

Guideline to Estimate Decommissioning Costs

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1. INTRODUCTION¹

The primary objective of this work is to provide guidelines to estimate the decommissioning cost as well as the stakeholders with plausible information to understand the decommissioning activities in a reasonable manner, which eventually contribute to acquiring the public acceptance for the nuclear power industry.

Although several cases of the decommissioning cost estimate have been made for a few commercial nuclear power plants, the different technical, site-specific and economic assumptions used make it difficult to interpret those cost estimates and compare them with that of a relevant plant. In addition, it is clear that we are supposed to experience difficulties being created in the estimation process of the Kori-1. Hence we cannot help accepting that some of the variations in the estimate could be unavoidable.

2. COST CLASSIFICATION

Trustworthy cost estimates are crucial to plan a safe and economic decommissioning project. The typical approach is to break down the decommissioning project into a series of discrete and measurable work activities.

An activity broken down is given an appropriate Work Difficulty Factor (WDF) which is used to determine reasonable time period and a Unit Cost Factor (UCF) to calculate its decommissioning costs. The summation of each cost calculated in consistent manner, supported by defensible reference sources of cost data, provides a reasonable basis and builds confidence in the estimate of current and future costs. These cost estimates can then be rolled up periodically to reflect economic, political and technology changes such as inflation, regulations, design modifications or technology.

The types of costs are generally classified into three categories such as Activity-Dependent Costs, Period-Dependent Costs and Collateral or Special Item Costs responding to contingencies. A couple of activities to estimate the costs are delineated as follows.

2.1 Activity Dependent Costs (ADCs)

ADCs are the costs directly related to discrete activities such as decontamination, removal, packaging,

shipping and disposal. They include all labor, materials, energy, equipment and services such as shipping and disposal associated with the "hands-on" activities.

2.2 Period Dependent Costs (PDCs)

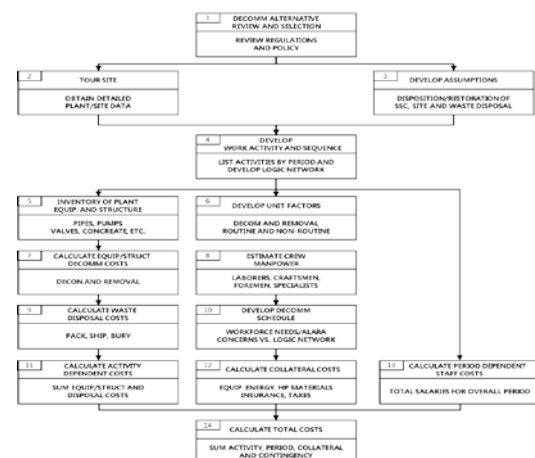
PDCs typically consists of costs difficult to be assigned to any single activity such as project management, administration, routine maintenance, radiological, environmental and industrial safety and security. These costs continue for all the period of the decommissioning project.

2.3 Collateral and Special item Costs (CSCs)

CSCs are normally composed of one-time costs that are not easily assigned to a specific decommissioning activity or period-dependent costs. CSCs could include heavy equipment purchase, health and safety supplies, energy costs, taxes and permits/licenses. In addition, some contingency for unexpected events of indeterminate effect is a part of collateral costs.

3. LOGICAL SEQUENCE OF ESTIMATION

In order to estimate a site specific decommissioning cost as reliably as possible, setting up a logical sequence of cost estimation helps identify the work to be performed during each activity for cost estimating. Fig.1 depicts the flow diagram for the cost estimate development.



Source: AIF/NESP-036

Figure 1. Cost estimate development flow diagram

3.1 Decommissioning Alternative Review

The key to Decommissioning Alternative Review and Selection will be selecting the alternatives to be

¹ The author summarize the report, AIF/NESP-036 to outline the approach of cost estimation for a decommissioning project

analyzed regarding prompt (Decon) or delayed (Safstor) dismantling or the combination of both alternatives. Decommissioning Alternative is the most prerequisite for the estimator to calculate the decommissioning costs.

3.2 Site Tour

The site tour will be a good cornerstone when defining site-specific decommissioning work activities. While they tour the relevant site, the recent drawings and specifications for the plant could be obtained such as copies of general arrangement (GA) drawings, piping and instrumentation drawings (P&IDs), electrical diagrams and plant specifications.

