The Uncertainty estimation of Alanine/ESR dosimetry

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1. Introduction

Machinery, tools and cable etc are in the nuclear power plant which environment is very severe. By measuring actual dose, it needs for extending life expectancy of the machinery and tools and the cable. Therefore, we estimated on dose (gamma ray) of Wolsong nuclear power division 1 by dose estimation technology for three years. The dose estimation technology was secured by ESR(Electron Spin Resonance) dose estimation using regression analysis. We estimate uncertainty for secure a reliability of results. The uncertainty estimation will be able to judge the reliability of measurement results. The estimation of uncertainty refered the international unified guide in order; GUM(Guide to the Expression of Uncertainty in Measurement)[1]. It was published by International Standardization for Organization (ISO) in 1993.
In this study the uncertainty of e-scan and EMX those are ESR equipments were evaluated and compared. Base on these results, it will improve the reliability of measurement.

2. Methods and Results

The measurement uncertainty was observed by evaluation method and expression method from GUM(Guide to the Expression of Uncertainty in Measurement).

2.1 Uncertainty evaluation

Constructing a mathematics model of the factors those affect in measurement result and then standard uncertainty was obtained by calculating Type A and Type B uncertainty. Those were calculated separately. Based on this idea, expanded uncertainty was obtained using combined uncertainty, effective degree of freedom and coverage factor (k) [2-3]. The uncertainty method is described in Figure 1.

1) Type A uncertainty

The uncertainty factors of Type A consist of response variation, mass variation, repeatability, calibration curve error and standard uncertainty of standard alanine.

2) Typer B uncertainty

The uncertainty factors of Type B consist of contamination, marker, correction, system drift, temperature coefficient, dose rate and energy dependence.

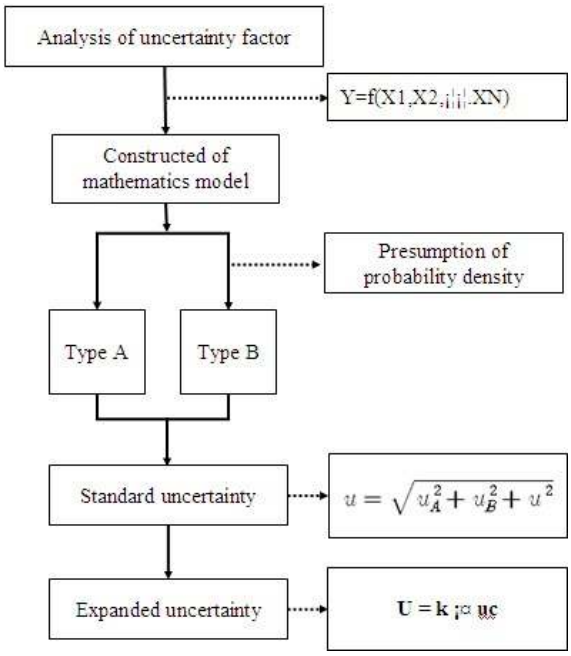

Figure 1. Uncertainty method

2.2 e-scan and EMX uncertainty

The alanine specimen which is used in uncertainty calculation was used as standard specimen. It was exposed each dose point by γ -ray in NPL(National Physical Laboratory). Also, in the case of e-scan, the range of uncertainty calculation was obtained each insert (PU-I, PU-II, PL) on High, Mid and Low separately. The dose ranges that are applicable for each e-scan dosimeter insert: PU-20Gy~500Gy, PL-250Gy~10kGy, PH-2KGy~80kGy.
In the case of EMX, the range was separated two section; PE-1(50~500Gy) and PE-2(500~3kGy), and then it was obtained separately High, Mid and Low like e-scan method.

2.3 Results

1) e-scan alanine analyzer

For the e-scan, the expanded uncertainty with approximate 95% level of confidence was about 2~6%. At insert PU-1, only uncertainty which under Low range was significantly large, this is because, the result was out of range of the dose measurement for equipment itself. Hence, this method is not suitable in the dose

estimation of under 10Gy. Table 1 indicated that the expanded uncertainty at each insert for e-scan.

Table 1. The expanded uncertainty (%) was obtained at LOW, MID and HIGH of each insert for e-scan.

	LOW(%)	MID(%)	HIGH(%)
PU- I (1~20Gy)	-	5.97	3.90
PU- II (20~250Gy)	3.10	2.63	2.95
PL(250~3kGy)	5.15	2.47	1.76

2) EMX

For the EMX, the expanded uncertainty with approximate 95% level of confidence was about 3~7%. This results had a tendency which is larger than case of e-scan. This is because, in the case of e-scan, the alanine specimens were fixed same position and then measured. However, in the case of EMX, the results were changed on the position of specimens which is the depth or insertion angle could be changed by skill of researcher. Table 2 shows that the expanded uncertainty was calculated on each range of EMX.

Table 2. The expanded uncertainty (%) was calculated by each dose range (LOW and MID) of EMX

	LOW (%)	MID (%)	HIGH (%)
PE-1(50~500Gy)	6.00	3.50	5.95
PE-2(500~3kGy)	6.64	5.15	6.80

3. Conclusion

The estimation of uncertainty could secure the reliability of the dose estimation result using regression analysis which is using ESR(Electron Spin Resonance). Hence for obtain the reliability result it needs more efforts for minimize the measurement uncertainty such as a standardized test method, skill up of researcher, secure of standard material, correction of equipment and environment administrate

REFERENCES

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