AACE INTERNATIONAL RECOMMENDED PRACTICE

47R-11

COST ESTIMATE CLASSIFICATION SYSTEM - AS APPLIED IN ENGINEERING, PROCUREMENT, AND CONSTRUCTION FOR THE MINING AND MINERAL PROCESSING INDUSTRIES

SAMPLE

AACE INTERNATIONAL

AACE International Recommended Practice No. 47R-11

COST ESTIMATE CLASSIFICATION SYSTEM – AS APPLIED IN ENGINEERING, PROCUREMENT, AND CONSTRUCTION FOR THE MINING AND MINERAL PROCESSING INDUSTRIES

TCM Framework: 7.3 – Cost Estimating and Budgeting

Rev. August 7, 2020

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Any terms found in AACE Recommended Practice 10S-90, *Cost Engineering Terminology*, supersede terms defined in other AACE work products, including but not limited to, other recommended practices, the *Total Cost Management Framework*, and *Skills & Knowledge of Cost Engineering*.

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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 fund projects). The *Cost Estimate Classification System* maps the phases and stages of project cost estimating together with a generic project scope definition maturity and quality matrix, which can be applied across a wide variety of industries and scope content.

This recommended practice provides guidelines for applying the principles of estimate classification specifically to project estimates for engineering, procurement, and construction (EPC) work for the mining and mineral processing industries. It supplements the generic cost estimate classification RP 17R-97 [1] by providing:

- A section that further defines classification concepts as they apply to the mining industries.
- A section on the geopolitical nature and investment regulation of mining projects that impact on the estimating process and its basis definition deliverables.
- 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 improve communications among all the stakeholders involved with preparing, evaluating, and using project cost estimates specifically for the mining and mineral processing industries.

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The overall purpose of this recommended practice is to provide the mining and mineral processing industry with a project definition deliverable maturity matrix that is not provided in 17R-97. It also provides an approximate representation of the relationship of specific 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.

This document is intended to provide a guideline, not a standard. It is understood that each enterprise may have its own project and estimating processes, terminology, and may classify estimates in other ways. This guideline provides a generic and generally acceptable classification system for the mining and mineral processing industries that can be used as a basis to compare against. 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.

As a final note regarding purpose, users must be aware of the industry's well documented history of challenges with overruns of feasibility estimates [6,7,8,9]. An intent of this RP is to help improve upon this past performance.

2. INTRODUCTION

For the purposes of this document, the term *mining industries* is assumed to include any firm that is involved in a mining (mineral) project, which is defined in NI 43 as "any exploration, development or production activity, including a royalty interest or similar interest in these activities, in respect of diamonds, natural solid inorganic material, or natural solid fossilized organic material including base and precious metals, coal and industrial minerals"[4].

Mining estimates depend on data from/for project permitting; drilling and exploration; underground and surface mining; ore handling, milling and metallurgical processing; tailings and water management; and other onsite and offsite infrastructure facilities that may be familiar to any process plant or uniquely mining. This recommended practice is intended to cover entire mining projects; this extends from the mine (surface or underground) through the initial processing phase of producing a marketable product, including all associated process and infrastructure facilities within the scope of the project. However, if the project is for a processing plant with no other mining aspect, it is assumed covered 17R-97. Standalone exploration programs based on drilling or remote means are not included in this RP; however, exploration such as sinking shafts, driving drifts from an operation or drilling funded as part of mine development may be covered. In addition, projects for mine reclamation and closure may be included. Other than these exclusions, this document is specifically intended to cover the full mining project scope and should not be combined with other RPs.

An unusual characteristic of mining projects is that some portion of the mining scope needed for initial production may be capitalized and included in the project estimate. Therefore, the initial capitalized elements of the mining plan (e.g., tunnels, pre-stripping, initial water management, pit crushers, initial mining equipment, etc.) must have more advanced definition than later elements that will be charged to operations or later sustaining capital costs.

This guideline reflects generally-accepted cost engineering practices. This recommended practice was based upon the practices of international companies who are engaged in mining projects around the world, as well as published references and standards.

This RP applies to a variety of project delivery methods such as traditional design-bid-build (DBB), design-build (DB), construction management for fee (CM-fee), construction management at risk (CM-at risk), and private-public partnerships (PPP) contracting methods.