3.3 Assumptions Development

The assumptions should be the basis to identify the essential and non-essential systems, extent and type of decontamination, reactor vessel (RV) and RV internals (RVIs) segmentation, waste packaging, transportation and burial disposition, salvage/scrap criteria, and plant and site restoration. Depending on the assumptions, costs estimate would be fluctuated.

3.4 Decommissioning Work Activity Development

The work activity has the sequence of planning, licensing, detailed engineering, work performance and site/facility closeout.

3.5 Inventory of Plant Equipment and Structures

Estimating a detailed inventory of plant equipment and structures is the basis to calculate the entire cost. This detailed inventory will be used in concert with unit factors to establish ADCs, requirements of management and operations staff and, total project schedule. Table 1 presents the general sources and type of data.

Table 1. Information for Cost Estimate

Information Sources		Information Provided
Final Safety Analysis Report		General description/details of plant design; operation and systems list
General Arrangement Drawings (Building Plans & Elevations)		Building volume, surface area, concrete and steel quantities by building
Equipment/Component Descriptions and Drawings		Component/equipment quantities, weight and dimensions by system
Piping and Instrumentation Drawing (all fluid, HVAC and electrical)		Equipment inventory by system
Isometric Drawing		Pipe sizes, lengths and number of pipe hangers per system
Reactor Vessel/ Internals Descriptions or Drawings		Reactor vessel/ internal weights and dimensions
Property Asset Records		Concrete and steel quantities, by building; component/equipment inventories; quantities, weights, and dimensions; pipe sizes, lengths, numbers of pipe hangers, and cable quantities, by system
Craft Labor Contracts		Craft hourly labor rates/benefits and taxes; hourly travel and subsistence; and contractor overhead and profit
Utility Compensation Plan		Utility plant position, salaries and overhead rates
Radioactive Waste Burial Facility Rate Schedule		Radwaste burial fees and surcharges
Radioactive Waste Transportation rate schedule		Shipping fees and surcharges

3.6 Develop Unit Factors

The first effort in determining activity-dependent costs is to develop unit cost factors. For example Unit Cost Factors (UCFs) for Decon are calculated by applying site-specific craft labor rates. Routine factors are those that may already be available to the estimator while non-routine factors are those that are not commonly

found in the estimator's data base but are necessary to accurately determine costs.

3.7 Program Schedule Development

The estimated durations of work activities and the sequential relationships between activities can be the basis point for a detailed program schedule. For this sake, the estimator should identify and assign the labor hours for critical path activities to establish the overall schedule. The noncritical path work activities can be sequenced in parallel with critical path activities. Normally PERT (Program Evaluation and Review Technique) networks can be used to assist the estimator in the sequencing of decommissioning work activities.

3.8 Activity Dependent Costs

The activity dependent costs are regarding the hand-on equipment decontamination/dismantling and removal activities.

3.9 Period Dependent Staff Costs

The period dependent costs are estimated as a function of work duration representing costs related to specific periods or phases of a decommissioning project. PDCs are expressed in cost per unit time, salary dollars per year, etc. Period-dependent costs consist of project administration, site security, health physics support and quality assurance and the like.

3.10 Total Decommissioning Costs

A best estimate of the actual costs of decommissioning is the sum of the activity dependent, period dependent and collateral costs. But there will always be variances influenced by project assumptions and cost factor accuracy.

4. CONCLUSION

Although plant specific differences derived from the economic and technical assumptions make a licensee difficult to estimate reliable decommissioning costs, estimating decommissioning costs is the most crucial processes since it encompasses all the spectrum of activities from the planning to the final evaluation on whether a decommissioning project has successfully been preceded from the perspective of safety and economic points.

Hence, it is clear that tenacious efforts should be needed to successfully perform the decommissioning project. Furthermore, we should keep focus on the trends and changes of regulations and government policies and the status of a few decommissioning cases performed in other countries.

REFERENCES

- [1] Daniel et. Al, "Guideline for producing commercial nuclear power plant decommissioning cost estimate", AIF Inc.