Risk Management of Large Component in Decommissioning

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1. Introduction

The need for energy, especially electric energy, has been dramatically increasing in Korea. Therefore, a rapid growth in nuclear power development has been achieved to have about 30% of electric power production.

However, such a large nuclear power generation has been producing a significant amount of radioactive waste and other matters such as safety issue. In addition, owing to the severe accidents at the Fukushima in Japan, public concerns regarding NPP and radiation hazard have greatly increased.

In Korea, the operation of KORI #1 has been scheduled to be faced with end of lifetime in several years and Wolsong #1 has been being under review for extending its life. This is the reason why the preparation of nuclear power plant decommissioning is significant in this time.

Decommissioning is the final phase in the life-cycle of a nuclear facility and during decommissioning operation, one of the most important management in decommissioning is how to deal with the disused large component. Therefore, in this study, the risk in large component in decommissioning is to be identified and the key risk factor is to be analyzed from where can be prepared to handle decommissioning process safely and efficiently.

2. Methods and Results

In this section comprehensive literature review was followed by making a questionnaire. Then a statistical analysis of the survey result was performed.

2.1 Literature Review

Risk is defined as "an uncertain event or condition that, if it occurs, has an effect on at least one project objective" [1] and risk management is described as "a systematic way of looking at areas of risk and consciously determining how each should be treated" [2].

The significance score for each risk estimated by each respondent can be calculated through equations as below [1].

$$r_{xy}^{z} = p_{xy} i_{xy}^{z}$$

Where x=ordinal number of risk; y=ordinal number of valid respondent; z=ordinal number of project objective; r_{xy}^{z} =significance score assessed by respondent y for the impact of risk x on project object z; p_{xy} =likelihood of occurrence of risk x, assessed by respondent y; i_{xy}^{z} =impact of risk x on project objective z, assessed by respondent y.

The average score of each risk was used for risk significance score. All identified risks are ranked in accordance with this average score.

$$R_{xy}^{z} = \frac{1}{n}\sum_{y=1}^{n} r_{xy}^{z} = \frac{1}{n}\sum_{y=1}^{n} p_{xy} i_{xy}^{z}$$

Where n=total number of valid respondent; R_{xy}^{z} =significant score for risk x on project object z.

2.2 Identification of risk factor

Risk factor was identified by reviewing relevant document through lesson learn from other decommissioning project and braining storming among working group. Total risk factor for dealing with large component in decommissioning was summarized 56 items through above method. In order to identify risk for managing large disused component, 5 different aspects were investigated such as regulatory aspects, technical aspects, safety aspects, economic aspects and public acceptance aspects. Those aspects were also considered at each stage of process of decommissioning, transportation, waste treatment and disposal.

Table I: Structure of risk identification

Type of risk	Number of items
1) Regulatory and licensing risk	11
- Decommissioning	3
- Transportation	3
- Waste treatment	3
- Disposal	2
2) Technical risk	15
- Decommissioning	4
- Transportation	4
- Waste treatment	3
- Disposal	4
3) Safety risk	12
- Decommissioning	5
- Transportation	1
- Waste treatment	3
- Disposal	3
4) Economic and Schedule risk	12
- Decommissioning	2
- Transportation	5
- Waste treatment	3

- Disposal	2
5) Public acceptance risk	6
- Decommissioning	2
- Transportation	2
- Waste treatment	1
- Disposal	1
Total risk factors	56

2.3 Data Collection

A Questionnaire was composed of two groups which stand for probability level of the risk occurrence and the degree of impact or the level of loss if the risk occurs. The Questionnaire form on the risk management awareness for large component in decommissioning was distributed to 25 people who have worked at the area of nuclear power plant. Prior to be handed over to them, sufficient explanation for this survey was given to improve the quality of it. 25 feedbacks were received in valid and Distribution of respondents by working years in NPP was shown in the following figure.

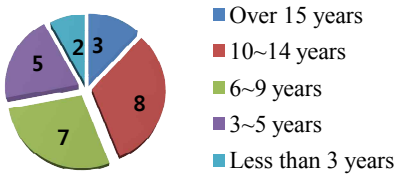


Fig. 1. Distribution of respondents

2.4 Analysis of data result

Two high risk factors marked highest values of score index were prioritized among 5 each aspect based on survey results.

