

**INTERNATIONALLY STANDARDISED COST ITEM DEFINITIONS
FOR THE
DECOMMISSIONING OF NUCLEAR INSTALLATIONS**

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ABSTRACT

Various European decommissioning projects have shown that there are substantial variations in cost estimates for individual installations. Studies to understand the reasons for these differences have been somewhat hampered by the fact that different types of cost estimation methods are used, having different data requirements. Although some uncertainty is inevitable in any costing method, an understanding of the costing methods used in particular projects is useful to avoid key uncertainties. Difficulties of understanding can be encountered and invalid conclusions drawn in making cost comparisons without regard to the context in which the various cost estimates were made.

The above-mentioned difficulties are partly due to the lack of a standardised or generally agreed-upon costing method that includes well structured and defined cost items and an established estimation method. Such a structure and method would be useful not only for project cost comparisons, but would also be a tool for a more effective cost management.

The European Commission (EC), the International Atomic Energy Agency (IAEA), and the OECD/Nuclear Energy Agency (NEA) have all ongoing activities addressing various aspects of decommissioning and decommissioning costs. Based on these concurrent activities and common objectives, and on the advantages of standardised cost item definitions, the three organisations have agreed to jointly prepare and publish a standardised list of cost items and related cost definitions, for decommissioning projects. The work is being carried out by Belgoprocess n.v. in the framework of a shared-cost contract with the European Commission (Nuclear Fission Safety Programme 1994-1998).

The paper presents the result of this co-operative work.

INTRODUCTION

For nuclear facilities, decommissioning is the final phase in the life cycle after siting, design, construction, commissioning and operation. It is a process involving operations such as decontamination, dismantling of plant equipment and facilities, demolition of buildings and structures and management of resulting materials. All these activities take into account

requirements of health and safety of operating personnel and the general public, and any implications for the environment.

In various nuclear decommissioning projects, it has been shown that technical methods and equipment are available to safely dismantle nuclear facilities, of whatever type or size. A lot of experience in the use of these techniques has resulted from maintenance and repair work, and from the decommissioning of prototype, demonstration, and small power reactors or facilities from the nuclear fuel cycle.

The decommissioning projects have also demonstrated that decommissioning costs can be managed. However, comparisons of individual cost estimates for specific facilities may show relatively large variations, and several studies have attempted to identify the reasons for these variations.

In the past, the basis of the cost estimates for decommissioning projects lay in the world-wide experience obtained either in decommissioning projects or in maintenance and repair work at operating nuclear facilities where conditions are to some extent similar. This experience was utilised directly or as an analogue for estimating the costs of similar tasks in current decommissioning projects, or indirectly for the assessment of unit costs for basic decontamination and dismantling activities.

Different costing methods have different data requirements, however, and consequently, their reliability depends on the extent to which various data are available and applicable to the specific case being considered. Independent of the assessment method, some uncertainty is inevitable in all estimates of future costs, and no costing method may generally be superior to others in this respect. However, analysis of the costing method is useful in order to locate the key uncertainties in each specific estimate. It has been shown, indeed, that there is a potential for making errors, and that difficulties can be encountered in performing quick international cost comparisons. Numbers taken at face value, without regard to their context, are easily misunderstood and misinterpreted. This is due, among other things, to the fact that there has been no standardised listing of cost items. Such a standardisation would be useful not only for making cost comparisons more straightforward and meaningful, but should also provide a good tool for cost effective project management.

In the past, a Task Group on Decommissioning Costs of the OECD/NEA Co-operative Programme for the Exchange of Scientific and Technical Information Concerning Nuclear Installation Decommissioning Projects considered and evaluated the reasons for the large variations in reported cost estimates from decommissioning projects [1]. In November 1994, a new Task Group on Decommissioning Costs was set up with similar objectives, looking this time (specifically and separately) at power reactors and fuel facilities.

Similarly, in 1995 the International Atomic Energy Agency began developing a technical document on cost of radioactive waste management and decommissioning of nuclear facilities, and called international experts in a Consultants Group on Decommissioning and Waste Management Costs.

In its 1994-1998 Nuclear Fission Safety Programme the European Commission decided to continue its developments of the database on unit costs in the decommissioning of nuclear installations.

Based on these parallel activities and their similar aims, the three organisations agreed to start a co-ordinated action in order to produce a standardised list of cost items and related cost item definitions for decommissioning projects. Such a standardised list would facilitate communication, promote uniformity, and avoid inconsistency or contradiction of results or conclusions of cost evaluations for decommissioning projects.

