Study of developing nuclear fabrication facility's integrated emergency response manual

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1. Introduction

As radiation contamination and leakage accident become worldwide issue and increase its occurrence frequency such as TMI Nuclear Power Plant(hereinafter NPP) accident (1979), Chernobyl NPP accident (1986) and Fukushima NPP accident (2011), a radiological accident response systems is being issued. Also, there was tragic 'Se-wol ferry sunk accident (2014)'. Taking this opportunity, public begin to pay attention to emergency management. Thus, public's consensus on having high level of emergency management system up to advanced country's is reached. In this social atmosphere, manual is considered as key factor to prevent accident or secure business continuity.

Therefore, we first define possible crisis at KEPCO Nuclear Fuel (hereinafter KNF) and also make a 'Reaction List' for each crisis situation at the view of information-design. To achieve it, we analyze several country's crisis response manual and then derive component, indicate duties and roles at the information-design point of view. From this, we suggested guideline to make 'Integrated emergency response manual' (hereinafter IERM).

2. Research crisis management manual

2.1 Concept and system of domestic crisis management manual

Crisis management manual is procedure that describes matters of gradate management when disaster occurred. According to 「Framework act on the management of disasters and safety」 (article 34), the head of disaster control agency make and operate crisis management manual to cope with disaster efficiently. Crisis manual is classified into three category ; standardized manual, practical manual, action manual.

Standardized crisis manual is document that describes government agency's response system, duties, roles and cooperation relation to systematically manage national 31 crisis.

Practical crisis manual describes detail action and procedures which government agency specified at standardized manual and it is a sort of standardized crisis manual's lower document.

Action manual is that describes response list, contents and roles and duties of organization which supposed to be put and accomplish site work when crisis occur. It tends to be different from standardized crisis manual because characteristics of disaster is differ from each site and diversity exist.

2.2 Concept and System of advanced country's crisis management manual

USA's 'State National Incident Management System((hereinafter NIMS) Integration' include both EOP(Emergency Operations Plan) and SOP(Standard Operating Procedure) which state/local government currently operates or has. EOP is classified to Basic plan, ESP (Emergency Support Plan) and Financial Support. Also, EOP provide checklist type to match concept with terminology of NIMS.

There are four types document of SOP ; whole document, standard action procedure, site operation guidelines and task support.

Also, USA's state/local government establishes EOP(Emergency Operations Plan) to conduct disaster management task efficiently within their own district. EOP is not just make independent crisis plan to possible crisis element but integrated crisis plan for common effect among variety crisis element. To prepare disaster happen, fundamental disaster management stuff such as precaution/alert and evacuation/medical treatment is well being in systematic. The function of EOP consist of organizational action; Functional format, emergency support function format.

3. Construct IERM for administrative level

3.1 Direction of developing IERM

IERM is action manual when emergency happen for giving information to a person who is scheduled to take action at the site and it could be divided by 3 management section according to its purpose.

First, once manual describe both action know-how and measuring list, it gives confusion as information that should be recognized instantly but conflict with other information. Therefore, on this research we use color notice and numbering to catch emergency level information instantly.

Second, manual which describe proper action measure when emergency situation should consider numerous variable that could happen when disaster or emergency situation. Therefore, we develop manual by considering each user's characteristic and their environment as much as we can.

Finally, one of action manual's requisite is user based(handy and easy to read). Therefore, we develop

action manual include individual's response list card to access essential information easily and quickly.

3.2 Constitution system of IERM

This manual is written as working level to response immediately at the site when emergency happen by listing proper task. Manual should give related information as fast as possible to those who need information. Especially, in a crisis, information of the manual should be written by considering user and environment to reduce damage . As KNF department is organized by its process and used material. Therefore, we list response measure following accident type as shown in the table 1.

