General Approach and Element for Estimating Decommissioning Cost

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1. Introduction

Cost estimation for the decommissioning of nuclear facilities has tended to vary considerably in format and content reflecting a variety of approaches both within and between countries. These differences do not facilitate the process of reviewing estimates and make comparisons between different estimates more complicated. The joint study of OECD/NEA, IAEA and EU was undertaken to propose a standard itemization of decommissioning costs either directly for the production of cost estimates or for mapping estimates onto a standard, common structure for purposes of comparison.

This paper will briefly introduce the general approach and element for developing the decommissioning cost.

2. Approached to Cost Estimation

There are five recognized approaches to cost estimating [1, 2].

2.1 Bottom-up Technique

Generally, a work statement and a set of drawings or specifications are used to "take off" material quantities required to be dismantled and removed, and unit cost factors are applied to these quantities to determine the cost for removal. Direct labor, equipment, consumables, and overhead are incorporated into the unit cost factor.

2.2 Specific Analogy Technique

Specific analogies depend on the known cost of an item used in prior estimates as the basis for the cost of a similar item in a new estimate. Adjustments are made to known costs to account for differences in relative complexities of performance, design, and operational characteristics. It may also be referred to as ratio-by scaling.

2.3Parametric Technique

Parametric estimating requires historical databases on similar systems or subsystems. Statistical analysis may be performed on the data to find correlations between cost drivers and other system parameters, such as units of inventory per item or in square meters, per cubic meters, per kilogram, etc. The analysis produces cost equations or cost estimating relationships that may be used individually or grouped into more complex models.

2.4 Cost Review and Update Technique

An estimate may be constructed by examining previous estimates of the same or similar project for internal logic, completeness of scope, assumptions, and estimating methodology.

2.5 Expert Opinion Technique

This may be used when other techniques or data are not available. Several specialists can be consulted iteratively until a consensus cost estimate is established.

3. Elements of Cost Estimation

There are four basic elements to a cost estimate: BoE (Basis of Estimate), SoE (Structure of Estimate), WBSS (Work Breakdown Structure and Schedule), and RA (Risk Analysis) [3].

3.1 BoE (Basis of Estimate)

The BoE is the foundation upon which the cost estimate is developed. It is based on the currently applicable decommissioning plan for the facility. Consistent and accurate cost estimates rely upon the documentation, procedures and underpinning contained in the BoE. The items of the BoE are shown in the following:

- Assumptions and exclusions
- Boundary conditions and limitation
- Decommissioning strategy
- End state of site to be decommissioned
- Site Type (one or more units)
- Facility overview and site characterization
- Waste management
- Sources of data
- Cost estimating methodology
- Contingency basis
- Discussion of techniques and technology to be applied
- Overview of computer codes or calculation methodology employed
- Schedule analysis

- Uncertainty, Contingency and Management of Risk

3.2 SoE (Basis of Estimate)

The work scope cost elements are broken down into activity-dependent, period-dependent and undistributed costs. Contingency, another work scope element of cost, may be applied to each of these elements on a line-item basis because of the unique nature of this element of cost. Scrap and salvage are other elements of cost where non-contaminated materials may be recycled for reuse, but it must be clear what these terms mean and whether credit was taken for a cost reduction.

- Activity-Dependent Costs

These costs are associated with performing decommissioning activities. This activity includes decontamination, removal, packaging, transportation and disposal or storage, etc. These activities lend themselves to the use of unit cost factors due to their repetition. Work difficulty factors can be added and applied against the physical plant and structures inventories to develop the decommissioning cost.

- Period-Dependent Costs

These costs include activities associated primarily with the project duration: program management, engineering, licensing, health and safety, security, energy, and quality assurance.

- Undistributed-Dependent Costs

These costs are for special items, such as construction or dismantling equipment, site preparations, insurance, property, taxes, health physics supplies, liquid radioactive waste processing. And independent verification surveys.

- Contingency

This item is defined as "a specific provision for unforeseeable elements of cost within the defined project scope, particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events that increase costs are likely to occur [4]."

- Scrap and Salvage

The cost estimate can consider the asset value, e.g., form scarp and salvage, from materials that might be recovered from decommissioning, if necessary.

3.3 WBSS (Work Breakdown Structure and Schedule)

The WBS is used to categorize cost elements and work activities into logical groupings that have a direct or indirect relationship to each others. The work groupings are usually related to the accounting system or chart of accounts used for budgeting and tracking major elements of the decommissioning costs. The WBS elements are generally arranged in a hierarchal format. The topmost level of the WBS would be the overall project. The second level would be the major cost groupings under which project costs would be gathered. The next level would be the principal component parts of each direct or indirect cost category for that cost grouping. The WBS should include a WBS dictionary which describes the associated activities performed or events occurring in the decommissioning program. Decommissioning projects are usually performed in phases or periods describing specific activities of work. The WBSS is identified by decommissioning strategies: Immediate Dismantling, Deferred Dismantling and Entombment [5]. The WBSS should be developed based on the each strategy.

3.4 RA (Risk Analysis)

The RA is a means of dealing with decommissioning project problems that extend beyond the project scope, the risk potentially causing an increase in cost or an opportunity potentially resulting in a decrease in costs. RA has become an integral part of cost and schedule estimating in recent years. RA addresses problems that are beyond the project scope, such as a change in regulations regarding worker exposure limits, site release limits, waste transportation, and a change in waste disposal acceptance criteria, and extraordinary increase in costs for labor, equipment, and consumables, exceptionally difficult decontamination campaigns, extraordinary difficult remote vessel internals segmentation campaigns, or delays caused by stakeholder intervention [3].

4. Conclusion

The ultimate objective of the estimate is to assure adequate funding for decommissioning. The decommissioning cost estimating is highly dependent on the strategies and cost methodologies. The method most widely adopted internationally in estimating is the bottom-up technique, based on a building block approach known as the WBS. Therefore, cost estimator should consider various approaches and elements of cost estimation to achieve the ascension of accuracy.

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