

# ATTACHMENT 20: Feasibility Study (FS) Cost Estimate Guidelines

## INTRODUCTION

The cost of implementing an ISCO design is a key factor for determining its feasibility versus employing alternative remediation techniques. This attachment describes the recommended components of an FS cost estimate, and provides a link to an example FS cost estimate exercise. The FS cost estimate process should be initiated only after having completed all preceding ISCO Conceptual Design processes beginning with the selection of a target treatment zone (TTZ) and concluding with the refinement of the final conceptual design. The information contained in this guidance and illustrated in the example is provided as a recommended level of detail to be included at the FS stage of an ISCO project. Users are encouraged to review the [EPA's \(2000\) Guide to Developing and Documenting Cost Estimates During the Feasibility Study](#) for additional guidance.

The example, [A21. FS Cost Estimate Exercise](#), evaluates costs for an ISCO project using conventional injection wells and activated persulfate oxidation. The example includes a series of three worksheets. The first is the "Cost Details" worksheet, which contains input data based on site-specific conditions, oxidant delivery and design methods, quantities, and unit pricing. The second worksheet provides the "Present Worth Details" worksheet, which outlines the timeframe of remediation and provides the life cycle costs. The "Cost Estimate Summary" worksheet is displayed last, summarizing the capital, operation & maintenance (O&M), and closure costs in a table format ideal for presentations and slideshows.

Each worksheet and its components are described within the following sections.

## COST DETAILS WORKSHEET

The "[Cost Details](#)" worksheet consists of three subsections (Capital Costs, Operations and Maintenance Costs, and Post Remediation Closure Costs) and contains data that assist with quantifying the total cost. The first column describes the activity and cost item. The quantity/units column is next, followed by the unit cost and subtotaled cost columns for the activity/cost item. It is important that the unit costs are researched thoroughly by consulting a professional cost estimator, contacting potential vendors, and evaluating costs from past ISCO projects. Additional literature/guides available to the user to estimate unit costs include:

- 1.) Means construction cost data books
- 2.) Richardson process plant construction estimating standards
- 3.) Walker's building estimator's reference book
- 4.) Dodge estimating books
- 5.) Craftsman estimating books
- 6.) Mechanical and electrical trade services books
- 7.) Mechanical Contractors Association of America (MCAA) and National Electrical Contractors (NECA) labor hours books

Note, that each of these cost data books summarizes and reports costs differently. It is important to know how the costs for a particular guide are structured and how they should be applied to the estimate you are producing.

Each of the three cost detail worksheet subsections is described below. The last column (comments and references) captures details of the line item not described anywhere else in this tool.

### Capital Cost

Capital costs are the expenditures initially incurred and required to construct the ISCO remediation system (e.g., procurement or construction of an ISCO mixing/injection trailer, installation of injection wells,

or a pilot test performance). They are exclusive of costs required to operate or maintain the remedial action throughout its lifetime. Capital costs include all labor, equipment, and material costs, including contractor fees. Capital costs also include expenditures for professional oversight and equipment that are necessary to support construction of the ISCO system. In the example exercise (injection into conventional injection wells), ISCO injections are included in the operations and maintenance costs. However, if direct-push methods are used, the costs for the first injection event could be included in the capital costs.

### **Operation and Maintenance Cost**

The example exercise includes five years of O&M. These costs are post-construction costs necessary to maintain and monitor the continued effectiveness of ISCO remediation and are estimated mostly on an annual basis, but can be calculated on a quarterly or semi-annually basis as well. Annual O&M costs include all labor, reporting, equipment, laboratory, and material costs, including contractor fees. Annual O&M costs also include expenditures for professional oversight services necessary to support O&M activities. These costs should include sampling, reporting, and follow-on injection costs (if applicable), and may also consist of additional construction activities (e.g., installation of additional injection wells) that occur after the initial construction begins.

### **Post-Remediation Closure Costs**

Post-closure costs are similar to capital costs. These are expenditures required to satisfy regulatory agency requirements, de-mobilize the remediation system (e.g., well abandonment and ISCO trailer decommission) and possibly make the site available for land transfers. Post-remediation closure costs include all labor, equipment, and material costs, and contractor fees. Capital costs also include expenditures for professional oversight and equipment that are necessary to demobilize the remediation system.

Within each of the three cost detail subsections, allowances, professional/technical services, and contingency factor costs are also allocated. Allowances, markups, contingency, and professional / technical services are typically estimated as a percentage of the total cost of the activity and are described below.

**Allowances:** Allowances are costs associated with construction activities (e.g., capital and post closure) that are required to prepare for, connect, power, control, and otherwise build and implement the ISCO remedy. These are activities that are typically either relatively small in comparison to the items included in capital costs or activities that can not be scoped in enough detail to produce a contractor estimate. Allowance cost elements can be broken down into sub-elements and include, but are not limited to:

- Site work – may include demolition, soil grading, vegetation clearing, or other physical activities required to prepare the site for ISCO infrastructure and implementation
- Mechanical – may include labor and materials for installing pumps, pipes, and other connections required to convey oxidants to injection/extraction infrastructure
- Instrumentation and controls – may include labor and materials for electronics necessary to control and automate the ISCO treatment system
- Electrical – may include labor and materials for installing a supply to power the ISCO treatment system equipment
- Miscellaneous equipment – may include minor operation appurtenances such as flow meters, injection well head fittings, and pressure gauges, or support equipment such as health and safety eye wash/shower or waste water collection drums.

