

Consideration of Radiation Dose Terms of the Korea Nuclear Safety Act for Evaluation of Dose Limit of Radiation Workers

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1. Introduction

“Peepok-bangsaseolyang” is a term defined as the sum of the radiation doses exposed externally and internally according to Subparagraph 19 of Article 2 of the Korea Nuclear Safety Act (KNSA). Table 1 of Enforcement Decree of the KNSA provides effective dose limit and equivalent dose limit for radiation workers. Dose limit is the upper limit of Peepok-bangsaseolyang according to Subparagraph 5 of Article 2 of Enforcement Decree of the KNSA. Notice of Korea Nuclear Safety and Security (KNSSC) No.2012-29 defines effective dose and equivalent dose. To utilize these requirements for dose limit of radiation workers, a simple diagram of all kind of radiation doses described in the KNSA, called “dose pedigree of Peepok-bangsaseolyang” has been developed. This dose pedigree of Peepok-bangsaseolyang is described herein, and, in order to be available more effectively in our regulatory system, some suggestions are presented.

2. Methods and Results

In this section all kind of doses used to calculate the effective dose and equivalent dose are described. These doses include an absorbed dose, committed equivalent dose, committed effective dose and total effective dose.

2.1 External dose, Internal Dose and Absorbed Dose

In accordance with the Article 2 of Notice of the KNSSC No.2012-29, external dose means the dose (i.e., absorbed dose or equivalent dose) received from radiation sources outside the human body. Internal dose means the dose (i.e., absorbed dose or equivalent dose) received from radioactive material entered into the human body. Absorbed dose means the absorbed radiation energy per unit mass of material. Its unit is the Gray (Gy) and 1Gy is 1 joule/kilogram (J/kg).

2.2 Equivalent dose

The equivalent dose, as defined in the Article 2 of Notice of the KNSSC No.2012-29, means the product of average absorbed dose ($D_{T,R}$) in Gray in tissue or organ (T) and a radiation weighting factor (W_R). Equivalent dose is expressed in units of Sievert (or Sv).

For internal dose, the committed equivalent dose ($H_{T,50}$), as defined in Subparagraph 8 of Article 2 of Notice of the KNSSC No.2012-29, is the equivalent dose calculated to be received by the tissue or organ over a 50-year period after the intake of a radionuclide into the body. It is expressed in units of Sievert (or Sv).

For evaluation of external dose, the external dose to the whole body, i.e., whole body equivalent dose assessed at a depth of 1 cm in tissue (i.e., Deep dose) is used. The equivalent dose to the lens of eye is assessed at a depth of 0.3 cm in tissue, and the equivalent to the skin and extremity is assessed at a depth of 0.007 cm in tissue (i.e., Shallow dose).

2.3 Effective dose and Committed Effective Dose

In accordance with Subparagraph 8 of the Article 2 of Notice of the KNSSC No.2012-29, the effective dose (H_E) means the summation of the products of the equivalent dose received by specified tissues or organs of the body (H_T) and the appropriate tissue weighting factor (w_T), that is, $H_E = \sum w_T H_T$. It includes the dose from radiation sources internal and/or external to the body. For purpose of convenience of dose calculation, equivalent dose to the whole body may be used as effective dose for external exposures. The effective dose is expressed in units of Sievert (or Sv). The committed effective dose ($H_{E,50}$) means the sum of the committed equivalent doses to various tissues or organs in the body ($H_{T,50}$), each multiplied by the appropriate tissue weighting factor (w_T), that is, $H_{E,50} = \sum w_T H_{T,50} + w_{\text{Remainder}} H_{\text{Remainder},50}$. Where $w_{\text{Remainder}}$ is the tissue weighting factor assigned to the remainder organs and tissues and $H_{\text{Remainder},50}$ is the committed equivalent dose to the remainder organs and tissues.

2.4 Peepok-bangsaseolyang

Peepok-bangsaseolyang of Subparagraph 19 of Article 2 of the KNSA is a unique quantity defined as having a meaning of total dose (i.e., sum of external dose and internal dose) for purposes of compliance with the KNSA. Fig. 1 shows a diagram of all kind of doses, i.e., “dose pedigree of Peepok-bangsaseolyang”. Peepok-bangsaseolyang by the definition can be divided by equivalent dose components and committed equivalent dose components. In Fig. 1, H_p (1 cm), H_p (0.3 cm) and

Hp (0.007 cm) values are the personal dose equivalents measured from individual dosimeters (i.e., TLDs) as discussed in Section 2.2, respectively. It is noted that the Hp (1 cm) is taken as an assessment of effective dose under the assumption of a uniform whole body exposure. To demonstrate compliance with dose limits of the Korea Nuclear Safety Act, Hp (1 cm) value and $H_{E,50}$ are combined and compared with effective dose limit of Table 1 of Enforcement Decree of the KNSA. Hp (0.3 cm) and Hp (0.007 cm) values are those that can be compared with Dose Equivalent Limit for Lens of Eye and Dose Equivalent Limit for Skin of Table 1 of Enforcement Decree of the Korea Nuclear Safety Act, respectively.