OBJECTIVES AND SCOPE

The objectives of the actions are the identification, definition, harmonisation and verification of general and specific decommissioning tasks and relating cost items to create a standardised and uniform list of cost items and their respective definitions for decommissioning projects.

The above-mentioned list as well as underlying principles, were discussed with representatives of the organisations in view of general harmonisation and completeness in order to obtain a standard for a decommissioning cost structure that could be acceptable to the three organisations. The outcome will be described in a final report including:

- the methodology and the terminology used;
- the methodology for managing decommissioning projects at different stages;
- a glossary of terminology used in the decommissioning and waste management sector.

HISTORY AND INITIATION OF A COORDINATED ACTION

In the following sections, an overview is given of the historical steps that contributed to the decision taken to start the co-ordinated action with the European Commission (EC), the International Atomic Energy Agency (IAEA), and the Nuclear Energy Agency (NEA) of the Organisation for Economic Cooperation and Development (OECD), in order to adopt a similar (standardised) or uniform list of cost items and related cost item definitions for decommissioning projects. In addition, it is described how the tasks were organised.

Activities carried out within the OECD/NEA

In 1989, the OECD/NEA Co-operative Programme for the Exchange of Scientific and Technical Information Concerning Nuclear Installation Decommissioning Projects, set up a Task Group on Decommissioning Costs in order to identify reasons for the large variations in reported cost estimates of decommissioning projects. The Task Group gathered cost data from 12 projects in the Co-operative Programme, established a basis for comparison of decommissioning tasks adopted in all projects, prepared a matrix of cost groups and cost items with a cost breakdown in 'labour costs', 'capital equipment and material' and 'expenses', and incorporated the project cost data into this matrix.

One of the lessons learned by the Task Group was the potential for making errors and the difficulties encountered in performing quick international cost comparisons. It was evident that the answers to any cost questionnaire must be analysed and refined by follow-up questionnaires to understand the real contents. Numbers taken at face value, without regard to their context, are easily misunderstood and misinterpreted.

Another important observation the Task Group made is that there was no standardised listing of cost items or estimating methodology established for decommissioning projects.

The initial planning aimed to produce a final report somewhere end of 1996. As a result of the decision to start the co-ordinated action with EC, IAEA, and OECD/NEA, the Task Group decided that the questionnaire and related documents should be sent out to participants after preliminary approval on the list of cost items and cost item definitions within the international co-operation.

Activities carried out within the International Atomic Energy Agency

In its 1995-1996 programme, the IAEA initiated a technical document on cost of radioactive waste management and decommissioning.

The aim was to create a comprehensive list of cost groups, cost elements and cost factors (factors that influence costs) related to waste management and decommissioning from a waste generator/owner point of view.

It was thought beneficial to establish a 'standard' list of terminology, providing definitions of technical and cost terminologies and cost items. It was expected that such a list would facilitate communication, and possibly, encourage common usage among Member States.

The Consultants Group agreed on the following definitions: 'cost group', 'group of tasks', 'cost element', 'cost factor', and 'cost breakdown units' as 'labour cost', 'plant & capital equipment' and 'expenses'. In addition, a list of cost groups and cost items (defined by activities/steps) has been defined for both radioactive waste management and decommissioning, being very similar to the list prepared by the Task Group on Decommissioning Costs of the OECD/NEA Co-operative Programme [2].

The following activities were planned:

- prepare definitions of the technical cost groups, cost elements, and cost factors;
- prepare the questionnaire, send it out to volunteer organisations from Member States, review responses, review and analyse data for consistency and determine if additional clarification is required;
- edit a technical document, including an introduction, analysis of collected data, and case studies.

Activities carried out within the European Commission

In its 1994-1998 specific programme on Nuclear Fission Safety (section C.4, 'Decommissioning of nuclear installations'), the European Commission continued the setting up of decommissioning databases, as well as research and development in the field of the dismantling of nuclear installations, with particular view to issues of environmentally compatible conditioning of radioactive dismantling wastes, the minimisation of radiological impact and the reduction of costs, e.g., by the application of innovative techniques [3, 4].

Objectives of the programme were to develop relevant methodology, to collect, analyse and qualify relevant decommissioning data, to identify, test and evaluate decommissioning strategic planning tools, and to stimulate the exchange of information about the experience from the decommissioning of nuclear installations.

