Improvement of Evaluation Model for Emergency Response Exercise to the Nuclear Accident in Neighboring Countries

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1. Introduction

In addition to improving the emergency response plan for domestic nuclear facilities, it is necessary to continuously strengthen the system for responding nuclear accident in neighboring countries such as China, Japan and Taiwan. In the previous study [1], we developed exercise scenarios, evaluation methodology and model to enhance the periodic emergency response exercise system. In particular, the evaluation factors of the 2016 Emergency Response Exercise for the Safe Korea [2] were applied to the evaluation model.

In this study, we improved the evaluation model developed in the previous study in consideration of characteristics of exercise for emergency response to the nuclear accident in neighboring countries. Through reviewing the 2018 Emergency Response Exercise for the Safe Korea [3], evaluation areas and factors were revised for more systematic evaluation. We additionally created sub-factors for the evaluation factor that can check whether each item is satisfied or not. In addition, we established criteria for determining the qualitative evaluation results by counting the number of affirmative items.

2. Evaluation Model for Exercise

Exercise evaluation is an activity that documents strengths and any required improvements of the exercise organization. It is focused on the establishment of initial response capability. And, it is implemented by criteria such as establishment of manual and response plan, participation of experts, inclusion of detailed scenario, and etc. An evaluator and/or the evaluation committee should observe and record progress of the exercise, and the analysis results should be reflected in the improvement plan. More detailed description for the evaluation model established in this study is as follows.

2.1 Evaluation Category and Area

We developed the evaluation model for exercise composed of hierarchical structure exemplified in Fig. 1. The structure of model consists of evaluation category, area, factor and sub-factor. As the lowest level, sub-factors provide review contents in detail. The model suggested in this study has four (4) categories (i.e. planning, design, implementation, feedback), which are subdivided into evaluation areas and factors.

The evaluation category of the revised model is the same as that of the previous study [1]. However, components in the model is modified for considering efficiency and immediacy of evaluation and the characteristics of the emergency response exercise to the nuclear accident in neighboring countries. Table I shows the number of components in the model in comparison with the previous one.

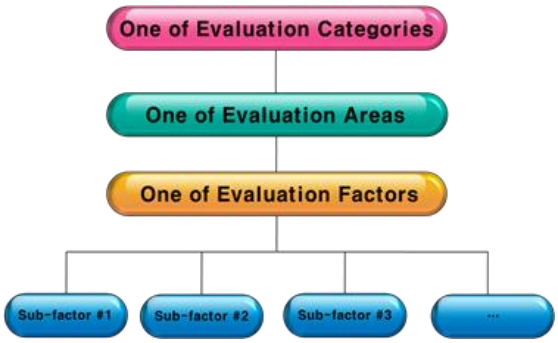

Fig. 1. Hierarchical Structure of the Exercise Evaluation Model Developed in This Study

Table I: Comparison of No. of Components in the Exercise Evaluation Model

Component	Previous Model	Revised Model
Category	4	4
Area	13	11
Factor	23	15

2.2 Evaluation Factor and Sub-factor

As shown in Table I, even if the number of factors is decreased from 23 to 15, it is possible to systematically evaluate progress and/or result of exercise by creating multiple sub-factors for each evaluation factor. Table II summarizes the revised contents of evaluation factor, compared with the previous model.

An evaluator and/or the evaluation committee mark with a checkmark in either of boxes for "Yes" or "No" depending on whether each sub-factor of the corresponding evaluation factor is fulfilled. And then, based on the total number of sub-factors and the number checked by "Yes", the qualitative result for the exercise can be evaluated as "Excellent", "Normal" or "Unsatisfactory". Table III exemplifies a template for the exercise evaluation model. And, Table IV tabulates criteria on determining the qualitative evaluation result for each factor.

Table II: Summary for Revision of Evaluation Factors in Comparison with the Previous Model

Previous Model	Revised Model
(2) Adequacy of exercise plan by collaborative function	Replaced by (2) Adequacy of improvements over the exercise in the previous year
(5) Participation rate of expert by disaster type	Replaced by (4) Adequacy of type, purposes, scope and goals for exercise
(4) Adequacy of situation settings (i.e. scenario) by disaster type	Subdivided into three (3) factors (5) Adequacy of situational messages (6) Adequacy of exercise messages (7) Adequacy of scenario for the comprehensive exercise
(6) Concreteness of scope in the execution plan (7) Substantiality of contents in the execution plan	Integrated into a single factor (8) Adequacy of exercise implementation plan
(10) Adequacy of the situation propagation system (11) Substantiality of situation judgment meeting (12) Substantiality of emergency organization operation	Deleted due to deletion of the superordinate evaluation area (i.e. "Adequacy of contents of exercise for initial response")
(13) Awareness of roles and duties of exercise participants (14) Adequacy of discussion contents (15) Adequacy of discussion process (16) Positiveness of participation in discussion	Integrated into a single factor (9) Whether goals of the discussion-based exercise are achieved
(17) Adequacy of installation (place) and situation presentation for on-site exercise (18) Participation rates and awareness of roles and responsibilities of on-site exercise institutions (19) Achievement of goals for on-site exercise	Integrated into a single factor (10) Whether goals of the execution-based exercise are achieved
(20) Performance of public relation	Deleted due to deletion of the superordinate evaluation area (i.e. "Public relation for exercise")

Table III: Example of Evaluation Model for the Comprehensive Exercise

Category	Evaluation Area	Evaluation Factor	Sub-factors	Whether to Check	Result of Evaluation
Design of exercise	Adequacy of preparation process for exercise	Adequacy of type, purposes, scope and goals for exercise	Was the type of exercise chosen to meet the purposes, scope and goals?	□ Yes □ No	□ Excellent □ Normal □ Unsatisfactory
			Were the matters to be achieved established as the purposes of exercise?	□ Yes □ No	
			Were the participating agencies and departments, functions, type of exercise, and resources established specifically?	□ Yes □ No	
			Were the specific objectives of organization established based on the aims of Ministry of Public Safety and Security?	□ Yes □ No	
			Were the goals specified in accordance with SMART* principles?	□ Yes □ No	
			Were the purposes established depending on issues identified through the previous cases of emergency response or weakness of participating organizations?	□ Yes □ No	

* SMART: Simple, Measurable, Attainable, Realistic, and Task-oriented

Table IV: Criteria on Determining the Qualitative Evaluation Result for Each Factor

No. of Sub-factors	No. of Boxes checked by "Yes"		
	Excellent	Normal	Unsatisfactory
2	2	1	0
3	3	1~2	0
4	4	2~3	0~1
5	4~5	2~3	0~1
6	5~6	2~4	0~1

3. Conclusions

In this study, we improved and revised the evaluation model for emergency response exercise to the nuclear accident in neighboring countries. The model is composed of hierarchical structure with 4 categories, 11 areas, 15 factors, and 62 sub-factors. Compared with the previous study [1], 2 areas are removed and the number of factors is decreased from 23 to 15 by integrating or removing some factors not only to improve efficiency and immediacy but also to better reflect characteristics of nuclear accident in neighboring countries.

In addition, we created multiple sub-factors for each evaluation factor to systematically evaluate progress and/or result of exercise. Based on the number of affirmative items for sub-factors, the qualitative result for each evaluation factor can be obtained.

The result of this study will be practically applied to the emergency response exercise for the nuclear accident in neighboring countries in the future. Ultimately, it can contribute to improvement and advancement of the national radiological emergency response system.

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