Divide	Content		
Chap. 1 General rule	Purpose of developing manual, scope, terminology		
Chap. 2 Emergency alert system	Define emergency type, alert level, response system(organization)		
Chap. 3 Reaction list by emergency alert level	1. Radiological accident	Reaction list by emergency alert level	Facility emergency
			Site emergency
			Area emergency
		Job card by reaction list	
		Action guide and form	
	2. Fire·Gas accident 3.Chemical·Environment accident 4. Natural disaster 5. Industrial accident	Reaction list by emergency alert level	Concern
			Attention
			Warning
			Alert
		Job card by reaction list	
		Action guide and form	
Chap. 4 Appendix	Contact list of related organizations & agency / detailed duty for response to the press / Equipment and spare part list / Format that needing disaster response action		

[Table. 1] IERM constitution system

3.3 Scope of IERM's crisis type

IERM's crisis type is following five accidents which could happen at the KNF while it operation ; Radiological, Fire/Gas, Chemical/Environment, Natural disaster, Industrial accident. The scope of individual accident type is based on related law as shown in the table 2.

Accident type	Accident Scope
Radiological accident	「Nuclear Safety Act」, 「Enforcement Regulation of the Act on Physical Protection and Radiological Emergency Act」, there is or is perceived to be, a hazard due to radiological exposure from a source during the operation so that urgent measures needs to be taken
Fire/Gas accident	Flammable gas leakage accident according to 「chemical substance control act」 of ministry of Environment 「High-pressure gas safety control act」 of Ministry of trade, Industry and Energy and 「Industry safety & health act」 of Ministry of employment and labor.
Chemical Environment accident	-「Leakage accident of harmful chemicals by Chemicals Control Act」 of the Ministry of Environment -Environmental accident by of 「Soil Environment Conservation Act」, 「Air Environment Conservation Act」, 「Water Quality Conservation Act」 and 「Environmental Dispute Adjustment Act」
Natural disaster	Disaster resulted from storm and flood damage(typhoon, heavy rain, earthquake, etc.) according to the Countermeasures against 「Natural Disaster Act」 of the Ministry of Public Safety and Security, which can influence the core process of the KNF or be advanced to other secondary accident
Industrial accident	The risk resulted from the industrial disaster at the working field of the KNF according to 「Occupation safety and health acts」 of the Ministry of employment and labor, which can seriously influence the smooth company activity such as worsened outside image

[Table 2.] Scope of each IERM's crisis type

3.4 IERM's reaction list by emergency alert level

IERM's reaction list is developed by different 4 traits to deliver information which user need when they conduct emergency actions. IERM's radiological accident alert level is categorized to three; Facility emergency, Site emergency and Area emergency based on related law.

On the other hand, for other accident type, alert level is classified to four; Concern, Attention, Warning and Alert according to National alert level.

Second, we make manual using 'Ministry of Public Safety and Security's 13-cooperative function concept to cope with national-level disaster for cooperation with central administrative agency/government or city public office. 13-cooperative function is that if accident happen at the site and it could be national-level disaster, duties of government agency are classified with 13-funtions. We refer and bring it in IERM's crisis alert level.

Third, in this manual, crisis alert standard, judgment and situation describe as shown in table3 and different from other manual. From this, user can easily make exact judgement and decision making.

Classify	Content
Judgement criteria	1. Large amount of UO_2 powder leaked while processing - 200kg of more of UO_2 powder leaked from power discharge facility, homogeneous mixing facility, powder preparation facility and others to spread the contamination to the lower layer 2. UF_6 leaked from evaporator and peripheral facility(ventilating facility stopped) - UF_6 leakage detector activated to automatically stopped the ventilating facility 3. Ventilating facility failed to increase the radiation density in the air 3Bq/㎥ or more of radiation density in the air lasted for 24 hours or longer at the controlled zone of radiation
Situation	200kg of power or more was leaked from the powder discharge facility and spread to contaminate to the lower layer 0000y/00m/00d 00:00 at present

