

CALENDAR

- **Asia Mining Congress 2009**
March 23 – 27, 2009
Raffles City Convention Centre
Singapore, Singapore
Email: winnie.koh@terrapinn.com
- **AR Minera 2009**
April 28 – 30, 2009
Costa Salguero Center
Buenos Aires, Argentina
Email: info@viewpoint.com.ar
- **2009 CIM Conference and Exhibition**
May 10 – 13, 2009
Metro Toronto Convention Centre
Toronto, Ontario, Canada
Email: cmurphy@cim.org
Visit PAH/Runge at Booth 1320
- **U2009 Global Uranium Symposium**
May 10 – 13, 2009
Keystone Resort & Conference Center
Keystone, Colorado
Email: dani.wright@ur-energyusa.com
Visit PAH/Runge at Booth 34
- **World Mining Investment Congress 2009**
June 2 – 4, 2009
Park Plaza Victoria London
London, United Kingdom
Email: paul.gilbertson@terrapinn.com
- **Mines and Money Asia 2009**
June 3 – 4, 2009
Four Seasons Hotel
Hong Kong, China
Email: pablo.martin@mining-journal.com
- **African Mining Congress 2009**
July 14 – 17, 2009
Sandton Convention Centre
Johannesburg, Gauteng, South Africa
Email: taryn.vanzanten@terrapinn.co.za

Minimum Engineering Study Requirements Update

Pincock Perspectives Issue No. 70 (September 2005), Minimum Requirements for Feasibility Studies, remains one of our most requested newsletters. This month's issue is an update of that newsletter and accompanying table to reflect the changes in reporting requirements over the last three years.

INTRODUCTION

The evaluation of a mining project from exploration through development and production is a lengthy and complicated process. Mine development commitment activities for a potential project are initiated when a mineral resource is identified and continue through to the start of construction. The technical feasibility and the economic viability of each project are determined during the phases of mine development, with more detailed engineering data required at each stage. There are three levels of engineering studies during development that are commonly acknowledged by the mining industry, as follows:

- ◆ Conceptual
- ◆ Prefeasibility
- ◆ Feasibility

The enclosed table lists PAH's assessment of the minimum reporting requirements for the three levels of engineering studies.

In April 2005 The SEC Reserves Working Group/SME Resources and Reserve Committee submitted to the U.S. Securities and Exchange Commission their recommendations concerning estimation and reporting of mineral resources and mineral reserves. Included in these recommendations was a report specific for reserve reporting referred to as a "Mineral Reserves Declaration Report". For this newsletter PAH is addressing the standard types of reports that are used by companies to evaluate projects and seek financing, which are different requirements than reserve reporting, although reserves can be reported as part of the evaluation process. PAH will address the "Mineral Reserves Declaration Report" in a future newsletter when it is appropriate.

CONCEPTUAL STUDY

The conceptual study, also commonly referred to as a scoping study, is the first level study and the preliminary evaluation of the mining project. The principal parameters for a conceptual study are mostly assumed and/or factored. Accordingly, the level of accuracy is low at ± 50 percent. Although the level of drilling and sampling must be sufficient to define a resource, flow sheet development, cost estimation and production scheduling are often based on limited data, test work, and engineering design. The results of a conceptual study typically identify:

- ◆ Technical parameters requiring additional examination or test work
- ◆ General features and parameters of the proposed project
- ◆ Magnitude of capital and operating cost estimates
- ◆ Level of effort for project development

A conceptual study is useful as a tool to determine if subsequent engineering studies are warranted. However, it is not valid for economic decision making nor is it sufficient for reserve reporting.

PREFEASIBILITY STUDY

The prefeasibility study represents an intermediate step in the engineering process to evaluate a mining project. The principal parameters for a prefeasibility study are based on some engineering basis. The level of accuracy is higher than the scoping study at ± 25 percent. The engineering objectives of a prefeasibility study are to determine:

- ◆ Resources/reserves
- ◆ Mine and mill extraction methods
- ◆ Mine and mill production rates
- ◆ Tailings containment options
- ◆ Environmental issues and permitting requirements
- ◆ Development period and mine life
- ◆ Product(s) recovery rates
- ◆ Product(s) marketability
- ◆ Capital cost estimates
- ◆ Operating cost estimates
- ◆ Economic analysis with sensitivity

At the prefeasibility study stage adequate geology and mine engineering work has been conducted to define a resource and a reserve (reserves at this stage depend on reporting jurisdiction). Sufficient test work has been completed to develop mining and processing parameters for equipment selection, flow sheet

development, and production and development scheduling. Capital and operating cost estimates are derived from preliminary test work, assumed factors and some vendor quotes. The economic analysis of a prefeasibility study is of sufficient accuracy to assess various development options and the overall project viability. However, these cost estimates and engineering parameters are typically not considered of sufficient accuracy for final decision making or bank financing. Depending upon the government reporting jurisdiction, the study may or may not be sufficient for reserve reporting.