The existing EC DB COST database (costs, occupational doses, waste arising from decommissioning), set up with the co-operation of various partners within the European Union,

was improved by an Oracle 7 environment, allowing 'Windows' like icons, which are easier to apply by common PC-users.

Initiation of a co-ordinated action for decommissioning cost items

Such a standardised list would facilitate communication, promote uniformity, and avoid inconsistency or contradiction of results or conclusions of cost evaluations carried out for specific purposes by different groups.

At a meeting in October, 1995, the Task Group on Decommissioning Costs of the OECD/NEA Co-operative Programme fully supported the idea, considering that they had already adapted their own list to make it completely similar to the list of cost items proposed by the IAEA Consultants Group on Decommissioning and Waste Management Costs.

The results of the discussions within the Task Group on Decommissioning Costs of the OECD/NEA Co-operative Programme were communicated to the technical secretary of the IAEA Consultants Group on Decommissioning and Waste Management Costs, and the proposal to develop a common standardised (uniform) list of decommissioning cost items was presented. The technical secretary considered that this proposal could be a unique contribution to have IAEA Member States talking the same language, also in discussing decommissioning cost items.

The European Commission, Directorate-General "Science, Research and Development" fully supported the idea in a letter of intent exchanged between the EC, the IAEA and the OECD/NEA: the organisations agreed on setting up a common list of cost items for decommissioning operations. Because the work done by the OECD/NEA Co-operative Programme, Task Group on Decommissioning Costs had advanced very well in this area and was, as to the structure, very close to the work done in the IAEA Consultants Group on Decommissioning and Waste Management Costs, the work of the OECD/NEA Co-operative Programme, Task Group on Decommissioning Costs was used as the basis for further discussions.

It was agreed that the three organisations had very similar objectives with respect to cost items for decommissioning operations, i.e.:

- facilitate communication;
- promote uniformity;
- encourage common usage;
- avoid inconsistency or contradiction of results/conclusions of cost evaluations;
- be of interest to all decommissioners.

General principles on co-operation were developed, to be carried out on two levels:

- a technical level, including the work carried out by experts in working sessions;
- a higher level, including follow-up of the co-ordinated action which should be done in a project committee; the director level of the three organisations could join the working party at topical meetings.

The contribution of the European Commission could be incorporated within the EC's 1994-1998 Nuclear Fission Safety Programme. As per EC formalities, the IAEA as well as the

OECD/NEA would be listed as associated partners, having no financial contract with the EC, and being responsible for assuring the participation of their own technical secretaries and experts.

A common final document, including the standardised list of cost items and cost item definitions, should be published.

The representatives also agreed that co-operation could be concluded by organising a common seminar or workshop, where the results of the work could be presented, discussed and demonstrated.

A detailed review of a working document was made, including proposed objectives, work content, project milestones and deliverables, benefits, economic and social impacts, project management structure and partnership. After evaluation, the representatives of the three organisations agreed on the contents of the work programme, and appointed Mr L Teunckens from Belgoproces n.v. (Belgium) as the project co-ordinator.

As a result, it was concluded that the co-ordinated action to produce a standardised or uniform listing of cost items for decommissioning projects with related cost item definitions could start officially on January 1, 1997.

DEVELOPMENT OF A STANDARDISED LIST OF DECOMMISSIONING COST ITEMS AND THEIR DEFINITIONS

Achieving the objectives required identification, definition, harmonisation and verification of the general and specific activities carried out during the decommissioning of nuclear facilities, as well as their relating cost items and include these in a standardised list of cost items for decommissioning projects. The tasks were subdivided into seven areas:

- identification of decommissioning activities and related cost items,
- harmonisation of decommissioning cost items,
- grouping of decommissioning cost items,
- identification of definitions of decommissioning cost items,
- harmonisation of decommissioning cost item definitions,
- identification, definition and harmonisation of cost categories for decommissioning activities,
- final report on standard structure and list of decommissioning cost items.

Identification of decommissioning activities and related cost items

The general and specific decommissioning activities and relating cost items considered in the evaluations or specific projects carried out by the individual participating organisations were identified and listed.

The Task Group on Decommissioning Costs of the OECD/NEA Co-operative Programme on the Decommissioning of Nuclear Facilities provided its proposed list of cost items for decommissioning projects.