The magnitude of allowance (as a percentage of the subtotal capital cost) is highly variable and should be based on site-specific considerations rather than typical values. It should be noted that while each of these allowances may be relatively small, when combined they can add up to a significant quantity.

**Professional / Technical Services:** Professional / technical services are costs associated with construction and O&M activities (e.g., capital, O&M, and post-closure) that are required to plan, design, procure, manage, oversee, and analyze the ISCO remedy. Professional/technical services cost elements can be broken down into sub-elements and include, but are not limited to:

- Project management
- Remedial design
- Construction management
- Technical support (O&M costs only)

Project management includes services that are not specific to remedial design, construction management, or technical support of O&M activities. Project management includes planning and reporting, community relations support during construction or O&M, bid or contract administration, permitting (not already provided by construction or O&M contractor) and legal services (e.g., licensing).

Remedial design applies to capital cost and includes services to design the remedial action. Activities that are part of remedial design include pre-design collection and analysis of field data, engineering survey for design, treatability study (e.g., pilot-scale), and the various design components such as design analysis, plans, specifications, cost estimate, and schedule at the preliminary and final design phases.

Construction management applies to capital cost and includes services to manage construction or installation of the remedial activities. Activities include review of submittals, design modifications, construction observations or oversight, engineering survey for construction, preparations of O&M manual, and documentation of quality control/quality assurance.

The following table from the EPA Guide to Developing and Documenting Cost Estimates During the Feasibility Study (2000) shows rule-of-thumb percentages that can be used for project management, remedial design, and construction management as a percentage of total construction cost. The percentages shown apply to the average remedial project and are provided as a guide. These values may be adjusted up for more complex projects or down for less complex projects, based on engineering judgment, which might consider actual costs data from similar projects.

Capital Cost Element	<\$100k (%)	\$100k-\$500k (%)	\$500k-\$2M (%)	\$2M-\$10M (%)	>\$10M (%)
Project Management	10	8	6	5	5
Remedial Design	20	15	12	8	6
Construction Management	15	10	8	6	6

Technical support during O&M includes services to monitor, evaluate, and report progress of remedial action (i.e. all O&M professional/technical services not provided under project management). This includes oversight of O&M activities, update of O&M manual, and progress reporting. O&M technical support generally ranges from 10 to 20 percent of total annual O&M costs.

**Markups and Contingency:** After the direct cost of material, labor, equipment, and subcontractor's costs are subtotaled, markups in the form overhead, tax, bond and insurance and profit (fee) are applied to arrive at the total bid price. Overhead includes two main types: (1) job or field office overhead, also known as general conditions, and (2) home office overhead, also known as general and administrative (G&A) costs. Markups are applied to the estimate subtotal in a compounding manner to determine the total construction cost for the work. Markups used should be varied based on the judgment of the engineer/estimator.

Contingency is also factored into a cost estimate to cover unknowns, unforeseen circumstances, or unanticipated conditions that are not possible to evaluate from the data on hand at the time the estimate is prepared. It is used to reduce the risk of possible cost overruns. Contingency percentage is based on either a qualitative or quantitative assessment of the risk, developed by the project team. Additional methods used to evaluate risk are discussed with the EPA (2000) Guide to Developing and Documenting Cost Estimates During the Feasibility Study, and can also be derived from past remediation work. A typical contingency range for an FS-level ISCO design cost estimate (which combines design- and construction-related scope factors) is 15 to 30 percent.

## **PRESENT WORTH DETAILS**

The "[Present Worth Details](#)" worksheet represents the sum of the present values of all future payments associated with the project and is used to allow for comparison of different alternatives based on the same time value of money. The columns display the value of capital (includes capital and post remediation closure costs), O&M, and total cost per year for the life cycle of the remediation program. The present value of a future payment is the actual value that will be disbursed, discounted at an appropriate rate of interest. The discount rate should be carefully selected depending on the period of analysis to which they are applied. Current discount rates for federal projects can be obtained from the U.S. Office of Management and Budget website: [http://www.whitehouse.gov/omb/circulars/a094/a94\\_appx-c](http://www.whitehouse.gov/omb/circulars/a094/a94_appx-c). See the [EPA's \(2000\) Guide to Developing and Documenting Cost Estimates During the Feasibility Study](#) for further explanation of the present worth and calculations associated with this worksheet.

## **COST ESTIMATE SUMMARY**

The "[Cost Estimate Summary](#)" is the last worksheet presented in the example [A21. FS Cost Estimate Exercise](#). It presents summary cost data for the use in presentations or a report format.