Development of Training System for Emergency Response to a Nuclear Accident in Neighboring Country

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1. Introduction

In the Northeast Asia region where the Korean Peninsula is located, more than 100 nuclear reactors are in operation or under construction in China, Japan and Taiwan. As nuclear power plants are concentrated and new construction is expected to continue, it is necessary to continuously strengthen the emergency response system for radiological disaster in neighboring country.

In order to respond quickly and efficiently in the case of radiological disaster in neighboring country, conducting an infrastructure research to improve the emergency response system at the national level is required. Also, it is necessary to develop training scenarios, evaluation methodology and model to strengthen the periodic emergency response training system.

In this study, we develop a training system for preparing a radiological disaster occurred in neighboring country as a part of the advancement of the emergency response system.

2. Development of Training Methodology

2.1 Selection of Collaborative Function

One of the basic directions of the National Security Management Basic Plan is to establish a strong control tower and a collaborative system that integrates and supports the responding organizations in emergency. Therefore, when a disaster occurs, collaboration between related agencies should be built through 13 essential collaborative functions; situation management, urgent social stability, maintenance of site environment, traffic provision, promotion of disaster prevention, maintenance of social order, medical care and prevention, volunteer management, urgent repair of facility, energy recovery, resource support, urgent support of communication, search and rescue [1].

In the event of a radiation accident in neighboring country, the disaster managing department is the Nuclear Safety and Security Commission (NSSC). The collaborating organizations are limited to the main ministries among related organizations, but limited to the level of the institution holding the practical manuals. The collaborative organizations defined in this study are the following 21 organizations;

Nuclear Safety and Security Commission, National Security Office (crisis management center), The Office for Government Policy Coordination, Ministry of Public Safety and Security, Ministry of Strategy and Finance, Ministry of Science, ICT and Future Planning, Ministry of Education, Ministry of Foreign Affairs, Ministry of Justice, Ministry of National Defense, Ministry of Culture, Sports and Tourism, Ministry of Agriculture, Food and Rural Affairs, Ministry of Trade, Industry and Energy, Ministry of Health and Welfare, Ministry of Environment, Ministry of Land, Infrastructure, and Transport, Ministry of Oceans and Fisheries, Korea Communications Commission, Ministry of Food and Drug Safety, Korea Customs Service, Korea Meteorological Administration.

In this study, we selected 9 collaborative functions that can be applied in case of nuclear accident in neighboring country among the above 13 collaborative functions. Table I shows collaborative functions among corresponding organizations according to four levels of crisis alert. The four levels of crisis alert are in the standardized manual [2] of risk management prepared by Nuclear Safety and Security Commission.

2.2 Development of Training Scenario

A base study that enhances emergency response at the national level is required by supplementing the response manual for radiological disaster in neighboring country. In this study, we developed the anticipated scenarios and response systems by collecting, searching, and analyzing data such as related regulations and manuals on the radiological disaster in neighboring country.

Training scenarios that integrate the radiological disaster situation of neighboring country and the measures of related organizations according to the time of the accident are under development. Table II is the base accident scenario of Hongyanhe nuclear power plant in China and this can be utilized as prototype in development of training scenarios.

As a fundamental scenario, it is supposed that LOCA and SBO due to an earthquake occurred at Hongyanhe NPP in China, which has the shortest distance of about 500 km from Korea. Since the accident, air current may be introduced directly to the Korean peninsula, and thus serious phase is issued.

Level	Blue	Yellow	Orange	Red
Function	-Synthesizing and managing crisis	information and situation		
Situation management	 Analysis and response to nuclear accident in neighboring country Providing information on the public to the media 	- Enhancing environmental radiation monitoring	- Early start of Neighboring Country's Incident Response Center and the Central Disaster Relief Center, if necessary - Analyzing and evaluating domestic radiation effects	- Start and operation of Neighboring Country's Incident Response Center and the Central Disaster Relief Center - Operating National Crisis Evaluation Conference
Resource support		Supporting activities of related ministries such as contamination inspection, decontamination and exposure management Supporting materials and human resources for radiation emergency medical care		
Maintenance of social order	- Access control for damaged area, maintenance of social order, prevention of public order			
Urgent social stability		- Preparing countermeasures to radioactive contamination inspection and shipment restriction for domestic agricultural, livestock, marine and processed products		 Performing radioactive contamination inspection and shipment restriction for domestic agricultural, livestock, marine and processed products
		- Performing radioactive contamination inspection and import restriction, if necessary, for agricultural, livestock, marine and processed products from nation occurring accident		
Traffic provision		- Restriction of aircraft flight agai	 nst radioactive contaminated areas. Restriction of ship navigation agareas 	gainst radioactive contaminated
Medical care	 Establishing and checking cooperation for radiation emergency medical treatment support 	 Installation of on-site medical ce Acquisition and use of medicines 	ychological and life stabilization ination inspection of public in dama nter, operation of medical institution s and medical equipment	
Maintenance of site environment	- Investigating characteristics of radioactive contamination in disaster area	 Establishment and implementation of decontamination plans for radioactive contaminated areas Establishment of contaminated area and restriction of access to local public Enforcement of traffic control measures 		
Search and rescue	- Emergency relief action such as	tion such as transportation of person contaminated to designated hospital - Performing public protection action		
Promotion of disaster		- Support for disaster broadcasting	g and response to rumor via SNS	
prevention			 Sending disaster message for the Support for disaster online broad 	

