A Re-Calibration of the DUPIC Safeguards Neutron Counter (DSNC)

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1. Introduction

The Dupic Safeguards Neutron Counter (DSNC) was developed by KAERI & LANL from 1993 to 1999. The DSNC was used for a nuclear material accounting in DUPIC from 2000 to 2003. The main uses are accounting for DUPIC fuel pellets/rods for a HANARO irradiation, de-cladding radiation measurement and uniformity control measurement for a spent fuel powder. But the DSNC showed an abnormal status after high burn-up measurement in 2004 and this abnormal status was continued until 2006. LANL's professional visited in April, 2004 to solve this problem. In November, 2005, IAEA cabinet was opened to adjust the DC power supply as another effort. A DC power supply to the PDTs was increased to 6V as in Fig. 1. The neutron counting efficient of the DSNC was 13.5% using the Cf-252 source K868. But the efficient of the DSNC was decreased because of the abnormal PDTs. In Feb., 28, 2007, the verification test of the 3's groups signal was carried out by using spent fuel standards (SFS). The results show that the DSNC is not normal. The DSNC can be confirmed as a normal state from the LED panel. But the current LED states of the DSNC do not have confidence due to a unstable blink.

2. Result and discussion

1) The detection efficiency

The neutron intensity of ^{252}Cf (K868) is weaked through a decay curve. In 20/03/08, the neutron intensity of ^{252}Cf (K868) was 734 n/c (0.314161782E-09g).

A count time of 30s and a 5 cycles measurement on 20/03/08 resulted in;

$$\text{Singles} = 195 \text{ c/s}$$

$$\text{Background} = 116 \text{ c/s}$$

Therefore, the efficiency was

$$\varepsilon = (195-116) / 734 = 10.76 \%$$

2) High voltage plateau

To select the operating HV, 3 SFS were placed in the DSNC and the bias was varied from 1600 to 1940V. The used SFS were B7 (40,600 MWD/MTU), B8 (40,500 MWD/MTU), B9 (40,400 MWD/MTU). The results are given in Fig. 1. At about 1930V, the gamma-ray pileup becomes significant and Doubles start to decrease and the Singles increase. Fig. 1 and the original HV plateau curve are almost same. As a result, HV set value was changed from 1840V to 1810V.