Similarly, the International Atomic Energy Agency provided the list of cost groups and cost elements for radioactive waste management and decommissioning defined at the IAEA consultants meeting of June 1995 in Vienna. When considering the structure, this list proved to be very similar to the list prepared by the Task Group on Decommissioning Costs of the

OECD/NEA Co-operative Programme. It was assumed, therefore, that this list could be used as the basis for further discussions.

Preliminary comments on the list of cost items from the OECD/NEA Task Group on Decommissioning Costs and the IAEA Consultants Group were obtained on the database on decommissioning costs (EC DB COST) from the European Commission, as well as two documents giving a description of the structure of the EC DB COST.

The provided information was the basis on which to prepare a standardised list of cost items, cost groups and cost item definitions for decommissioning activities.

Harmonisation of decommissioning cost items

The information received on decommissioning cost items and considered by the three organisations had to be incorporated into one single and uniform list. In several meetings, this list was discussed by representatives of the three organisations with a view to harmonisation and completeness. After discussion, it was considered that the resulting list was a good basis for a single, uniform and agreed reference list of decommissioning cost items for which specific definitions had to be prepared.

Grouping of decommissioning cost items

After harmonisation of the information received about decommissioning cost items discussed in the individual organisations, an overall concept was provided to concentrate the decommissioning cost items of the reference list into groups.

The concept is based on the approaches adopted within the OECD/NEA Task Group on Decommissioning Costs and the IAEA Consultants Group, in which cost items are grouped that are related to activities that are carried out with a similar emphasis, whether or not tied to a similar time schedule for decommissioning, or that are based on overall activities that cannot be categorised in a specific time period.

It is considered that these principles are not in contradiction to the approach adopted in the EC DB COST of the European Commission, in which a number of work packages are defined describing decommissioning tasks and related costs. A work package is considered to be a coherent set of decommissioning activities or tasks that are selected from the standardised list of cost items, and that should be carried out as a part of a decommissioning project or as a decommissioning project itself. It was therefore encouraging to learn that it was decided to bring the organisation of the EC database on decommissioning costs in line with the strategy and the structure as discussed in order to achieve internationally harmonised cost items.

Based on these considerations, eleven cost groups were identified:

- pre-decommissioning actions,
- facility shutdown activities,
- procurement of general equipment and material,
- dismantling activities,
- waste treatment and disposal,
- security, surveillance and maintenance,
- site clean-up and landscaping,

- project management, engineering and site support,
- research and development,
- fuel,
- other costs.

This list of cost groups was presented to, and then adopted by, the representatives of the three co-operating organisations.

Identification of definitions of decommissioning cost items

As a next step, the identification and listing of the definitions of the general and specific decommissioning activities and relating cost items considered in the evaluations or specific projects carried out by the individual participating organisations was started.

The Task Group on Decommissioning Costs of the OECD/NEA Co-operative Programme on the Decommissioning of Nuclear Facilities, provided definitions for the decommissioning activities considered in their evaluations. These definitions were elaborated at cost item and/or sub-item level.

Together with the list of cost groups, cost elements and cost factors for radioactive waste management and decommissioning defined at the IAEA consultants meeting in June, 1995 in Vienna, the IAEA also provided publication ISBN 92-0-103493-8, IAEA Waste Management Glossary, as well as Safety Series No. 111-F and No. 111-S-1 glossaries, in order to be used when preparing a draft of decommissioning cost item definitions based on the proposed standard terminology.

Similarly, an overview of the working groups (elements of cost item definitions) and related work packages (cost items) considered in EC DB COST was obtained as well as a description of its structure.

As this was the main information existing within the three co-operating organisations, it was considered to be the basis for developing the definitions for the proposed single and standardised list of cost items for decommissioning operations.

Harmonisation of decommissioning cost item definitions

The information received from the individual organisations was evaluated, compared and compiled into one document by the co-ordinator (L Teunckens) in order to present a draft for a single and standardised list of cost items, cost groups and cost item definitions.

It should be re-emphasised that, as indicated in Section 4.3, the concept is based on the approaches adopted within the OECD/NEA Task Group on Decommissioning Costs and the IAEA Consultants Group, and that the principles are not in contradiction to the approach adopted in the EC DB COST, in which a number of work packages are defined describing decommissioning tasks and related costs.

