

ESTIMATION OF NUCLEAR FACILITY DECOMMISSIONING COSTS

CURRENT STATUS AND PROSPECTS



It is now common practice to prepare decommissioning plans and associated cost estimates for nuclear power plants and other nuclear facilities even before the start of construction. Typically these plans and estimates are updated regularly during plant operation, in the transition period after shut down, and during decommissioning. Specific requirements on contents of the plan are usually set out in regulation, which has its basis in national legislation.

Transparent, underpinned cost estimates have a number of important functions. They provide: a rationale for the chosen decommissioning strategy, a basis for assessing the cost-effectiveness of the decommissioning activities, and a basis for ensuring the necessary funds are available when needed to cover the actual cost of decommissioning. Practices for estimating decommissioning costs vary across countries and projects. Efforts are being made to improve cost comparability.



Status of cost estimation for decommissioning

Most countries have established requirements for cost estimation and reporting. For nuclear power plants and other commercial facilities, legal requirements include the preparation of a decommissioning plan and associated cost estimates, with periodic updates - usually every three to five years.

National regulations include both administrative and substantive requirements. Substantive requirements generally relate to explaining and justifying boundary conditions and assumptions used to calculate cost estimates. Examples of boundary conditions include the year of the estimate, possible site end states, characteristics of the facility or waste clearance limits, as well as the expected decommissioning activities. The latter may include facility characterisation, transitioning from operation to dismantling, waste processing, legacy waste disposition, spent fuel disposition, storage, transportation and other materials management activities. Assumptions regarding contingency costs and the labour market are also to be reported. In some countries, substantive requirements stipulate the use of present value costs and means for handling escalation.

Periodic updates and reviews are carried out in light of the fact that the timeframe for active decommissioning comes several years or even decades after the initial estimate is made.

The nuclear safety regulator plays an important role in the review and approval of decommissioning plans and, in some cases, decommissioning cost estimates and funding plans. Some regulators require a cost-benefit analysis or the equivalent for assessing alternative decommissioning technologies and techniques. Reviewing cost estimates regularly and comparing them with the actual cost of decommissioning activities ensures the quality of these estimates.

Most countries have adopted an internally consistent formal structure for estimating and reporting costs. There is variability from country to country, however, in the methodology.

To structure their estimates, many countries have adopted a breakdown into activity-dependent and period-dependent costs. These cost breakdowns can be used to divide decommissioning financing into tranches; it is likely that there is greater confidence in the more immediate tranches. Several countries reflect the degree of confidence by specifying different contingency factors for different tranches of the project.

Contingencies and uncertainties

In order to comprehend and address cost escalation two concepts are important: "contingency" and "uncertainty".

In preparing and managing cost estimates the concepts of "contingency" and "uncertainty" are important.

"Contingency" addresses potential increases in the defined cost of an activity item and is specific to that item. When increases occur these are mainly due to the novelty of some of the tasks. However, the overall contingency of completed projects is usually limited to between 10 and 30 %.

"Uncertainty" is the word used to refer to cost variations from causes outside the control of the project, such as currency exchange rate fluctuations, unex- →

pected inflation rates, regulatory changes, availability of new technologies or disposal routes, etc. The effect of uncertainty on project costs can be much greater than that of contingency factors. Various approaches are used for dealing with uncertainty, and each country may use a different combination of tools, such as numerical simulations or scenario analysis.

Challenges in comparing the costs of decommissioning projects

The most significant cost elements and their ranking as cost drivers within a decommissioning project are:

- Scope of work through to the endpoint of the site.
- Regulatory requirements, including detail of reporting and clearance levels.
- Stakeholders' demands.
- Characterisation of physical, radiological, and hazardous materials inventory.
- Waste processing, storage and the availability of ultimate disposition facilities.
- Disposition of spent nuclear fuel and on-site storage prior to emplacement in a permanent repository.
- Clean structure disposition and disposal of the site for new developments.
- Contingency application and use in estimates.
- Availability of experienced personnel with knowledge of the plant.
- Assumed duration of the dismantling and clean-up activities.

The elements shown in the left column have been found to drive costs in the actual decommissioning of plants that have not undergone a major accident. Most of these elements are outside the control of the project and are affected by uncertainty. Cost figures should not be taken at face value unless these elements and their history are specified in comparative tables.

In general, only a range of values can be given for the costs of decommissioning projects; median or average cost values should not be given. Better comparability is achieved by benchmarking the cost ranges of specific decommissioning activities rather than of entire projects.

It must be considered further that the cost of decommissioning projects will vary with the number of facilities or units on the same site and with the degree of experience from previous decommissioning activities. These factors will affect the efficiency of processes or alternative strategies.

Overall, these normal sources of variability make it challenging to compare entire project costs across projects and countries.

Progress in cost comparability

The NEA, the EC, and the IAEA have developed an international structure for estimating and reporting decommissioning costs that will facilitate cost reporting, transparency and comparability.

Any decommissioning project can be broken down into a series of technical and non-technical activities. The new (2012) International Structure for Decommissioning Costing (ISDC), developed from the previous 'Yellow Book' (1999), is based on such activity items in an attempt to aid cost comparisons. The ISDC general cost platform considers typical decommissioning activities and cost categories. The ISDC document provides guidance in establishing the basis of the estimate (assumptions, boundary conditions, end points, costing methodology, etc.). It includes a detailed guide for preparing structured cost estimates and contains an example to follow.

Additional international guidance is under preparation.

Additional guidance based on an Earned Value Management System (EVMS) is under preparation at the OECD/NEA. The EVMS is now being adopted in many large government programmes and some commercial projects as an effective tool for cost control.

THE MOST IMPORTANT CONSIDERATIONS IN ENSURING STABLE AND MORE ACCURATE DECOMMISSIONING COST ESTIMATES INCLUDE: AVOIDING CHANGES IN PROJECT SCOPE, FIXING REGULATORY STANDARDS DURING THE PLANNING PHASE TO AVOID DELAYS DURING ACTIVE DECOMMISSIONING, AND ACCURATE CHARACTERISATION OF MATERIALS AND SOIL. COMPARABILITY OF ENTIRE PROJECT COSTS IS DIFFICULT TO ACHIEVE AND COST FIGURES SHOULD NOT BE TAKEN AT FACE VALUE UNLESS ALL BOUNDARY CONDITIONS AND ASSUMPTIONS ARE MADE CLEAR. IT IS ADVISABLE TO BENCHMARK THE COSTS OF SPECIFIC ACTIVITIES RATHER THAN OF ENTIRE PROJECTS. AN INTERNATIONAL STRUCTURE FOR DECOMMISSIONING COSTING (ISDC) IS NOW AVAILABLE THAT ALLOWS BETTER COMPARABILITY OF THE COSTS OF SPECIFIC ACTIVITIES. INDUSTRY, GOVERNMENTS AND REGULATORS ARE INVITED TO MAKE USE OF THE ISDC AND TO PARTICIPATE IN IMPROVING GUIDANCE, E.G., THROUGH THE ACTIVITIES OF THE OECD/NEA WORKING PARTY ON DECOMMISSIONING AND DISMANTLING.