Table I: Collaborative Functions according to Crisis Alert Level

3. Development of Training Evaluation Model

Not only development of training scenarios but establishing an evaluation methodology that can enhance the effectiveness of training to respond for radiological disaster in neighboring country is necessary. In this study, the evaluation factors of 2016 Disaster Response Safety Korea Training Plan [3] were applied to the emergency response training system for radiological accidents in neighboring country. These factors evaluate the implementation of the four stages of emergency response training (training planning, design, implementation, evaluation and devising improvement plan) and include 13 evaluation areas (Fig. 1).

A training evaluation model was developed, reflecting characteristics of nuclear accident in neighboring country based on the Fig. 1. Table III suggests an evaluation model that can improve the training system by subdividing evaluation criteria for 23 evaluation factors. Each color in Table III indicates the corresponding evaluation area shown in Fig. 1.

Table II: Base Accident Scena	rio of Hongyanhe NPP
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Table II: Base Accident Scenario of Hongyanhe NPP			
Time	Situation	On-site	NSSC's Action
(hh:mm)	Setting	Situation	
ea	00:00 Scale 9.0 earthquake occurred near Hongyanhe NPP in China	Reactor trip	
00:00		Occurrence of LOCA and SBO	
00:05		Establishing emergency plan and response center	- Recognizing and judging situation
00:10			 Issue of blue alert Propagating the situation to the relevant organizations
00:30	Performing actions of blue step		Checking cooperation system with related organizations Establishing ways to manage the situation Providing information to respond to media
01:00	Occurring severe accident	Determining core cooling failure, declaring emergency situation	 Issue of yellow alert Propagating the situation to the relevant agencies
01:10			- Establishing a situation management team

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01:20	Performing actions of yellow step	Ordering public evacuation	Enhancing environmental radiation monitoring and open to the press Supporting the response activities of related organizations such as contamination inspection, decontamination, exposure management Conducting contamination inspection for the entry.
02:00	Release of Radioactive material	Core disruption	
		Hydrogen explosion	
02:05		Expanding radius of evacuation area	 Issue of orange alert Propagating the situation to the relevant agencies
02:10			- Establishing Radioactive Central Control Center
02:20	Performing actions of orange step		 Analysis and evaluation of domestic radiation effects Review of public protection action Enhancing environmental radiation monitoring and open to the press Supporting the response activities of related organizations such as contamination inspection, decontamination, exposure management
	Inflow of radioactive material		- Confirmation of increased environmental radiation.
03:00			-Discussing with National Security Office and Ministry of Public Safety and Security on issuing red alarm
03:05			 Issue of red alert Propagating the situation to the relevant organizations
03:10			- Establishing and operating neighboring incident response center
03:20	Performing actions of red step		Review and request of public protection action Strengthening national environmental radiation monitoring system Supporting radiation protection and radiation emergency medical technology. Carrying out radioactive exploration for damage (expected) area and contamination inspection for local public cooperating with local governments, Ministry of National Defense, etc.
04:00	End of training		

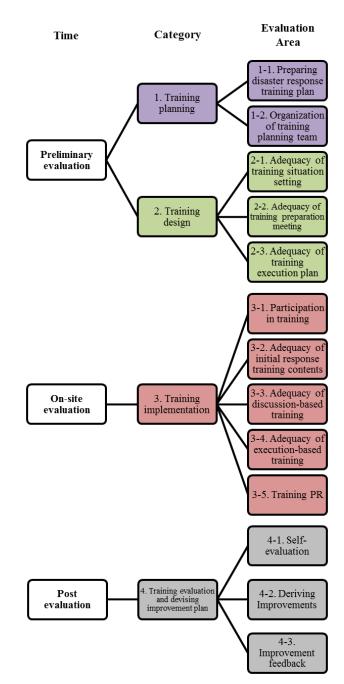


Fig. 1. Structure of Training Evaluation Model.