3. GEOPOLITICAL NATURE AND INVESTMENT REGULATION OF MINING INDUSTRIES

The geopolitical nature and significant investment risk of the mining project industries increases the public profile and influences the capital cost estimating process, including the interpretation of estimate classifications. The following are regulations and situations that are applicable to the mining industries.

Security exchanges in the various jurisdictions have established regulatory codes for reporting of mining project feasibility that cover reports to potential investors and other stakeholders in the projects. This includes well recognized national and international codes and standards such as the following:
- Canada: *Canadian Securities Administrators (CSA) National Instrument (NI) 43-101, Standards Of Disclosure For Mineral Projects*, which is widely used and represents the proxy of international reporting standards and is a primary reference for this RP [5] Note that NI 43-101 defers to the Canadian Institute of Mining and Metallurgy (CIM) to provide definition standards for mineral resources and reserves [5].
- United Kingdom: *Institution of Metals, Minerals and Mining (IMMM)* or *Pan-European Reserves and Resources Reporting Committee (PERC)*
- Australia (and New Zealand): *Joint Ore Reserves Committee (JORC)*
- South Africa: *South African Code for Reporting of Exploration Results, Mineral Resources and Mineral Reserves* (SAMREC)
- USA: *United States Securities And Exchange Commission (SEC) Industry Guide 7: Description of Property by Issuers Engaged or to be Engaged in Significant Mining Operations*
- International standards (for general reference):
  - *United Nations Framework Classification (UNFC) for Fossil Energy and Mineral Resources*
  - *Committee for Mineral Reserves International Reporting Standards (CRIRSCO)*

The regulatory codes recognize the evolutionary nature of feasibility studies (FS). NI 43-101 focuses on two aspects of estimates: 1) geologic knowledge and confidence including volume and purity of the mineral ores based on exploration results, and 2) modifying factors influencing the profitability of extraction including mining, processing, metallurgical, economic, marketing, legal, environmental, socio-economic and governmental factors. Capital costs are one of the drivers of profitability and hence one of the modifying factors. The geologic factors such as drilling and assay results are the basis for establishing if the asset is a resource which may or may not be profitable. Resource categories are inferred, indicated or measured (listed in the order of increasing confidence). The modifying factors are the basis for establishing if the resource is profitable and hence a reserve. Reserve categories are potential or probable.

To demonstrate that a geologic resource is profitable and hence an economic reserve, NI 43-101 requires that the economics be demonstrated through a study. The study must be at least a preliminary feasibility study (PFS). Based on this type of study an indicated resource can be established as a potential reserve, and a measured resource can be established as a proven reserve. The code prohibits disclosure of results of an economic analysis that includes inferred resources unless it includes certain declamatory statements (i.e., they are never a reserve). The regulatory codes require that feasibility study reports be signed by competent party (i.e., a Qualified Person or QP) responsible for the content. Interestingly, the code leaves the appropriate level of detail for the preliminary feasibility study to the discretion of the QP making the study. In respect to NI 43-101, this RP may be a useful guide for the QP's study in regards to capital cost estimates.

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It is important to highlight the NI 43-101 terminology (defined by CIM [4]) relative to economic studies because these are often used as *de-facto* capital cost estimate categories in lieu of more defined estimate classifications such as this RP. NI 43-101 includes the following definitions for study types:

- **feasibility study** - means a comprehensive study of a mineral deposit in which all geological, engineering, legal, operating, economic, social, environmental and other relevant factors are considered in sufficient detail that it could reasonably serve as the basis for a final decision by a financial institution to finance the development of the deposit for mineral production.
- **preliminary feasibility study** and **pre-feasibility study** - each mean a comprehensive study of the viability of a mineral project that has advanced to a stage where the mining method, in the case of underground mining, or the pit configuration, in the case of an open pit, has been established and an effective method of mineral processing has been determined, and includes a financial analysis based on reasonable assumptions of technical, engineering, legal, operating, economic, social, and environmental factors and the evaluation of other relevant factors which are sufficient for a qualified person, acting reasonably, to determine if all or part of the mineral resource may be classified as a mineral reserve.

The primary distinction between the above is that the feasibility study is a suitable basis for a final decision. This RP recommends that a best industry practice to manage investment risk is to equate mining feasibility study capital cost estimates as AACE Class 3 (basis for full funding) and preliminary and pre-feasibility study estimates as AACE Class 4.