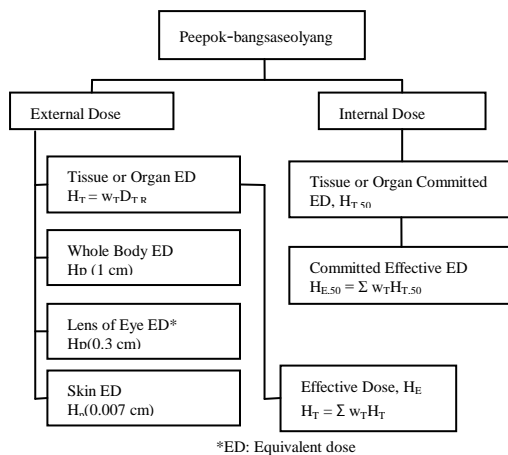


Fig. 1. Dose Pedigree of Peepok-Bangsaseolyang for dose limit evaluation of radiation workers

2.5 Dose limit requirements of Peepok-bangsaseolyang

All of dose limit requirements for Peepok-bangsaseolyang described in KNSA and its subsidiary regulations are illustrated in Table 1. In Table 1, Subparagraph 2 of Article 55(1) of the KNSA describes Peepok-bangsaseolyang caused by radioisotope, material contaminated by such radioisotope or a radiation generating device shall not the dose limit prescribed by the Enforcement Decree of the KNSA. Subparagraph 37 of Article 2 of the enforcement Decree of the KNSA defines the “Annual Limits of Intakes” as the intake to be determined by the Korea Nuclear Safety and Security (KNSSC) of a given radionuclide in a year by the radiation worker which would result in a Peepok-bangsaseolyang equal to the relevant dose limit. Article 86 (1) of Enforcement Regulation of the KNSA defines limitations of disposal of radioactive wastes. It means the radioactive wastes of which annual Peepok-bangsaseolyang to individual is not less than 10 microsieverts to total Peepok-bangsaseolyang to a group is not less than 1 man-sievert. Subparagraph of Article 52 (1) of the Regulation on Technical Standards for Nuclear Reactor Facilities describes the Peepok-bangsaseolyang of radiation workers, frequent enterers,

and temporary enterers to a radiation control area shall not exceed the dose limit.

Table 1. Dose limit Requirements by Peepok-bangsaseolyang in KNSA

Regulations	Articles
KNSA	§2 19, §55(1) 2, §91(1) 4, §91(2)
Enforcement Decree of the KNSA	§2 4, 7, and 13, §41 2, §68 2, §131(2), §133(1)
Enforcement Regulation of the KNSA	§2(1) 5 and 11, §4(4) 7, §53(4) 4, §67(1) 4 and 6, §92(7) 10, §99, §124(1), (2) and (4), §125 2, §126 4 and 6, §131(2) 1, §132(2) 2, §133 1 and 2, §143(1) and (2), Attachment 4 3.i
Regulation on Technical Standards for Nuclear Reactor Facilities, Etc.	§5(2), §25(3), §52(1) 1, §100(1)
Regulation on Technical Standards for Radiation Safety Control, Etc.	§7 4.a and 4.c, §7 6, §9(1) 11, §12 3.a and 3.c, §12 5, §3-2 1, §33 2 and 3, §35(1) 9, §38 3, §40 3, §44, §48, §51 1 and 3, §79(1) 5, §80(1) 3

3. Conclusions

Peepok-bangsaseolyang is a unique quantity defined as having a meaning of total doses (i.e., sum of external dose and internal dose) in accordance with Subparagraph 19 of Article 2 of the KNSA. It is a simple radiation dose term employed only for purposes of compliance with the KNSA. It means neither equivalent dose nor effective dose. Therefore, it is suggested that there needs to be careful evaluation of radiation dose terms, i.e., dose pedigree of Peepok-bangsaseolyang when dose limit of radiation workers described in KNSA and subsidiary regulations is evaluated.

REFERENCES

- [1] Korea Nuclear Safety Act, 2011.
- [2] Enforcement Decree of the Korea Nuclear Safety Act, 2011.
- [3] Enforcement Regulation of the Korea Nuclear Safety Act, 2011
- [4] Regulation on Technical Standards for Nuclear Reactor Facilities, Etc., 2008.
- [5] Regulation on Technical Standards for Radiation Safety Control, Etc., 2008.
- [6] Notice of the Korea Nuclear Safety and Security (KNSSC) No. 2012-29, 2012
- [7] ICRP, The 2007 recommendations of the ICRP , Publication 103, Pergamon Press, Oxford and New York, 2007.