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Calculating Program for Decommissioning Work Productivity based on Decommissioning Activity Experience Data

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1. Introduction

Since South Korea's first development of nuclear technology, the number of nuclear power plants (NPP) has reached 23, and 5 more are under construction. Researched and developed for decommissioning project of National NPP became needed a speedy solution because of lifetime of some NPP is a little remaining or already shut down and examining extend life time.

The Korea Atomic Energy Research Institute (KAERI) has Decommissioning Activity Experience Data for Korea Research Reactor-2 (KRR-2), Uranium Conversion Plant (UCP). KAERI is performing research to calculate a coefficient for decommissioning work unit productivity to calculate the estimated time decommissioning work and estimated cost based on decommissioning activity experience data for KRR-2. KAERI used to calculate the decommissioning cost and manage decommissioning activity experience data through systems such as the decommissioning information management system (DECOMMIS), Decommissioning Facility Characterization DB System (DEFACS), decommissioning work-unit productivity calculation system (DEWOCS) [1]. In particular, KAERI used to based data for calculating the decommissioning cost with the form of a code work breakdown structure (WBS) based on decommissioning activity experience data for KRR-2. Defined WBS code used to each system for calculate decommissioning cost. KAERI is prediction to estimate the cost of decommissioning an NPP using the already dismantled KRR-2, but it is not easy to guess the decommissioning cost of other NPPs in a research reactor decommissioning work experience.

In this paper, we developed a program that can calculate the decommissioning cost using the decommissioning experience of KRR-2, UCP, and other countries through the mapping of a similar target facility between NPP and KRR-2.

This paper is organized as follows. Chapter 2 discusses the decommissioning work productivity calculation method, and the mapping method of the decommissioning target facility will be described in the calculating program for decommissioning work productivity.

2. Methods and Results

2.1 Facility Code and WBS (Work Breakdown Structure) Code

In DECOMMIS have represented by facility code for decommissioning facilities of NPP and WBS code for decommissioning experience data of KRR-2, UCP and JAEA and then managed by the database. This WBS code made by the time sequence of decommissioning work and work schedule [1]. In particular, the WBS Code for the experience data of decommissioning is the defined attribute for dismantling work (GD), maintenance (GE), radiation/radioactivity management (RP), radioactivity waste management (WM), quality management (QC), expert application (SE), and common job (CO), and these attributes are each defined as a numeric value with a unit of Manpower /Area, Manpower /Volume, Manpower/Weight.

As shown in Figure 1, the form of he K2-4.4 WBS code is stored in the database, and attributes are stored in a table as decommissioning work costs.

Man-Power
- WBS 코드 : KRR-F > 연구로2호기 > 회전조사 시료대 분리 > 회전 조사시료대 분해 및 세절

면적	2.090	부피	0.196	무게	529.000	WBS No.	K2-4.4

작업분야	시간/면적	시간/부피	시간/무게
☐ RP	94.7368	1010.204	0.3742
☐ GD	227.5119	2426.0204	0.8988
☐ GE			
☐ WM	118.1818	1260.204	0.4669
☐ QC	57.177	609.6938	0.2258
☐ SE			
☐ CO			
SUM	497.6075	5306.1222	1.9657

Figure 1. WBS Code in DECOMMIS DB

2.2 Calculating Methodology for Decommissioning Work Productivity

In between KRR-2 and NPP building structure is the same purpose and there may be repeated work such as the general preparation work or decommissioning activities. This means that it can be used as an indicator to estimate how much time is spent on obtaining the decommissioning work productivity cost by recursively applying the WBS code of KRR-2, UCP, and JAEA.

$$\text{Average Work cost} = \frac{KRR+UCP+JAEA(WBS\ Codes)}{Total\ Number\ of\ WBS\ Codes}$$

Formula 1. The average decommissioning work productivity equation

In formula 1, 1 KRR-2, UCP can be applied to an NPP in Korea proceeds with reasonable accuracy in Korea. However, in the JAEA case it should not be used if the values do not fit exactly into the domestic NPP facilities. Because of the JAEA calculated according to the circumstance for the Japanese NPP decommissioning project. Therefore, the decommissioning cost of other countries as a more precise indicator when it is determined that they exactly match the target decommissioning facilities should be used for the purpose of a correct calculation.

