AACE® International Recommended Practice No. 107R-19

COST ESTIMATE CLASSIFICATION SYSTEM – AS APPLIED IN ENGINEERING, PROCUREMENT, AND CONSTRUCTION FOR THE ENVIRONMENTAL REMEDIATION INDUSTRIES

TCM Framework: 7.3 – Cost Estimating and Budgeting

Rev. August 7, 2020

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1. PURPOSE

As a recommended practice (RP) of AACE International, the Cost Estimate Classification System provides guidelines for applying the general principles of estimate classification to project cost estimates (i.e., cost estimates that are used to evaluate, approve, and/or fund projects). The Cost Estimate Classification System maps the phases and stages of environmental remediation project cost estimating together with a generic project scope definition maturity and quality matrix, which can be applied across a wide variety of environmental remediation industries.

This recommended practice provides guidelines for applying the principles of estimate classification specifically to project estimates for engineering, procurement, and construction (EPC) work for environmental remediation industries. It supplements the generic cost estimate classification RP 17R-97 [3] by providing:

- A section that further defines classification concepts as they apply to environmental remediation industries.
- A chart that maps the extent and maturity of estimate input information (project definition deliverables) against the class of estimate.

As with the generic RP, the intent of this document is to provide common terms to improve communications among all the stakeholders involved with preparing, evaluating, and using project cost estimates specifically for the environmental remediation industries.
The purpose of this recommended practice is to provide the environmental remediation industry with a project definition deliverable maturity matrix in addition to the general information provided in RP 17R-97.

This RP focuses on Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remedial projects and United States Resource Conservation and Recovery Act (RCRA) corrective action projects, as well as decontamination and demolition (D&D), ordnance and explosives cleanups, and other environmental cleanup work. This RP includes estimates for work encompassing the entire environmental remediation life cycle and thus could be applied to cost estimates for closure/post-closure of regulated facilities (e.g., hazardous waste facilities under RCRA); mine reclamation; asbestos abatement prior to demolition of a building. In addition, this legislative framework can be applied towards both local as well as international laws and regulations that follow similar processes for contaminated site characterization, cleanup and closure.

This regulatory framework also provides a general representation of the relationship between specific release site characterization and other design input data and design deliverable maturity to the estimate accuracy and methodology used to produce the cost estimate. The estimate accuracy range is driven by many other variables and risks, so the maturity and quality of the scope definition available at the time of the estimate is not the sole determinate of accuracy; risk analysis is required for that purpose. The project maturity is indicated by percentage completion or the extent and types of input information available that include project scope definition, requirements documents, specifications, project plans, drawings, calculations, learnings from past projects, and other information that must be developed to define the project. The set of deliverables becomes more definitive and complete as the degree of project definition progresses. This is listed in detail in Table 3 (see below).

This document is intended to provide a guideline, not a standard. It is understood that each enterprise may have its own project and estimating environmental remediation terminology and may classify estimates in other ways. This guideline provides a generic and generally acceptable classification system for the environmental remediation industries that can be used as a basis for comparison. This recommended practice should allow each user to better assess, define, and communicate their own processes and standards in the light of generally-accepted cost engineering practice.

2. INTRODUCTION

For the purposes of this recommended practice, the term environmental remediation refers to the process of bringing contaminated properties into environmental compliance under the U.S. Resource Conservation and Recovery Act (RCRA) and the U.S. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Typically, CERCLA addresses cleaning up the release of toxic and hazardous substances from soil, groundwater, and facilities. RCRA is focused on the safe and protective management of wastes from currently operating facilities as well as facilities where hazardous waste is stored. It is also applicable to certain wastes generated by CERCLA cleanups and in some instances serves as the regulatory basis for the entire site cleanup. These U.S. federal acts provide well understood frameworks for environmental remediation, and they can serve as a proxy for other regulations at the state and local level. In addition, this legislative framework can apply towards similar international laws and regulations. RCRA and CERCLA follow very similar site closure processes, which require liability owners to assess the extent of environmental contamination and the associated environmental risks, receive public/stakeholder input, and submit preferred alternative proposals to regulatory agencies or a magistrate for approval; and then, upon approval, carry out an executable project(s) to achieve contaminated site closure.

1 CERCLA, the United States public law also known as Superfund, which includes improvements and additions provided by the Superfund Amendments and Reauthorization Act of 1986 (SARA).
2 The Resource Conservation and Recovery Act (RCRA) is the United States public law that creates the framework for the proper management of hazardous and non-hazardous solid waste.
3 Seek legal counsel in your jurisdiction for specific application of these principles.
Although CERCLA is the predominant legislation for regulating cleanup, if the wastes associated with the cleanup site are listed on the RCRA hazardous waste list then that legislation is applicable.