FEASIBILITY STUDY

A feasibility study represents the last and most detailed step in the engineering process for evaluating a mining project for a “go/no-go” decision and financing purposes. Principal parameters for a feasibility study are based on sound and complete engineering and test work. Accuracy is higher than the prefeasibility study and is typically ± 15 percent. Feasibility study objectives are the same as those previously listed for the prefeasibility study, but the level of detail and accuracy for each objective are more stringent. The level of detail is typically dictated by whether the project is to be financed by the company or bank financed. Often the term “bankable” is used in describing a feasibility study. This term simply defines that the level of detail of the study is sufficient for financing provided the results are positive. In some cases, if the project is to be company financed the level of detail is higher than in a typical “bankable” feasibility study.

Detailed geologic and mine engineering work has been conducted to define a resource and reserve. Detailed test work has been

completed to develop all mining and processing parameters for pit slope design, hydrology, geotechnical, flow sheet development, equipment selection and sizing, consumables and power consumption, material balance, general arrangement drawings, production and development schedules, capital and operating cost estimates. Capital and operating cost estimates are derived from take-offs and vendor quotes. A draft EIS/EA has been submitted to regulatory authorities or is close to being submitted. Economic analysis with sensitivities is based on annual cash flow calculations for the mine life. Provided the project is feasible, a proven and probable reserve statement can be made.

The following sections contain a brief description of the major areas that are incorporated into engineering studies. As the level of the study increases in complexity the level of detail required increases, as shown in the attached table.

Geology and Resources

Every mineral deposit has its own unique geologic characteristics which must be considered in the preparation of engineering studies. The amount of required geologic information for the determination of resources varies significantly as a function of the engineering study level and the complexity of the deposit and mineralogy. Geologic features control economic mineralization, and with the appropriate geologic modeling, a reliable grade estimate will be determined using a combination of geologic controls and geostatistics.

Resource estimation is based on the development of a three-dimensional model of the deposit with either manual or computer methods. The

completed resource allows for rapid tabulation of mineral inventory and provides a basis for all subsequent determinations of reserves, mine design and planning. The objective is to provide the most reliable and accurate resource estimate with available data. The resource estimate is classified according to internationally recognized standards including the following (as well as others):

- ◆ Canadian National Instrument 43-101;
- ◆ Australasian Code for Reporting of Mineral Resources and Ore Reserves - prepared by the Joint Ore Reserve Committee (JORC);
- ◆ U.S. Securities & Exchange Commission Industry Guide 7; and
- ◆ The 2005 SME Guide for Reporting Exploration Results, Mineral Resources and Mineral Reserves.

Mining

Upon completion of the deposit's geologic interpretation and resource estimate, the mining method, either surface and/or underground, is selected. This selection is based on the geometry of the deposit and depth of the deposit. As the studies progress the detail incorporated into the actual design of the mine increases.

Optimization analysis is a tool that is being utilized more in the evaluation of projects especially surface mines. With this tool companies can determine what the impact of changes in prices, costs, and recoveries are on the project so that the areas in which the project is most sensitive to can be identified. Including inferred resources in an optimization analysis can help a company determine where to focus exploration drilling to increase measured and indicated resources. Preliminary production schedules can also be developed using this tool.

Results from optimization analysis, however, do not constitute reserves because they are generally based on pit shells that do not include roads and ramps and contain unmineable shapes.

As the studies increase in complexity the detail incorporated into the mine design, production scheduling, and capital and operating cost estimation increases. For the mine design the detail and quantity of geotechnical data is one of the critical components as it dictates the pit slopes in surface mines and the design of underground openings and specific underground mining methods. Mine design and scheduling can also be impacted by the need to meet processing requirements such as maintaining mill feed grades or rock type blends, and by environmental requirements such as surface and groundwater control. As the knowledge of the project is increased the more refined and detailed the mine design and production schedule can become.

Process Engineering

Process engineering for the mined ores is initiated in the engineering study after the production rate is established in the mining phase. Processing facilities are typically designed to produce marketable products for shipment directly to the consumers (e.g. copper cathodes from SX-EW) or to subsequent processing facilities (e.g. concentrates to smelters-refineries).

Key components for process engineering in engineering studies include:

- ◆ Metallurgical test work
- ◆ Mineralogical studies
- ◆ Consideration of project site conditions

- ◆ Identification of best tailing containment location and form
- ◆ Selection of processing flow sheet and basis
- ◆ Determination of processing design criteria and description
- ◆ Plant processing facilities layout
- ◆ Equipment sizes and specifications
- ◆ Plant services

Infrastructure

The infrastructure requirements for mining projects are site specific. The capital cost for infrastructure can vary substantially from site to site as a percentage of the total capital cost, and are often more of a function of the location rather than the mining or processing methods. Thus, the capital cost estimate in engineering studies must be based on a proper identification and assessment of the infrastructure requirements. Infrastructure covers a wide range of facilities and services as listed below:

- ◆ Access and service roads
- ◆ Utilities
- ◆ Water supply
- ◆ Communications
- ◆ Port and marine
- ◆ Fuels
- ◆ Waste disposal systems
- ◆ Administration facilities
- ◆ Industrial facilities
- ◆ Transportation
- ◆ Townsite/Camp facilities

Environmental

Today, complex environmental issues faced by the global mining industry include:

- ◆ Environmental Impact Statements (EIS)
- ◆ Base line studies
- ◆ Environmental assessments
- ◆ Mine Permitting at the local, state, federal and international levels

- ◆ Mine-waste management design/ remediation
- ◆ Water management
- ◆ Wetlands mitigation/construction design
- ◆ Air quality and noise assessment
- ◆ Acid-rock drainage assessment and abatement
- ◆ Closure planning

Surface Reclamation

Environmental scientists and regulatory specialists help develop effective and economical environmental controls for mining operations, which comply with all applicable environmental regulations (international, federal, state, and local) affecting the mining industry.

