Review of NPP Decommissioning Cost Estimation Methodology and Programs

Minhee Kim, Sunil Kim, Kwangho Lee*
Korea Research Institute of Decommissioning(KRID)
kmh0408@krid.re.kr

1. Introduction

Nuclear power plant(NPP) decommissioning cost estimation is the process of assessment the cost required to safely and efficiently decommission a NPP. It is performed to manage reserve funds to prepare for the cost required for decommissioning a NPP in advance, and is conducted to establish a pre-decommissioning plan. There is not much actual experience with decommissioning a NPP, and there is a lack of data, so there is uncertainty in the cost estimation.

To reduce this uncertainty, standards for decommissioning cost estimation are being presented internationally. Representative examples include the international atomic energy agency (IAEA) and organization for economic co-operation and development/nuclear energy agency (OECD/NEA). Based on these standards, many countries are developing NPP decommissioning cost estimation programs that can be utilized in each country and are conducting cost estimations. This study aims to suggest ways to utilize them domestically by reviewing the NPP decommissioning cost estimation method and program.

2. NPP Decommissioning Cost Estimation Methodology

There are various cost estimation methods for decommissioning projects. In order to estimate the cost, the latest technology of the project, availability of databases, cost estimation techniques, and engineering data levels are required [1]. Among them, the IAEA and NEA suggested the bottom-up technique, specific analogy technique, parametric technique, cost review and update technique, and expert opinion technique for general estimation techniques. The department of energy (DOE) additionally suggested the trend analysis technique.

The following table compares and organizes the advantages and disadvantages of general estimation methods. Among them, the bottom-up method can be evaluated by dividing the individual activities and measurable activities of a decommissioning project. In addition, the application of unit cost factors(UCFs) to repetitive tasks is useful [2].

Table I: Comparing the advantage and disadvantage of general estimation methods

Estimating method	Advantage	Disadvantage
Bottom-up	• Most accurate as it accounts for site specific radiological and physical inventory. • Relies on UCFs.	• Requires detailed description of inventory and site specific labor, material and equipment costs for the UCFs.
Specific analogy	• Accurate if prior estimates are appropriately adjusted for size differences, inflation and regional differences in labor materials and equipment.	• Adjustments as noted may require detailed documentation and introduce approximations that reduce accuracy.
Parametric	• Suitable for use for large sites where detailed inventory is not readily available. • Suited for order of magnitude estimates.	• Approximations based on areas or volumes introduce additional inaccuracies. • There is no way to track actual inventory. • Not suited for project planning of work activities.
Cost review and update	• Suitable for large sites where detailed inventory is not available. • Suited for update of previous estimates, or order of magnitude estimates.	• There is no way to track actual inventory. • Generally not suited for project planning of work activities.
Expert opinion	• Suitable when expert opinion of the specific work is available. • Can be used for estimating productivity of smaller tasks based on expert′s experience.	• Expert opinion may not be specific to the work activities. • May not reflect the radiological limitations of the project.

3. Current Status of Overseas NPP Decommissioning Cost Estimation Programs

In the United States(U.S.), decommissioning cost estimations were conducted for not only U.S. research reactors but also Russia, Japan, and Korea through decommissioning costs, exposures and radwaste (DECCER) and cost estimation for research reactors in excel (CERREX). In Japan, NPP decommissioning cost estimations were conducted for JPDR and FUGEN through code system for management of JPDR

decommissioning (COSMARD) and decommissioning engineering support system (DEXUS).

3.1. DECCER

The DECCER program is an exclusive decommissioning cost model of TLG Service, Inc., which conducts NPP cost estimation in the U. S. It has a structure that is consistent with the format and content of NRC Regulatory Guide 1.202. It also follows the basic approach of the AIF/NESP-036 report, which derived the decommissioning list and unit cost factors based on the 1986 commercial NPP decommissioning experience of the american atomic energy industry conference. For items where it is difficult to estimate costs, a contingency fund was added to increase the uncertainty of cost calculation.

3.2. CERREX

CERREX is a program developed by the IAEA to support the decommissioning cost estimation of research reactors during the decommissioning planning process. The assessment is performed based on international structure for decommissioning costing (ISDC) and is calculated using a parametric technique using unit factors. The parametric technique is a method of calculating costs based on system performance or design characteristics using a database for similar systems. The program can collect databases and performance for similar systems, and is useful for assessment compared to estimates using other methods.

3.3. COSMARD

COSMARD reflects the reactor decommissioning project management code system and was established considering the site characteristics. The reactor decommissioning project management code system data is usually classified into three types: activity-dependent, period-dependent, and collateral types. It is configured to perform cost assessment based on work breakdown structure (WBS).

3.4. DEXUS

DEXUS is a program developed to improve safety, reduce radiation exposure, and minimize waste during decommissioning at the Japanese FUGEN NPP. It includes a function to simulate the decommissioning plan using 3D, VR, and visualization technologies in COSMARD, which was developed for the JPDR decommissioning. In addition, since it is based on COSMARD, a decommissioning information management system, there is a cost estimation function within the system.

4. Discussion and Conclusion

Since the cost estimation of NPP decommissioning has high uncertainty, international standards are being proposed to reduce uncertainty. In order to increase accuracy in a situation where there is no actual decommissioning experience, specific presentation of assumptions is necessary. As a result of reviewing various overseas cost estimation programs, a clear understanding of the structure of the NPP to be decommissioned is necessary. This method is generally a cost estimation using the bottoms-up methodology, which is the most widely used method. As shown in Table 1, the bottoms-up method has the disadvantage of having to present a detailed UCF. Therefore, it is judged that detailed research should be conducted to present a specific UCF in future cost estimation methods.

REFERENCES

[1] Financial aspects of decommissioning, IAEA, 2005
[2] The practice of cost estimation for decommissioning nuclear facilities, OECD, 2015