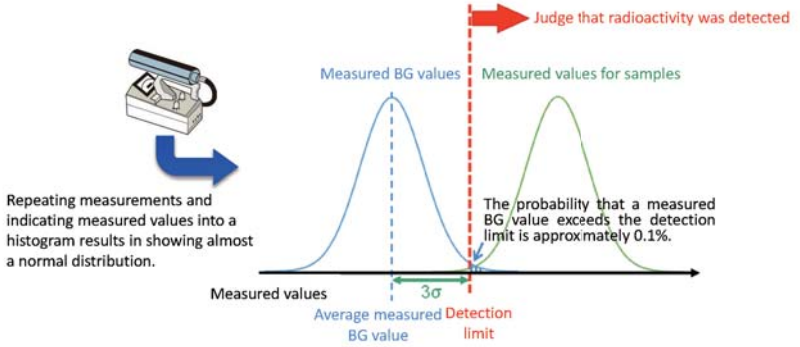
Dose Measurement and Calculation

Ideas on Detection Limits (3σ Method)

- Even a minor change in measurement conditions can influence measurement results and there is also background (BG) radioactivity derived not from samples themselves. Therefore, due consideration is required when setting a detection limit in order to assure statistical reliability.
- One of the representative ideas on detection limits is the 3σ method. Under the 3σ method, a detection limit is defined as a value obtained by adding three times sigma of the measured background values to their average. When a measurement result exceeds this value, it is judged that signals (radioactivity, a dose rate, etc.) from a sample are detected.



When measuring background radioactivity or dose rates using a survey meter or other equipment, even a minor change in measurement conditions can influence measurement results. Therefore, it is necessary to repeat measurements in order to obtain reliable measurement results.

Indicating values obtained through repeated measurements into a histogram results in showing a normal distribution. The minimum amount of radioactivity that can be detected as a statistically significant value under the condition of fluctuating background dose rates is referred to as a detection limit (or lower limit).

Under the 3σ method, one of the representative ideas on detection limits, a detection limit is defined as a value obtained by adding three times sigma to the average of the measured background values. This is because when the measured value is larger than 3σ, the probability of BG measurements that exceed the detection limit by fluctuation is approximately 0.1%.

In addition to the 3σ method, there is the Currie method. Under this method, a lower detection limit is set in consideration of the fluctuation of sample measurements so as to reduce the probability of a “false negative,” where measurements close to but above the detection limit are judged as Not Detected (ND).

Reference:

- “Practical handbook for γ-ray measurement,” authored by Gordon Gilmore and John D. Hemingway, translated into Japanese by Yonezawa Nakashiro, et al., NIKKAN KOGYO SHIMBUN, LTD. (2002)
- “Ideas on detection limits and minimum limits of determination,” by Uemoto Michihisa, Bunseki 2010 5, 216-221 (2010)

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