

## Parameters of Dismantling Techniques Related to Costs for Decommissioning of Nuclear Facilities

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### 1. Introduction

Decommissioning cost estimates are generally based on a detailed decommissioning strategy and a detailed decommissioning plan, and may also be used as a basis for contracting, as a starting point for establishing a project baseline for costs and schedule management, and for cost accounting and scheduling purposes during the decommissioning operation[1]. Reliable cost estimating is one of the most important elements of decommissioning planning[2]. Alternative technologies may be evaluated and compared on their efficiency and effectiveness, and measured against a baseline cost as to the feasibility and benefit derived from the technology. This principle ensures that the cost consideration is economically sound and practical for funding. This paper provides a list with basic review of cutting and dismantling techniques, including some typical characteristics if available, as well as aspects of implementation, parameters of cutting and dismantling techniques in decommissioning costing. This paper gives an overview of the principles of the unit factor approach and its implementation in costing in relation to dismantling activities.

### 2. Parameters of dismantling techniques related to decommissioning costing

#### 2.1 Principles of the unit factor

A method widely adopted in cost estimating is the bottom-up technique. Using this approach, a decommissioning project is divided into discrete and measurable work activities. This division provides a sufficient level of detail so that the estimate for a discrete activity can apply to all occurrences of the activity. Groups of repetitive elementary activities can be identified in decommissioning projects.

Examples of elementary repetitive activities are cutting a unit length of pipe, removing a valve, a pump, or a unit quantity of concrete, etc. The bottom-up principle means that costs are evaluated for each elementary decommissioning activity; the extent of elementary activities corresponds with the decommissioning scenario as presented in the decommissioning plan and with the level of detail of the costing case. In the case of dismantling activities, their extent should be identified in relation to the accepted scenario. Practical costing is carried out by identifying all work activities together with their associated material, equipment and service requirements. Subsequently, an estimate is made of the costs arising from each activity, which is subdivided into a series of discrete and measurable elementary work activities for which unit costs are calculated or estimated - unit cost factor approach. The unit factors define the normalized amount of work related to the unit of input variable for typical decommissioning activities in the decommissioning plan. Unit factors should be adapted for specific conditions at the facility to be decommissioned and to overall decommissioning background related to the case. If for some work activities only limited experience is available, preparing the cost estimate includes a phase-by-phase review of the required data and adequate engineering judgement is needed in order to assess manpower requirements, work efficiencies and time schedules.

#### 2.2 Types of unit factors for dismantling activities

The extent of unit factors depends on the details of the costing approach. For simple cost calculations one cost unit factor may be sufficient in relation to the decommissioning categories. This section gives an overview of the extent of unit factors for a costing approach. In this case, the cost groups necessary for a presentation at the level of

elementary D&D activities are:

- Labor costs related to personnel allocated in relation to the techniques used;
- Investment costs as the cost elements with an investment character;
- Expenses which represent all items of technical media, materials and other items spent during performance of the elementary activity;
- Contingency as the cost element for compensating unforeseen constraints within the scope of the project.

This list of cost groups defines the extent of unit factors which should be developed for dismantling activities. Calculation of labour costs is based on manpower components. So, manpower unit factors are needed for the calculation of manpower as a first step. The investment costs and expenses are in general calculated in two steps. In a first step, the quantities of investment and expense items are calculated and in a second step the costs for these quantities. Remaining cost elements are calculated in direct relation to cost categories. Based on this, the unit factors are classified following:

- Manpower for performing the decommissioning activity;
- Consumption unit factors defined separately for items with investments and expenses character;
- Cost unit factors for individual items listed in the previous paragraph;
- Cost unit factors for investment costs and for expenses not listed in the previous paragraph; the costs are calculated in direct relation to the decommissioning category.

### 2.3 Other data related to dismantling activities

In addition to the above listed unit factors, the following main groups of data for dismantling techniques are required for decommissioning costing:

- Working group data;
- Non-productive working time components and increase factors;
- Data for the procurement of equipment and tools for D&D techniques;
- Generation of secondary wastes and radioactive aerosols.

Some of these data are organised within data sheets for individual dismantling techniques and some within the general database for calculation data.

### 3. Conclusion

In general, proper evaluation of decommissioning costs is important for following issues and relevant measures for achieving the listed aspects are:

- Selection of a decommissioning strategy and activities: several decommissioning options should be evaluated;
- Support to a cost-benefit analysis to ensure that the principle of optimization and reasonably practicable measures are applied: the extent of evaluated decommissioning options should cover all possible scenarios for dismantling activities;
- Estimate of required financial resources for the selected strategy: the selected option should involve the dismantling activities in a structure and extent relevant to real procedure of dismantling activities;
- Preparation of the project schedule, workforce requirements and phased funding needs: dismantling activities should be structured according to the tasks of the decommissioning schedule;
- Definition of measures for proper management and maintenance of resources for safe and timely decommissioning: the time distribution and safety related parameters of dismantling activities should be known.

### 4. Acknowledgement

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### 5. References

- [1] Co-ordination Network on the decommissioning of nuclear installations, Cost Aspects of Decommissioning, Brussels, 2009
- [2] IAEA, Financial aspects of decommissioning, TECDOC-1476, 2005