There is no economic study defined by CIM pursuant to NI 43-101 that is strictly equivalent to Class 5; however, NI 43-101 itself defines the following term that is usually applied to studies done prior to the PFS and FS but does not imply reserve status;

- **preliminary economic assessment (PEA)** - means a study, other than a pre-feasibility or feasibility study, that includes an economic analysis of the potential viability of mineral resources.[4]

In common mining practice, the term PEA usually is equivalent to Class 5, but not always; it may also be used for a more advanced study that simply does not meet the qualifications for a PFS or FS. Another term in common use is scoping study which is more or less equivalent to Class 5.

Mining industry estimators must be aware that other industries do not use the term feasibility (or the other terms above) for their estimates of an equivalent AACE class. One of the reasons for this RP is to encourage the use of the common, numbered class terminology.

Other geopolitical circumstances (or modifying factors per NI 43-101) for mining projects may directly or indirectly impact on the interpretation of the status and quality of project definition deliverables and hence estimate classifications. Examples of status considerations include:

- Mining projects are often in remote sites and have unique logistical and environmental issues.
- Resources are often seen as national legacies with attendant political, legal and socio-economic considerations.
- Improved metal prices and/or extraction technologies may lead to reacquisition of abandoned mining properties that have unforeseen environmental legacies and regulatory implications.
- Volatility in metal prices have led to abrupt study deferrals and resumptions causing problems such as ambiguous mining rates, skipped study steps and an unrealistic study schedule.
- Feasibility studies may tend to focus on technical issues at the expense of business and project delivery issues (e.g., execution strategy and planning deliverables).

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4. COST ESTIMATE CLASSIFICATION MATRIX FOR THE MINING AND MINERAL PROCESSING INDUSTRIES

A purpose of cost estimate classification is to align the estimating process with project stage-gate scope development and decision-making processes.

Table 1 provides a summary of the characteristics of the five estimate classes. The maturity level of project definition is the sole determining (i.e., primary) characteristic of class. In Table 1, 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 specific deliverables, and their maturity or status are provided in Table 3. 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 post feasibility classes (Class 1 and 2) are only indirectly covered by the regulatory codes where new funding is indicated. Again, the characteristics are typical but may vary depending on the circumstances.

ESTIMATE CLASS	Primary Characteristic	Secondary Characteristics		
	MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES Expressed as % of complete definition	END USAGE Typical purpose of estimate	METHODOLOGY Typical estimating method	EXPECTED ACCURACY RANGE Typical variation in low and high ranges at an 80% confidence interval
Class 5	0% to 2%	Concept and planning	Capacity factored, parametric models, judgment, or analogy	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	Screening options	Equipment factored or parametric models	L: -15% to -30% H: +20% to +50%
Class 3	10% to 40%	Funding authorization	Semi-detailed unit costs with assembly level line items	L: -10% to -20% H: +10% to +30%
Class 2	30% to 75%	Project control	Detailed unit cost with forced detailed take-off	L: -5% to -15% H: +5% to +20%
Class 1	65% to 100%	Fixed price bid check estimate	Detailed unit cost with detailed take-off	L: -3% to -10% H: +3% to +15%

Table 1 – Cost Estimate Classification Matrix for the Mining and Mineral Processing Industries

This matrix and guideline outline an estimate classification system that is specific to the mining and mineral processing industries. Refer to Recommended Practice 17R-97 [1] for a general matrix that is non-industry specific, or to other cost estimate classification RPs for guidelines that will provide more detailed information for application in other specific industries. These will provide additional information, particularly the *Estimate Input Checklist and Maturity Matrix* which determines the class in those industries. See Professional Guidance Document 01, *Guide to Cost Estimate Classification.* [10]

Table 1 illustrates typical ranges of accuracy ranges that are associated with the mining industries. The +/- value represents typical percentage variation at an 80% confidence interval of actual costs from the cost estimate after application of appropriate contingency (typically to achieve a 50% probability of project cost overrun versus underrun) for given scope. Depending on the technical and project deliverables (and other variables) and risks associated with each estimate, the accuracy range for any particular estimate is expected to fall within the ranges identified. However, this does not preclude a specific actual project result from falling outside of the indicated