This recommended practice addresses cost estimate classification solely in environmental remediation projects, programs and portfolios. It is important to note that this RP focuses on environmental remediation in response to the result of the release of toxic and hazardous substance. However, it does not include major capital construction projects such as building a wastewater treatment system for a manufacturing facility.

The cost estimates discussed in this recommended practice are for the full lifecycle costs for a remedial cleanup solution from initial investigations through site closure, including long term term surveillance and long-term maintenance (SLTM) (also referred to as long term surveillance or long term stewardship) that may extend for many years. Although these costs are often easily estimated and high quality estimates can be readily performed, very often there is uncertainty as to how many years these activities will need to be performed, creating uncertainty in the estimated costs for this phase.

Also, this RP does not cover the costs associated with research and development of remedial technology, the costs associated with regulatory or community relations, or the additional liability (e.g., tort) that may be associated with contaminated properties. Also, care must be taken in using this document for accounting environmental liabilities, which are subject to specific financial accounting standards. This is described in detail in a monograph discussing using the TCM Framework for a variety of environmental cost estimates [4]. Cost estimates for accounting and financial reporting of environmental remediation liabilities may be based on engineering cost estimates. However, the user of this RP should be aware that estimates for financial accounting and reporting of environmental liabilities may require the use of different timeframes for operations and maintenance (O&M) and monitoring; assumptions; quantities; unit prices; contingency allowances; time value of money (interest and discount factors); and other variables than would be used in cost estimates for day to day execution of the remediation project.

When applying this RP to cost estimates for environmental remediation that may or will be used for financial accounting and reporting, the estimator should consult with the entity’s financial management. Also, the Statement of Federal Financial Accounting Standards (SFAS) 5, Accounting for Liabilities of the Federal Government [5] outlines the specific requirements for stating government liabilities. However, there is guidance available where many of the challenges for the estimates reported for environmental liabilities can be constructed to be fully aligned with best cost engineering practice [6]. There is also a standard available for state and local governments, Governmental Accounting Standards Board (GASB) Statement 49 [7]. In addition to the aforementioned cost accounting standards the Financial Accounting Standards Board (FASB) Accounting Standards Codification (ASC) Topic 410, Asset Retirement and Environmental Obligations, as well as ASC 410-30 (for corporations): ASC 410-30, "Asset Retirement and Environmental Obligations" [8].

3. Cost Estimate Classification Matrix for the Environmental Remediation Industries

Table 2 provides a summary of the characteristics of the five estimate classes. The maturity level of project definition at the point at which the estimate is being made is the sole determining (i.e., primary) characteristic of class. In Table 2, the maturity is roughly indicated by a percentage of complete definition; however, it is the maturity of the defining deliverables that is the determinant, not the percent. The other characteristics are secondary and are generally correlated with the maturity level of project definition deliverables, as discussed in the generic RP [1]. The specific deliverables, and their maturity or status are provided in Table 4. The post sanction (post funding authorization) classes (Class 1 and 2) are only indirectly covered where new funding is indicated. Again, the characteristics are typical but may vary depending on the circumstances. With minor variations in the definitions, the following phases of the environmental remediation project life-cycle generally apply to all environmental cleanup projects and
programs including remediation, decontamination and decommissioning, ordnance and explosive cleanups, and other environmental work.

3.1. Phase 1: Site Investigations - Assess and Inspect Site, and Prepare Site Inspection Reports

In CERCLA, the first step includes the preliminary assessment (PA) and the site inspection (SI). The PA consists of collecting readily available property information, including a site visit to determine if potential contamination exists on the property due to former activities. Once there is information that a potential release has occurred on a property the SI is executed. The SI involves confirming and supplementing PA-phase information through limited environmental sampling to address a relative risk as it relates to human health and the environment.

In RCRA, work similar to the CERCLA preliminary assessment/site inspection (PA/SI) is performed in the RCRA Facility Assessment (RFA) which is a four-stage process for identifying and gathering information on releases and making preliminary determinations about the need for further investigations and interim actions.

After the site is characterized there are two general types of responses to releases of hazardous substances into the environment:

- Remediation is the study, design, and construction of long-term actions directed toward permanent remedy; and
- Removal actions (known in RCRA as an interim measure [9]) are short-term actions to stop, avoid, minimize, stabilize, alleviate, or eliminate a release or the possibility of a release.

