

Current Status Analysis of Radiological Criteria for Decision-Making on Urgent Public Protective Actions in Nuclear Emergencies

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1. Introduction

At the preparedness stage of nuclear accidents, justified and optimized national protection strategy should be developed not only to avoid severe deterministic effects but also to reduce the risk of stochastic effects. For the purpose of radiation protection, radiological criteria should be pre-determined by national authorities. International Atomic Energy Agency (IAEA) published safety standards reports on the safety requirements and safety guides dealing with the criteria for decision-making of public protective actions [1,2]. Some countries have directly used these criteria as IAEA suggested, however, some other countries have adopted the revised criteria through their own reviews. In Korea, the research project for updating the radiological criteria for the decision-making of public protective actions was initiated in 2022. As part of the project, the radiological criteria adopted in foreign countries were investigated, and the distribution of the criteria was analyzed in the present work.

2. Methods and Results

IAEA has provided the radiological criteria for the decision-making of public protective actions. In this work, the criteria not only suggested by IAEA but also applied in 24 different countries were investigated for statistical analysis. As urgent public protective actions, sheltering-in-place (shortly sheltering), evacuation and iodine thyroid blocking (ITB) were mainly considered. The concepts of radiation dose applied (projected dose or avertable dose) were also reviewed for each protective action. The effective dose, one of the protection quantities, was commonly used for this purpose. But in case of ITB, thyroid dose should be used for the decision-making. Appropriate protection quantities were also reviewed for ITB.

2.1 Radiological Criteria Provided by IAEA

Table 1 shows the radiological criteria for public protective actions provided by IAEA. IAEA GS-R-2 [3] suggested the radiological criteria (termed *Generic Intervention Levels*) depending on the protective actions, which have been applied in Korea so far. The lower criterion was applied for sheltering even though the period considered as the exposure duration is shorter.

However, the recent radiological criteria (termed *Generic Criteria*) show one single value for sheltering or evacuation, which is quite high compared with the previous criteria.

The criterion for ITB decreased in the recent IAEA reports [1,2]. The committed equivalent dose to the thyroid was applied in the recent version whereas the committed absorbed dose to the thyroid was applied in the past version.

Table 1: Radiological Criteria for Public Protective Actions

Protective Actions	IAEA GS-R-2 (2002)	IAEA GSR-7 (2015) & GSG-2 (2011)
Sheltering	10 mSv in 2 days	100 mSv in the first 7 days
Evacuation	50 mSv in 7 days	
ITB (Iodine Thyroid Blocking)	100 mGy	50 mSv in the first 7 days

2.2 Criteria for Sheltering and Evacuation

The radiological criteria for sheltering and evacuation were investigated for 24 countries [4,5,6]. Figures 1 and 2 show the distribution of effective doses adopted for sheltering and evacuation. More than half of the countries have adopted an effective dose of 10 mSv for the decision-making of sheltering. 12.5% (3 countries) have applied operational intervention levels (OIL) instead of dose criteria, and the remaining 20.8% (etc.) include applying the dose range or different single values depending on the age. Among 24 countries, 7 countries (29.2%) have applied exposure duration of 2 days and 6 countries (25%) have applied 7 days. For the decision-making of evacuation, most countries have adopted higher radiological criteria than those for sheltering. Among 24 countries, an effective dose of 50 and 100 mSv accounts for 29.7% (7 countries each), respectively. The remaining 16.7% (etc.) have applied the dose range. 58.3% (14 countries) of 24 countries have applied exposure duration of 7 days. The projected dose accounts for 37.5% (9 countries), and the avertable dose accounts for 29.2% (7 countries) as the concept of dose adopted in radiological criteria.

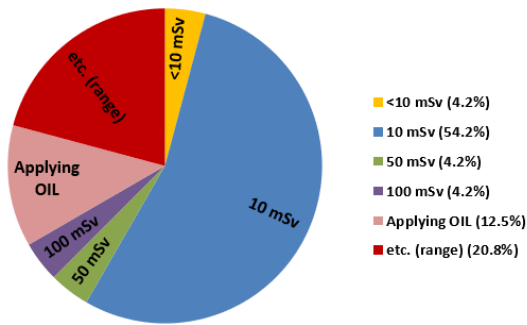


Fig. 1. Distribution of effective doses adopted for sheltering in 24 countries.

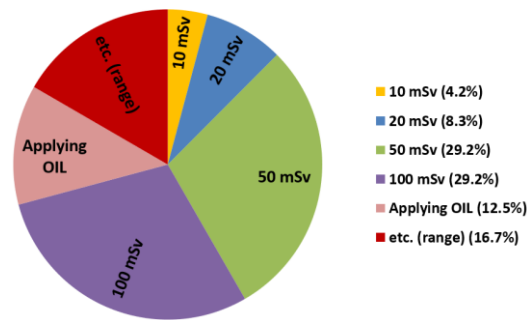


Fig. 2. Distribution of effective doses adopted for evacuation in 24 countries.

2.3 Criteria for Iodine Thyroid Blocking

Among 24 countries, 12 countries (50%) have applied radiological criteria for ITB regardless of age. On the other hand, 7 countries (29.2%) have applied different criteria for ITB depending on the age (for children under 18 and adults). The radiological criteria applied for ITB in 12 countries were shown in Fig. 3. Thyroid dose of 50 mSv accounts for 41.7%, while 100 mSv accounts for 33.3% for the decision-making of ITB. The remaining 16.7% represent applying the dose range. Figure 4 shows the thyroid dose quantities applied for ITB in 24 countries. 58.3% (14 countries) have applied the committed equivalent dose to the thyroid, and 20.8% have applied the committed absorbed dose to the thyroid. The remaining 20.8% include applying OIL or not providing data on dose quantities. It was noted that only 5 countries have applied exposure duration of 7 days whereas most countries did not provide data on exposure duration. As the thyroid dose for ITB, the projected dose accounts for 33.3% (8 countries), and the avertable dose accounts for 29.2% (7 countries).

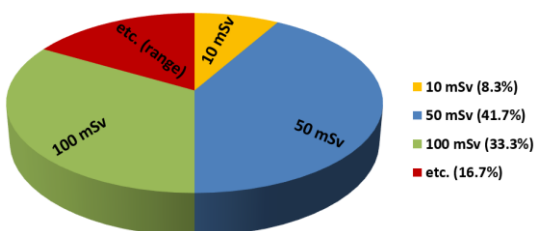


Fig. 3. Distribution of thyroid doses adopted for ITB in 12 countries.

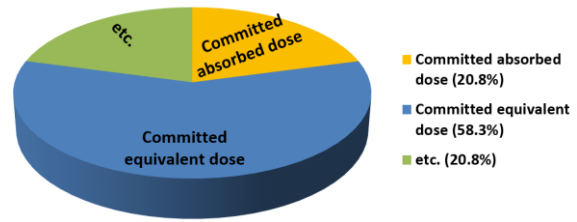


Fig. 4. Distribution of thyroid dose quantities for ITB in 24 countries.

3. Conclusions

In the present work, the radiological criteria adopted in the 24 foreign countries were analyzed. In particular, the radiological criteria on sheltering, evaluation, and ITB were investigated as urgent public protective actions. Many countries have applied the projected dose as the concept of dose for the decision-making in nuclear emergencies. And it was confirmed that the committed equivalent dose to the thyroid for ITB has been applied in many countries rather than the committed absorbed dose. The radiological criteria applied in foreign countries as well as the recent IAEA safety standards reports will be utilized for improvement of the radiological criteria for the decision-making of public protective actions in Korea.

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