[Table. 3] Crisis alert judgement criteria and situation example

Lastly, this manual is developed by 'making form and context' point of view to deliver information effectively which user need. Thus, as shown in Fig.1, we constitute response measures by table format; Task-Action-Person in charge

Step	Item	Task	Action	Person in charge
Receiving Risk symptom	(1)	First report & alert	- Initial report to the dept director at day and the executive staff at night - The director(day) or staff(night) issues the initial alert after receiving and determining the report	- Finder - Person in charge
Initial action	(2)	Evacuate and control the access	- Evacuate and gather the people at the designated place - Control the gate access	- Dept manager - Emergency control center
	(3)	Run the Emergency operation center	- Run the radioactive emergency org	
Reaction	(4)	Report to the upper org	- Initial report - Written report	- Situation section - Emergency org
	(5)	Minimize the radiation within the building	- Minimize the radiation to employee, outside staff and visitor and others and the contamination to the facility and the environment - The related dept manager checks whether all of the people is escaped or not by the roll call	
	(6)	Protect the in-house people	- Trace/report the damaged worker during the emergency - First aid for the wounded	
	(7)	Recover & decontaminate	- Run the task by each action team of emergency org - Control the situation and the spread - Rescue and protect (fire-fighting)	
	(8)	Support to protect	- Support the administrative task	

[Fig. 1.] Radiological accident (facility emergency) response measure format.

3.5 IERM's job card by reaction list

Action manual tends to be developed as handbook type to carry and use easily whenever it needing. Emergency response manual of USA is provided and exposed to various different media include card, pamphlet and poster type to give easy access to people.

From this manual, we make reaction list as shown in Fig.2 for user to understand immediately and then act as fast as possible. Characteristics of this reaction list is as follows.

First, a reaction list's color is diversified as White, Blue, Red to deliver threat level visually thus easily noticed.

Second, in terms of information delivering for user, we describe reaction list with minimum information not to give user confusion.

Finally, we give numbering and then connect each step to Critical Task, Action and Form to deliver information systematically. Also, cooperation function is described on the reaction list with numbering.

Person in charge	
Standard form	Form 5. Report on Radioactive alert at Nuclear facility(initial)
	Form 6. Report on Radioactive alert at Nuclear facility(follow-up)
	Form 7. Outside org emergency contact & report log
Action	⑨ Report to the higher organization

Accident	Radioactive	Alert level	ⒶWhite
Action	(4) Report to the higher organization		

Critical Task	Person in charge	Action	Form	13 cooperative functions
4.1 Initial oral report	Emergency operation center mgr Emergency res. team	⑨		#F1
4.2 Written report	Emergency operation center mgr Command team Emergency res. team		Form5 Form6 Form7	#F1
4.3 Request the related org to support	Emergency operation center mgr Command team Emergency res. team		Form7	
Resource	• Emergency contact network • Upper/related organization contact network			

Task to connect with 13 cooperative functions	Note for connected task
#F1.Emergency control	Nuclear Safety and Security Commission Emergency op dept 02-397-7352 Daejeon field center 042-612-3605

[Fig. 2] Reaction list card by Facility alert

4. Conclusions

This Study is to develop a working-level IERM to prepare radiological accident occurring frequently within a decade. The manual we used before have following few problems; difficult to applicate at the site, difficult to deliver information. To complement these problems, we searched manual elements from the view of information-design. As a result, we develop administrative manual. Although, this manual could be thought as fragmentary manual because it confined specific several agency/organization and disaster type. However, to make much practical use emergency response manual, this study's meaning is the thing that

we develop user-based, information design-centered emergency response manual. Followings are summarizing of research's contents and results.

First, through analyzing exist emergency response manual, we recognized that to increase practical use, visualization of delivering information following manual purpose and type should be differentiated.

Second, by analyzing various domestic and foreign emergency response manual, we caught problems of it and then deducted direction of new type emergency response manual.

Finally, by developing administrative manual, we drew guideline to search manual type and information type.

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