2009년도 춘계 학술발표회 논문집
대한방사선방어학회

Calculation of Element Calibration Factor for Extremity Dosimeters

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Key words : Extremity Dosimeters, Element Calibration Factor, Harshaw EXTRAD, Panasonic UD-807

Introduction

Korean nuclear power plants (NPPs) have provided continuously several measures to reduce the occupational radiation exposure to optimum levels. In particular, since the concern about radiation protection has been increased by NPP workers, the development of technology to measure and to estimate the extremity dose of radiation workers has been demanded. In terms of extremity dosimetry, Korea Electric Power Research Institute (KEPRI) has performed the research project, development on the technology at radiation extremity dose measurement and assessment for atomic radiation workers at NPPs, to provide the technical backgrounds and criteria for extremity dosimetry[1].

In this paper, the process for calculation of element calibration factors or coefficients (ECF or ECC) for thermoluminescent dosimeters (TLD) especially extremity dosimeters was investigated. Two types of extremity dosimeters, Harshaw EXTRAD dosimeters and Panasonic UD-807 dosimeters, which were purchased to do the experiment of radiation exposure, were used to calculate ECF.

Method and Process

ECF(or ECC) is defined as a response ratio of an element of each TLD to average of response values of each element of reference TLD[2,3].

$$ECF \ or \ ECC(i,j) = \frac{e(i,j)}{EM(i)}$$

Here, $e(i,j)$ is a response value of element 'i' of TLD(j) for radiation exposure and $EM(i,j)$ is an average response value of element 'i' of reference TLD for radiation exposure. The process for determination of ECF used at Korean NPPs is demonstrated in Figure 1 [2-4].

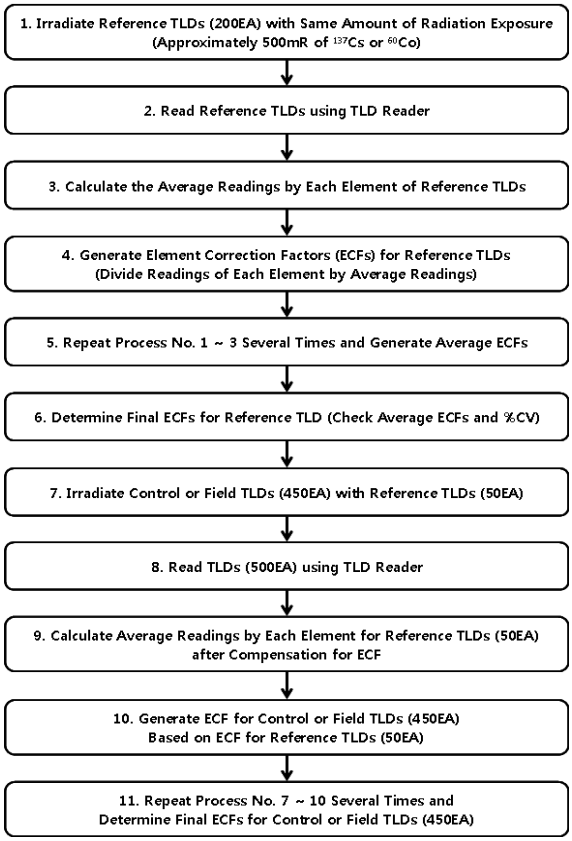

Fig. 1 Process for Determination of ECF

ECF Results

To obtain ECF, 400EA of Harshaw EXTRAD dosimeters and 500EA of Panasonic UD-807 dosimeters were analyzed. EXTRAD and UD-807 dosimeter use lithium fluoride and lithium borate as thermoluminescent materials, respectively. The reading of radiation exposure was performed using Harshaw TLD Reader Model 8800 Plus and Panasonic UD-716 TLD Reader[5,6]. The ECF distribution are shown in Figures 3 and 4 for EXTRAD and UD-807 dosimeters, respectively.

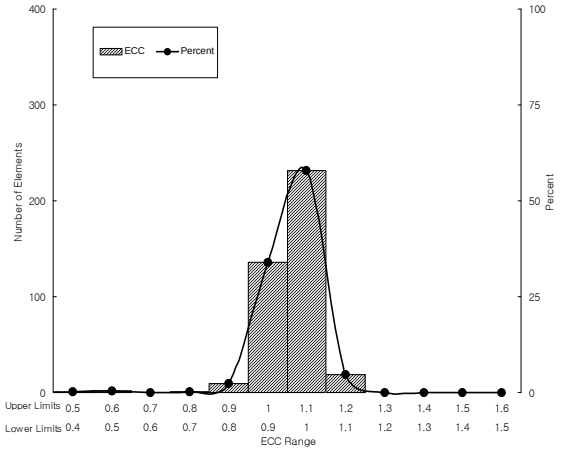

Fig. 2 ECC Distribution for EXTRAD Dosimeters

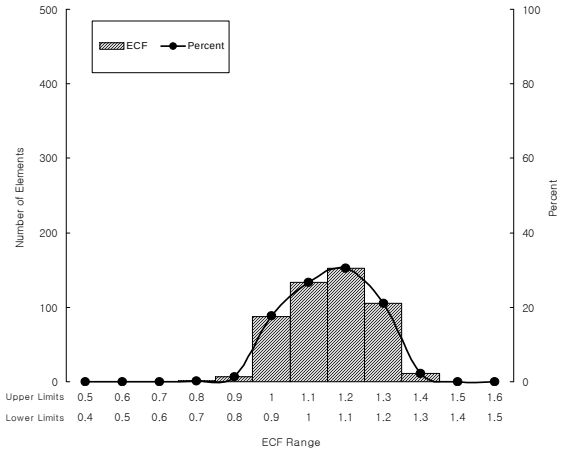

Fig. 3 ECF Distribution for UD-807 Dosimeters

Conclusion

This paper describes ECF results for TLD. In particular, the process of Harshaw EXTRAD and Panasonic UD-807 extremity dosimeters were briefly explained and its ECF results were analyzed. As a result, the response ratios for Harshaw EXTRAD dosimeters were almost within the range of 10% and it is regarded that it is possible to use Harshaw EXTRAD dosimeters for measurement of extremity dose without the compensation of ECF. In case of Panasonic UD-807 dosimeters, ECFs are distributed from 0.8 to 1.4 and it is regarded that it is necessary for the compensation of ECF to each extremity dosimeters. However, it can be possible to use only UD-807 dosimeters which have ECF range within 10% if users are difficult to apply ECF to their extremity dosimetery service. These results will be used to measure and to estimate extremity dose exactly for radiation exposure experiments and field tests.

Acknowledgement

This research is carried out with financial support from the Korea Hydro & Nuclear Power Corporation.

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