

Reclassification by ISDC Structure to Management and D&D Costs in NPP Decommissioning

Jae Yong Oh^{a*}, Hyung-woo Seo^a

^a*KHNP Central Research Institute, 70, Yuseong-daero 1312beon-gil, Yuseong-gu, Daejeon, Korea*

^{*}*Corresponding author: jaeyongoh@khnp.co.kr*

1. Introduction

Decommissioning of nuclear power plant (NPP) is a project that costs hundreds of billion Korean Won due to its characteristics of the target plant and site. Since there are diverse variables that affect the project, decommissioning cost estimation is essential to make economical and safe decommissioning project. Further, in order to conduct an efficient decommissioning, a detailed assessment of decommissioning cost should be prepared by taking into account the business environment, such as national regulation, policies and strategies, as well as conditions of NPP.

However, due to these characteristics of the decommissioning NPP and its own management system such as work breakdown structure and cost breakdown structure being developed by decommissioning operating organization, it is difficult to compare and refer to the previously assessed decommissioning costs for each NPP. In the same context, even in Korea, where the activities to compare for decommissioning of Kori-1 have been commenced, it is indispensable to deliberate the comparison with other decommissioning costs in terms of appropriate evaluation of the decommissioning costs.

In order to solve this problem, OECD/NEA, IAEA and European Commission have developed the International Structure for Decommissioning Costing (ISDC) [1]. Calculated decommissioning costs in unique system for NPPs can be transformed to ISDC structure uniformly, and then, decommissioning costs can be compared with ease.

Therefore, the objectives of this study is to reclassify decommissioning costs of project management, decontamination and dismantlement (D&D) items and categories according to ISDC structure.

2. Methods and Reclassification

In this section, the composition of decommissioning cost for commercial NPPs in Korea is analyzed in detail. And also, this paper introduces an overview of the ISDC structure developed and recommended as a standard by international organizations. Finally, the methodologies for reclassification and deployment of management and D&D costs within ISDC structure were investigated.

2.1 Composition of Decommissioning Cost in Korea

The basic methodologies for decommissioning waste quantity and cost estimation were utilized the methods

presented in AIF/NESP-036 report [2]. As the notice of Korean government, Ministry of Trade, Industry and Energy (MOTIE), appropriation fund for decommissioning cost has computed to 812.9 billion Won per NPP unit [3]. Including appropriation fund, decommissioning costs in Korea could be mainly divided into 3 categories: decommissioning management, D&D, and waste management costs.

In case of decommissioning management and D&D costs, they have been evaluated and comprised of project management, removal, decontamination, utilities, and etc. The cost of radioactive waste consists of the costs involved in the management of waste arising from the decommissioning. Waste management costs should be taken into account the final disposal and transportation of residual non-radioactive and radioactive waste on site.

2.2 Management and D&D Cost Items

Project management costs correspond to the expense required for the operation of management organization, on-site maintenance and safety control. Removal costs have used to dismantle all the structures, systems and components (SSCs) and demolish the buildings remained in decommissioning NPP. Decontamination costs are prepared to reduce the radioactive waste volume by using techniques such as melting, compaction, and decontamination. Decontamination works can be performed in a way of chemical or abrasion to lessen the final amounts of radioactive wastes which will be sent to Korean low and intermediate level radioactive waste disposal facility. And also, the decontamination of the primary system or nuclear steam supply system (NSSS) is planned to spend the costs for radiation safety of on-site decommissioning workers who will be exposed from radiological contaminated or activated remaining plant inventory during the decommissioning.

2.3 International Structure of Decommissioning Costing

ISDC has been established by OECD/NEA, IAEA and European Commission in 2012. Decommissioning costs of a NPP, in Europe, are currently calculated and subdivided by ISDC structure.

The primary categories for major activities listed in Table I are being classified by their characteristics and performance stage of relevant activities in decommissioning project. For example, "Waste processing, storage and disposal" involves various

management process, characterization, processing, conditioning and etc. for the decommissioning waste generated after permanent shutdown of a NPP whether it is radioactive or not.

Each primary category has composed of a number of subcategory known as activity group. Subcategories could be distinguished by boundary conditions and assumptions such as main target, work features and affiliation of performance worker on activity group.