As a result, definitions for the cost items in the standardised list were prepared considering that:

- decommissioning activities include an inventory of a coherent set of tasks, that cover the specific aspects that may have to be dealt with during the decommissioning of a nuclear facility, whether or not a specific task will be executed in a specific decommissioning project;
- processes or work packages comprise a selection of a coherent set of decommissioning activities or tasks that must be carried out as a part of a decommissioning project or as a decommissioning project itself;
- a global decommissioning project with a specific cost comprises a selection of processes or work packages, being as such a collection of dedicated decommissioning activities grouped in specific processes/work packages, that may be universally and independently selected from the standardised list of decommissioning cost items based on the specific application defined in the project itself.

A fair agreement was obtained with the OECD/NEA Co-operative Programme on the Decommissioning of Nuclear Facilities. Comments were also received in a written form from representatives of the OECD/NDC, as well as from the IAEA.

To fit EC DB COST, subdivision of cost item definitions into sub-items in order to allow specific identification and comparison of the available information was required and received from the EC DB COST group.

Based on the comments and the additional considerations received, a new version of the proposed standardised list of decommissioning cost items and related cost item definitions was prepared, including the comments and considerations received, except for the ones not in harmony with the general concepts described in the foregoing sections of this document.

Identification, definition and harmonisation of cost categories for decommissioning activities

In the evaluations or specific projects carried out by the individual participating organisations, the costs resources for the general and specific decommissioning activities and relating cost items are mostly split up in cost categories. A cost category specifies the nature of the cost, e.g., depreciation costs, salary costs, building rent, etc., and related cost categories may be grouped. The identification and listing of these cost categories and their specific definitions was also completed.

The Task Group on Decommissioning Costs of the OECD/NEA Co-operative Programme on the Decommissioning of Nuclear Facilities, provided its proposed list of cost categories compiled into groups as well as definitions for the cost categories or groups involved.

Similarly, the International Atomic Energy Agency provided the list of cost categories and the definitions related to radioactive waste management and decommissioning proposed at the IAEA consultants meeting of June, 1995 in Vienna.

As mentioned before, also a description of the structure of the EC DB COST and an overview of the work packages (cost items) and working groups (a kind of cost item definitions) considered in the EC DB COST database were received.

The information received was compared and compiled into one list, presenting a draft for a single and a standardised list of cost categories and related definitions. This list was discussed

with representatives of the three organisations in order to harmonise and complete the proposed overview of cost categories, similar as was done for the decommissioning cost item definitions.

Report on proposed standard list of decommissioning cost items

It is intended to produce a document describing the history, the scope, the implementation of the co-ordinated action to develop a standardised list of decommissioning cost items and cost groups, including their respective definitions.

It should be a comprehensive document trying to give a first answer to the detailed comments, questions and remarks received during the last few years, and containing underlying principles reviewed for consistency by the participating organisations.

CONCLUSIONS

The European Commission (EC), the International Atomic Energy Agency (IAEA), and the OECD/Nuclear Energy Agency (NEA) have ongoing activities addressing various aspects of decommissioning and decommissioning costs. Based on these concurrent activities and common objectives, and acknowledging the advantages of standardised cost item definitions, the three organisations have agreed to carry out a co-ordinated action to establish a standardised list of cost items and related definitions for decommissioning projects. Such a standardised list should mainly facilitate communication, promote uniformity, and avoid inconsistency or contradiction of results or conclusions of cost evaluations for decommissioning projects.

The co-ordinated action required identification, definition and verification of general and specific decommissioning activities and relating cost items.

Lists of decommissioning cost items and related definitions were received from each partner in the project, and their harmonisation carried out taking into account the underlying principles of the different organisations.

During the entire co-ordinated action, good progress was made in all tasks defined, thanks to the effective support the co-ordinated action received from the three organisations, and in particular thanks to the high effectiveness of the project co-ordinator (Belgoprocess). Links have been forged with other relevant projects and with other organisations that are interested to contribute to the general objectives of the programme. During the co-ordinated action, the initiative also obtained a growing interest from a lot of other organisations/companies involved in decommissioning all over the world. It is agreed to publish an interim technical document containing the standardised list of cost items and their definitions in the first half of 1999.

Although ultimately it is hoped that the standardised list will achieve wide acceptance and use, it is recognised that at this stage the list has achieved approval in theory but should be further evaluated in practice. It is therefore proposed that this list be viewed as an interim version, to be broadly distributed, discussed and used, and to be finalised, most effectively in a workshop format, after approximately three years. At that point, a more definitive and more broadly tested and supported list will be issued as a report.

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