

**The DOE ROM Methodology
Estimating D&D Costs and Waste Volumes
for
Life Cycle Maps**

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The Department of Energy (DOE) Office of Environmental Management (EM) does not currently have defensible, comprehensive estimates for the cost and quantity of waste that will be generated from its deactivation and decommissioning (D&D) activities over the next several decades. In addition, viable estimates do not exist for the cost and waste generation for the D&D of DOE Defense Program (DP) and Nuclear Energy (NE) program facilities. Those facilities are currently slated for transfer to EM over the next several decades. Long-term cost and waste volume estimates are needed to assist EM in developing strategies for establishing site baselines, evaluating mortgaged activities, reducing the funding gap, and identifying impacts on waste management facility schedules. The rough order magnitude (ROM) methodology rapidly establishes cost estimates for all phases of future D&D projects. The ROM methodology also rapidly provides waste volume estimates for hazardous, radioactive, mixed, and industrial landfill wastes that will be generated during D&D activities.

ROM Cost Estimating

The INEEL has developed an estimating methodology tool to establish ROM cost estimates for planned D&D activities. The ROM cost methodology was developed to estimate the three cost categories of primary concern for a D&D program. Those categories are decommissioning, deactivation, and surveillance and maintenance (S&M). The methodology is based on available data from completed facilities. Experience has shown the ROM estimates created by the methodology to be within $\pm 41\%$ of detailed cost estimates. The ROM estimates are typically developed for facilities with D&D activities planned four or more years in the future. A more accurate, traditional detailed cost estimating technique is used for facilities in the near term planning and budget cycle.

Decommissioning ROM Cost Estimating

The ROM cost estimating methodology considers the decommissioning cost the fundamental parameter for estimating the lifecycle D&D cost for a facility. The decommissioning cost of a facility is estimated by multiplying the square footage by a historical demolition rate (\$/square foot) for that size of facility and several adjustment factors. The adjustment factors reflect the current state and history of the facility operations and building systems. The adjustment factors are qualitative values that are established by local experts with a working knowledge of the facility. Each category, except construction type, is rated as high, average, or low for a facility. Construction type is designated as concrete, concrete block, steel, or miscellaneous. The experts assess each facility for asbestos, other hazardous constituents, radioactive constituents, systems

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complexity, characterization requirements, construction type, and entombment applicability. Numerical values for the factors correspond to historical waste volumes recorded from completed decommissioning activities. Applying the cost factors must be conducted carefully in order to achieve credible cost estimates. It should be noted that the ROM cost estimates do not include waste disposal or transportation costs.

S&M and Deactivation ROM Cost Estimating

Experience at the INEEL has led to a methodology for estimating S&M and deactivation costs based on the estimated decommissioning cost. These costs are estimated as follows:

- Deactivation cost is estimated to be 10% of the estimated decommissioning cost
- Initial year S&M cost is estimated to be 3% of the estimated decommissioning cost
- Annual S&M costs are estimated to be escalated at a rate of 5% per year due to facility degradation
- S&M cost for the last year of deactivation is estimated to be 25% of the estimated S&M cost of the next to last year of deactivation
- S&M costs are estimated to be zero during and after decommissioning.

The five percent annual escalation in S&M costs is primarily due to aging of facilities (e.g., roofs start to leak, pipes corrode, etc). S&M costs are generally reduced significantly by the completion of the deactivation phase. S&M activities during the decommissioning phase drop off rapidly and are absorbed in the decommissioning ROM cost estimate.

ROM Waste Volume Estimating

Another important aspect of analyzing impacts to EM is that of D&D waste generation and disposition. DOE sites and DOE-HQ do not currently have a defensible estimate for the life cycle quantity of waste that will be generated from D&D activities. Therefore, the impact of D&D waste volumes on existing or planned waste management treatment, storage, and disposal (TSD) facilities cannot be determined. In addition, EM must identify and plan for disposition of unknown waste volumes that will be generated during the D&D of DP and NE facilities slated for transfer to EM. These additional wastes increase the uncertainty EM already faces in determining future capacity and technology needs at TSD facilities from D&D activities.

The ROM methodology for estimating waste volume is based on historical data from completed D&D projects. The model includes formulas for each of the major waste types that will be generated during D&D activities. The waste types are combustible and compactable low-level radioactive waste; non-compactable and non-combustible low-level radioactive waste; hazardous waste; mixed waste; industrial landfill asbestos waste; and other industrial landfill waste.

The waste volume generated during the decommissioning of a facility is estimated by multiplying the square footage by a historical waste type generation rate (cubic feet/square foot) and several adjustment factors. The same facility ratings (high, average, and low) assigned by local experts are used in the waste volume estimates, as in the cost estimate, but the corresponding numerical values are based on historical waste generation instead of costs. In addition, only certain combinations of the factors are used for specific waste types. For instance, hazardous waste estimates are based only on the ratings for hazardous constituents, system complexity, and entombment applicability. The waste volume generated during facility deactivation is estimated to be ten percent of the volume estimated for facility decommissioning. Estimates for non-radioactively contaminated facilities also include the volume of recyclable material that will be generated, but eliminate estimates for all categories of low-level radioactive and mixed waste.

Life Cycle Mapping

The LCM process is a two-phased approach for baseline development. The first phase rapidly incorporates the ROM D&D program cost and waste generation estimates into a visual map depiction. During the second phase, analysis of costs, waste volumes, TSD schedules, and technology development schedules are conducted to identify long-term management solutions for D&D activities. This information helps EM identify and evaluate mortgage obligations, funding gaps, waste generation needs, and technology barriers that are inhibiting the ability to meet deactivation or D&D goals. Analysis of the information will assist EM in developing alternative management approaches to lower overall mortgage obligations and reduce funding gaps through improved task prioritization, TSD facility coordination, and focused technology development. As part of the methodology development, a feedback loop will be used to refine the process and improve analysis. In addition to providing an analysis tool for existing EM scope, the LCM methodology will be essential in evaluating the programmatic impact of accepting facilities from NE and DP for final disposition.

Conclusion

In order to evaluate long-term planning options, EM must have a better understanding of the magnitude of the mortgaged activities targeted for completion and the spending gap faced in meeting those commitments. A standard methodology for developing LCMs, ROM costs, and ROM waste volumes for D&D activities will help establish a consistent set of D&D baseline plans. Those baseline plans will provide a basis for understanding the magnitude of the long-term D&D mortgage. Options analyses using those baselines will result in higher confidence alternative selection regarding mortgage and spending gap reduction. EM needs a better understanding of the D&D mortgage and the operational impacts the D&D program will have on waste management activities at the site level in order to achieve the long-term goals of the program. Through this analysis, EM will achieve that understanding and establish the basis for executing a long-term, national strategy to for completing mortgaged activities and reducing the spending gap.