Table I: Primary categorization of major activities in ISDC

No.	Categories for major activities
1	Pre-decommissioning actions
2	Facility shutdown activities
3	Additional activities for safe enclosure or entombment
4	Dismantling activities within the controlled area
5	Waste processing, storage and disposal
6	Site infrastructure and operation
7	Conventional dismantling, demolition and site restoration
8	Project management, engineering and support
9	Research and development
10	Fuel and nuclear material
11	Miscellaneous expenditures

Each elementary cost items are made of labor, investment, expenses and contingency in ISDC as described in Fig. 1. Labor costs mean all payments such as salaries, overheads for corresponding workers. Investment costs are prepared for capital and rental or procurement of equipment and materials. Expenses refer to all charges paid in relation with decommissioning works and activities except for labor and investments. Contingency is additional and reserve cost provided for unexpected factors related with uncertainties in decommissioning project.

Hierarchical Activity Level	Cost Category				
	Labour	Investment	Expenses	Contingency	Total
Principal Activity (Level 1)	L_{01}	I_{01}	E_{01}	C_{01}	$L_{01} + I_{01} + E_{01} + C_{01}$
Activity Group (Level 2)	$L_{01.0100}$	$I_{01.0100}$	$E_{01.0100}$	$C_{01.0100}$	$L_{01.0100} + I_{01.0100} + E_{01.0100} + C_{01.0100}$
Typical Activity (Level 3)	$L_{01.0101}$	$I_{01.0101}$	$E_{01.0101}$	$C_{01.0101}$	$L_{01.0101} + I_{01.0101} + E_{01.0101} + C_{01.0101}$

Fig. 1. Outlines of ISDC composition, structure and matrix.

2.4 Management and Dismantlement Costs in ISDC

Almost project management cost in decommissioning in Korea could be considered as “Project management, engineering and support” category in ISDC. Table II shows the subdivision group of project management, engineering and support in ISDC. Unless decommissioning project is under consigned management by decommissioning operating contractors (DOC), group 08.06 to 08.10 is not being appraised the involved costs.

Removal activities and corresponding costs for SSCs contaminated or residual in radiation controlled area can be mainly transformed to primary category #4 in ISDC (Dismantling activities within the controlled area). Meanwhile, removal costs for physical plant inventories within non-radiation controlled area could be regarded as conventional dismantling, demolition and site restoration category in ISDC.

Decontamination costs would be separated by its purposes to volume reduction, processing and treatment to decrease the final waste disposal quantity and primary or full system decontamination (FSD) and to reduce the exposure dose of decommissioning workers. In case of radioactive waste management, almost all of costs are appropriate with “Waste processing, storage and disposal” category except for concrete scabbling to building surface contamination due to the main target of activity. Otherwise, costs about full system decontamination can be determined as decontamination for dose reduction in “Facility shutdown activities” category.

Table II: Project management in ISDC activity group

No.	Activity groups in Project management (08)
08.01	Mobilisation and preparatory work
08.02	Project management
08.03	Support services
08.04	Health and safety
08.05	Demobilisation
08.06	Mobilisation and preparatory work by contractors
08.07	Project management by contractors
08.08	Support services by contractors
08.09	Health and safety by contractors
08.10	Demobilisation by contractors

3. Conclusions

In this research, redistribution by ISDC of project management and D&D costs in decommissioning cost in Korea has been carried out. This reclassification is aimed to be easy to compare and contrast the various decommissioning costs of NPPs in worldwide. Eventually, it can be anticipated not only to confirm the appropriateness of decommissioning cost in Korea but also to contribute to analyze the trends and tendencies of global decommissioning costs.

REFERENCES

- [1] OECD, “International Structure for Decommissioning Costing (ISDC) of Nuclear Installations”, NEA No. 7088 (2012).
- [2] Thomas S. LaGuardia, et al., “Guidelines for Producing Commercial Nuclear Power Plant Decommissioning Cost Estimates”, AIF/NESP-036, Volume 1 (1986).
- [3] Notice of Ministry of Trade, Industry and Energy, 2019-217 (2019).