Table 1. Example of decommissioning work productivity calculation

	KRR-2	UCP	JAEA
Heat Exchanger	K2-9.3 (0.026)	Not applicable.	JAEA1 (0.0231)
Average	0.02455		

Examples of decommissioning work productivity calculations are given in Table 1. Table 1 shows the cost of dismantling the heat exchanger KRR-2, UCP, and JAEA. K2-9.3 is 0.026 while the work cost "reactor external exposure (purification and cooling) system disposure – part of heat exchanger". JAEA1 is 0.0231 while the work cost "General dismantling – part of heat exchanger". UCP is not applicable. In particular, K2-9.3 is the total combined dismantling work cost of the RC (0.123), DC (0.201) etc. It can be seen that, as a result of dismantling, the heat exchanger incurs a total work cost of 0.02455.

2.3 The Mapping Method of Between Facility Codes of NPP and WBS Codes of KRR-2

In this paper, the basic concept is to use the database of DECOMMIS in order to calculate the decommissioning work productivity. This means that the user must selectively target facilities between the WBS code and facility code. This work makes it difficult to map a similar facility between the WBS code and facility code because it is not made facility code of NPP in mind the WBS code made for the KRR-2. Therefore, it is necessary to accurately map a similar facility between the WBS code and facility code because of a greater influence on the actual decommissioning work cost.

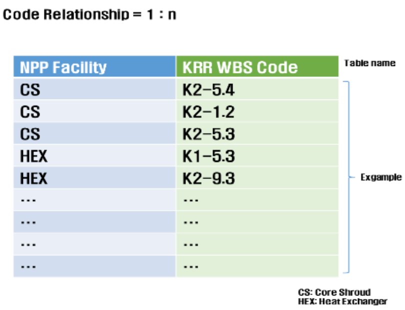

Figure 2. Mapping table structure for similar facility between facility code and KRR-2

In figure 2, as mentioned previously, this mapping method built in the database of DECOMMIS through a mapping table makes it easier to calculate the average value in the pre-mapping similar facility between WBS code for KRR-2 and NPP facility code. In this table, the NPP facility code and WBS code for KRR-2 have a relationship of 1:n. that is, one NPP facility code may have a number of WBS codes and can be applied repeatedly into a facility code so that made to have the predictable appropriate decommissioning work productivity cost.

2.4 The Calculating Program for Decommissioning Work Productivity

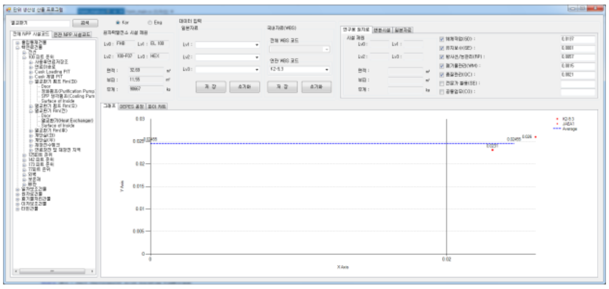

Figure 3. The main screen of calculating program for decommissioning work productivity

As shown in Figure 3, a calculating program was made to calculate the decommissioning work productivity for an efficient calculation. This program calculates formula 1 of the decommissioning work productivity equation and shows the resulting graph.

The calculating program for decommissioning work productivity performing directly accessing the database of DECOMMIS bring the data of WBS code for KRR-2 selected by user. The WBS code assign in equation 1.

In figure 3, the user selects a similar facility for mapping between the left side tree NPP facility code and the top right side WBS code combo box for KRR-2, UCP, JAEA. If user selected WBS code combo box it show to decommissioning work cost on the top right in attribute text box DC, DT, MR, RC, WR, QL. Select and save the check box and then it is displayed at the bottom point graph.

3. Conclusions

At KAERI, research on various decommissioning methodologies of domestic NPPs will be conducted in the near future. In particular, It is difficult to determine the cost of decommissioning because such as NPP facility have the number of variables, such as the material of the target facility decommissioning, size, radiographic conditions exist. This paper suggests a method for reducing a wide value range of decommissioning cost calculated using the actual NPP decommissioning experience data, and in future research, decommissioning cost should also be provided by applying government salary cost per decommissioning work.

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