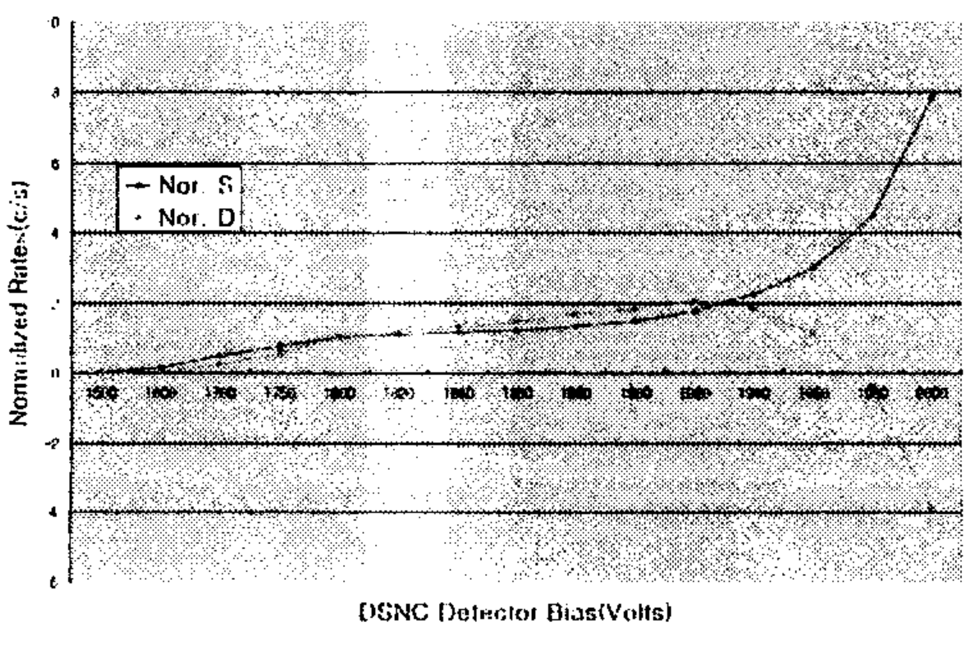

Fig. 1 High Voltage Plateau using SFS

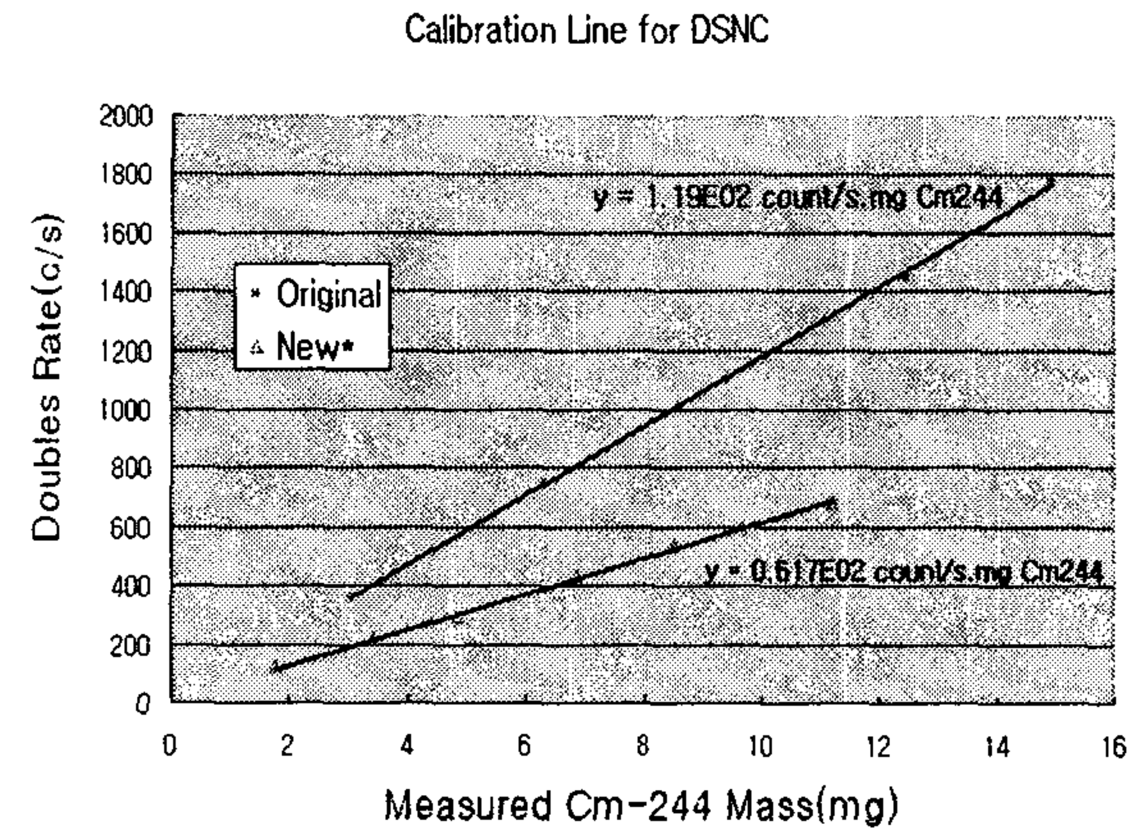

Fig. 2 Calibration line for the DSNC

3) Calibration Line

The Singles is given by the equation.

$T = \varepsilon\ m\ y\ M\ (1+\alpha)$

We calculated as follows.

$T = (0.1076)\ m\ (1.08\times10^7)\ (1.012)\ (1.04)$

$= m\ (1.222\times10^6)$

The Doubles calibration was established by fitting the Doubles vs m data as shown in Fig. 2. The slope of the original curve was $k=1.19\times10^2$ count/s.mg.cm but it was changed to $k=0.617\times10^2$ count/s.mg.cm.

3. Conclusion

The current status and performance test of the DSNC was analyzed. The result of the analysis is that several PDT are abnormal. Therefore, the ^{244}Cm calibration of the DSNC was changed as shown in Fig. 2. But the calibration was linear over the mass range of interest and the high voltage plateau using three SFS was stable. We have a usage plan for the DSNC. The practical uses are a de-cladding radiation measurement and a uniformity control measurement for spent fuel powder.

Acknowledgement

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