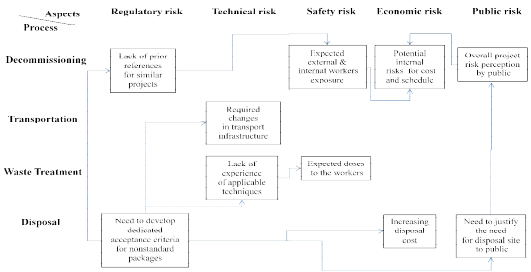
	Type of Risk	Summary of Mean		
		Pl(a)	Di(b)	Score Index
i) Regulatory and licensing risk				
- Decommissioning				
1	Lack of prior references for similar projects	0.536	0.362	0.195
- Disposal				
11	Need to develop dedicated acceptance criteria for nonstandard packages	0.62	0.352	0.219
ii) Technical and operational risk				
- Transportation				
8	Required changes in transport infrastructure	0.604	0.32	0.194
- Waste tratment/interim storage				
9	Lack of experience of applicable wastetreatment techniques/processes (decontamination, segmentation, volume reduction, etc.)	0.564	0.346	0.196
iii) Safety and ALARA risk				
- Decommissioning				
1	Expected external and internal workers exposure	0.652	0.494	0.323
- Waste tratment/interim storage				
7	Expected doses to the workers due to treatment processes	0.548	0.416	0.228
iv) Economic and scheduling risk				
- Decommissioning				
1	Potential internal risks for cost and schedule (high cost for advanced cutting technology, process of decommissioning delay etc.)	0.636	0.306	0.195
- Disposal				
11	Increasing disposal costs, including design, licensing,new process development and investment in new facilities	0.612	0.31	0.19
v) Public acceptance and stakeholder risk				
- Decommissioning				
1	Overall project risk perception by public	0.66	0.48	0.317
- Disposal				
6	Need to justify the need for disposal site to public	0.612	0.356	0.218

Fig. 2. Classified high risk factors

In the figure above, Pl describes a mean probability level of the risk occurrence and Di expresses a mean degree of impact or the level of loss if the risk occurs. Score index is the multiply of a Pl and a Di.

The result implies that 10 risk factors were classified as high risk on management of large component in decommissioning. According to the results of survey, "expected external and internal workers exposure during dismantle and treatment work" in safety aspect were highly recognized as risk. And high risk of public acceptance aspect was "justify the need for decommissioning including decision of disposal site to public" reflecting the rising concern of people for safety of NPP after the Fukushima accident. "Potential internal risk such as increasing disposal cost and high cost for advanced cutting technology" in cost aspect and "Lack of experience of applicable technique in waste treatment and probability of changes in transport infrastructure during the project" in technology aspect was also considered high risk factors. Finally, "lack of prior references for similar projects in overall decommissioning and need to develop dedicated acceptance criteria for nonstandard packages in disposal" in regulatory area were analyzed as high risk factors.

At that point, it was needed to draw key risk making a great impact on other risk factors through accurate analysis. Therefore, correlation analysis was used to perform to draw key risk. The correlation of each high risk was presented in Fig. 2.



The risk "Need to develop dedicated acceptance criteria for nonstandard packages" of disposal process was accessed as a key risk. It meant that if the criteria were not set for large components in disposal, the preceding process in decommissioning could not move forward and even though it does it would face critical problem after all.

3. Conclusion

Developing dedicated acceptance criteria for large components at disposal site was analyzed as a key factor. Acceptance criteria applied to deal with large components like what size of those should be and how to be taken care of during disposal process strongly affect other major works. For example, if the size of large component was not set up at disposal site, any dismantle work in decommissioning is not able to be conducted. Therefore, considering insufficient time left for decommissioning of some NPP, it is absolutely imperative that those criteria should be laid down.

REFERENCES

[1] A guide to the project management body of knowledge (PMBOK® guide) Fifth edition, 2013, Project Management Institute
[2] Essentials of Construction Project Management, Thomas E. UHER, A UNSW, 2012