Removal actions can result in significant savings to the cost and schedule for cleanup projects [10] or as permanent or part of permanent solutions [11, 12].

3.2. Phase 2: Conduct Detailed Site Investigations and Characterization

This phase includes risk assessment, characterization and investigations, development and analysis of treatment or remediation options, and treatability studies. In addition, the feasibility of various remedial alternatives are evaluated.

In CERCLA, this is managed through the remedial investigation/feasibility study (RI/FS) process which is used to gather the information and conduct the studies and analysis necessary to select a remedy for the site that will meet the statutory and regulatory requirements for cleanup and satisfy the requirements of the stakeholders. This includes gathering and addressing all of the Applicable or Relevant and Appropriate Requirements (ARARs) that apply to this project, as required by Section 121(d) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 as a part of this detailed investigation and planning phase. A significant factor involves the role of cost in the RI/FS process. In reviewing the selection of alternatives cost-effectiveness of site remediation needs to be considered while ensuring reliable protection of human health and the remediation of the environment [13]. Although the aforementioned reference applies to the RI/FS stage the principles of balancing cost effectiveness to protecting human health and protecting the environment should be considered throughout the life cycle of environmental remediation projects, programs and portfolios. [11, 12, 14]

The feasibility study portion of the RI/FS includes a review of alternatives based on how well they satisfy the compliance criteria, including costs; which is an important first step of environmental cost estimating. The RI/FS is followed by the proposed plan for implementing the preferred alternative. The proposed plan is a key step in the remedy selection process. It summarizes the remedial alternatives evaluated in the FS and specifies the preferred cleanup method. The public is offered the opportunity to comment on the proposed plan prior to a final decision.
The final step in the remedial alternative selection process is the record of decision (ROD) approved by the appropriate regulatory authority.

In the case of removal actions, the engineering evaluation/cost analysis (EE/CA) is the analogous document to the RI/FS but it is less comprehensive. The EE/CA report contains a comparative analysis of removal action options for a Superfund hazardous waste site. [12] The goals of the EE/CA are:

1. Satisfy environmental review requirements for removal actions;
2. Satisfy administrative record requirements for improved documentation of removal action selection; and
3. Provide a means for evaluating and selecting alternative technologies.

The EE/CA process is the procedure used by response personnel to develop, evaluate, and select a removal action. This report is the document that records this analytical process. A formal EE/CA report is required for all non-time-critical removal actions/expedited response actions. For other non-time-critical removal actions, site documents can be expanded to provide better documentation of the analysis of removal action options. To the extent possible, such documents should address the major elements of the formal EE/CA, as described in its guidance. [15]

In the RCRA corrective action process, the nature and extent of contamination is evaluated through a RCRA Facility Investigation (RFI), which is followed by a Corrective Measures Study (CMS). The RFI/CMS is analogous to the RI/FS process under CERCLA.

Decision Document:

In CERCLA, following the public comment period (initiated during the proposed plan) the proposed remedy is considered prior to developing the final cleanup remedy. The final remedy is required to be selected from remedies that are protective and address all ARARs. Compliant alternatives are evaluated based on:

1. Long-term effectiveness and permanence;
2. Reduction of toxicity, mobility, or volume through treatment;
3. Short-term effectiveness;
4. Ability to implement; and
5. Cost

RCRA requirements can add them as part of the ARARs. The selected remedy is summarized in the record of decision. The ROD documents all facts, analyses of facts, and site-specific policy determinations considered in the course of selecting a remedial action, and how the remedy selection criteria were used to select the remedial action for a site. It serves as the legal document that certifies the remedy selection process was carried out in accordance with CERCLA and how the selected remedy is protective of human health and the environment. The ROD defines applicable federal and state requirements that are relevant and appropriate to the site; it explains how the remedy eliminates, reduces, or controls exposure. The ROD also defines how the remedy is cost-effective in employing treatment that permanently and significantly reduces the toxicity, mobility, or volume of the hazardous substances, pollutants, or contaminants. Details concerning the role of cost in the remedy selection process are established in existing law, regulation, and policy with regard to CERCLA (including SARA and related legislation) [11, 13].

In RCRA, the analogous decision document to a ROD is the statement of basis or the permit modification.

### 3.3. Phase 3: Remedial Design - Engineering Design and Pre-construction Activities for Treatment or Remediation of the Selected Alternative