chamber and the EPCARD calculation. From Toronto to Vancouver, Vancouver to Seoul and Seoul to Singapore, the NRF20 indicated the dose equivalents, 7, 16 and 5 μSv, respectively. The small dosimeters gave comparable non-neutron dose equivalent for the flights. To obtain the total dose equivalent, the bubble dosimeter values were added to the two dosimeters' value because the bubble detector is the only neutron detector on these flights. From Toronto to Vancouver, Vancouver to Seoul and Seoul to Singapore, the NRF20 plus the bubble detector indicated the total dose equivalents, 17, 36 and 8 μSv, respectively.

The total dose equivalents agree with the other measurements and the calculations.

The dosimeters are useful due to their compact size and long battery life. Potentially, they will give correct results for any routes and it is possible that they could measure non-neutron radiation in space.