Evaluation Factor Criftration of regulation on the disaster response rules in the crisis management manual (1) Adequacy of crisis management manual Confirmation of individual mission card of crisis management manual (2) Adequacy of training plan by collaborative function Confirmation of the establishment of plans for the collaborative function and core work. (3) Adequacy of training plan by collaborative function plan to collaborative function and core work. Confirmation of approval by NSSC Chairperson for the collaborative function planning team includes working-level of nuclear accident in negibboring country (3) Adequacy of organization and operation of training planning team Confirmation of the approval by the manager or higher position for organizing the training planning team (4) Adequacy of organization and operation of training planning team Confirmation of work division such as command team, execution team, planning team under training planning team (5) Expert participation rate by disaster type Confirmation of participation of relevant organizations, civilian experts, and civilian organizations of the scole of training securatio Confirmation of participation of relevant organizations of the scole of training participation relevant organization of detailed schedule such as training time and place, etc. (6) The specificity of the execution plan scope Confirmation of operation of the following agencies and departments (7) Substantiality of execution plan scope Confirmation of operation of the following agencies in the training plansing relipforing C		: Training Evaluation Model
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(11) Substantiality of situation judgment Confirmation of availability of materials to identify disaster damage level Confirmation of formation and dispatch of practical		involved in the target organization
(11) Substantially of situation judgment meeting Confirmation of formation and dispatch of practical		Confirmation of availability of materials to identify
Confirmation of formation and dispatch of practical		disaster damage level
group, and the scope of call for workers		
	J J	group, and the scope of call for workers

	Confirmation of discussion by collaborative function such as prompt propagation of situation, maintenance of social order and urgent evacuation which is the most important in the beginning of a disaster
	Confirmation of determination on the crisis stage
(12) Fulfillment of operation of emergency equipment	Confirmation of presiding of meeting according to the operation regulations of neighboring incident response center
(13) Awareness of roles and duties of training participants	Confirmation of understanding of the roles and tasks of participants through inquiry
	Confirmation of division of collaborative functions according to the characteristics of accident in neighboring country
(14) Adequacy of discussion contents	Confirmation of deduction of mutual problems by collaborative function Confirmation of focus on problem solving that is
	most likely to occur Confirmation of the possibility of disaster spread in the future
	Confirmation of promotion of voluntary
(15) Adequacy of	participation and provision of sufficient
discussion process	participation, not just announcement of simple mission
(16) Initiative of participation in	Confirmation of active participation in discussions
discussions	to resolve mutual problems
(17) Adequacy of on-site	Confirmation of operation of actual disaster
training installation	facilities and direction of real-time situation
(place) and situation presentation	Confirmation of past disaster situation
presentation	Confirming the participation rate of the number of
	participating organizations in the on-site training compared to the number of those in the discussion-
(10) A	based training
(18) Awareness of participation rates and	Confirmation of designated roles and
roles and responsibilities	responsibilities of organization in on-site training
of on-site training	Confirmation of execution of commanding system during on-site training
institutions	Confirmation of application of golden time to the
	training situation
	Confirming adequacy of step-by-step warning
(10) A 1:	announcement (issuer, issuance procedure)
(19) Achievement of on- site training goal	Confirming achievement of on-site training compared to training goal
(20) Public information	Confirming the number of public relation type and
(20) I done information	performance
(21) Establishment and	Confirmation of establishment of self- evaluation plan
implementation of self-	Confirmation of affiliated and related organizations
evaluation plan	in the self- evaluation plan
	Confirmation of self- evaluation
	Confirmation of deduction of problems,
(22) Problems,	recommendations and achievements Confirmation of deduction of problems and
recommendations and	achievements in initial response
achievements	Confirming ratio of deduced cases compared to the
	number of organizations participating in training
	Confirmation of establishment of improvement planning
(23) Progress compared with improvement	Confirming specificity and feasibility of the improvement planning
	Confirming ratio of performance of improvement
	compared to deduced cases

4. Conclusions

In this study, we developed fundamental materials such as training scenarios and evaluation factors to establish the emergency response training system for nuclear accident in neighboring country. Through this study, it is possible to improve relative regulation and establish the countermeasures for the radiological disaster in neighboring country by supplementing the existing manuals.

For the enhancement of emergency response system, we can expect the economic effect of saving health and property damage by performing prompt public protection measures. It is also expected to provide a basis for meeting the demand on information of public for radiological disaster in neighboring country. Furthermore, the result of this study will strengthen the capability of international emergency response through the linkage of disaster prevention training of Northeast Asian countries.

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