Economic Analysis

Economic analysis is performed as the final step in the engineering study to provide a measure of the project's economic viability. Economic analysis is performed using conventional pro forma cash flow analysis for the mining industry incorporating the following:

- ◆ Constant or current dollars
- ◆ Leveraged or unleveraged financing
- ◆ Project basis (stand alone or combined)
- ◆ Pre- or after-tax basis
- ◆ Discounting period of project's annual cash flows (i.e. mid- or end-of-year)

Economic measures determined in the analysis typically include:

- ◆ Net present values at selected discount rates
- ◆ Discounted cash flow return of investment
- ◆ Internal rate of return
- ◆ Payback period

Inputs to the cash flow derived from the various sections of the engineering study include:

- ◆ Ore production and grade schedules
- ◆ Commodity recovery (ies) and
- ◆ Commodity production schedule
- ◆ Capital costs (preproduction, sustaining and working)
- ◆ Operating costs

In addition to the inputs from the engineering study, other parameters to the pro-forma cash flow include:

- ◆ Royalties (private and governmental)
- ◆ Commodity price (s)
- ◆ Host country's tax regime (tax rates [federal, state, provincial], depreciation, depletion, etc.)

Sensitivity analyses to the base case are performed to key project variables which typically include:

- ◆ Commodity price(s)
- ◆ Commodity recovery (ies)
- ◆ Capital costs
- ◆ Operating costs
- ◆ Currency exchange rates

The results of the sensitivity analysis are plotted in a spider diagram to determine the project's sensitivity.

As can be seen above, the development of any level of study requires professionals with extensive mining experience in many different disciplines. Enhancing the capabilities of the study team will reduce the risk faced during the development of the property. For example, during the conceptual study, the study team may identify a fatal flaw that places the project at such risk that the project should not proceed at that particular point in time.

On the other hand, an experienced team can provide the knowledge base to optimize the project as much as possible or apply the best-available proven technology during the prefeasibility and feasibility study stages. Beyond the team's basic mine development experience is the consideration of the knowledge and experience of project financing and financial requirements that is required for bankable study preparation. Therefore, it is of critical importance to select the correct project team to ensure the timely and accurate completion of the study. Following this formula will reduce both project development and cost risks. Additionally, following the traditional progression of the studies from conceptual to prefeasibility to feasibility generally saves time and money in the long run as critical issues can be identified and addressed early on rather than at a later stage where the impact can be a delay in the project which is generally costly.

This month's article was provided by PAH's Engineering and Geology departments.



Consultants for Mining and Financial Solutions

Pincock, Allen & Holt is a consulting and engineering firm serving the international mineral resource industry. Your comments and suggestions are always welcome. Contact Pincock, Allen & Holt • 165 S. Union Blvd., Suite 950, Lakewood, Colorado 80228 • TEL 303.986.6950 • FAX 303.987.8907 • www.pincock.com. Pincock Perspectives is published as a free information service for friends and clients.



Minimum Report Contents for Engineering Studies

DESCRIPTION	Conceptual (Scoping) Study	Prefeasibility Study	Feasibility Study
INTRODUCTION			
Location, Topography and Climate			
Site Location Map	Basic map	Preliminary map showing claims and boundaries	Detailed map showing all claims and boundaries
Topography Map	Basic map showing site topography	Preliminary map showing site topographic features	Detailed topographic map; aerial surveys verified with ground controls and surveys
Property Ownership	Review of property lease	Review of property lease; claims list provided; mineral rights known	Property lease and rights secured and controlled; claims list and map provided; mineral rights secured
Current Status and History			
Historical Chronology	Basic presentation	Full presentation	Detailed presentation
Past Production (if any)	Basic presentation	Full presentation	Detailed presentation
EXPLORATION AND GEOLOGY			
Geologic Description			
Review	Preliminary review	Preliminary site-specific analysis	Detailed site-specific analysis
Data Posting	Review of available existing maps	Detailed geologic mapping with cross-sections	Deposit well-defined with three dimensional mapping, geologic maps, long sections, level plans
Geologic Assessment	Preliminary	Basic assessment and review	Detailed assessment of structures/rock contacts, alteration, mineralization, deposit trends
Mineralogical Sampling & Analysis	Limited sampling; preliminary assessment	Preliminary mineralogical sampling and analysis; preliminary mineralogical study	Detailed mineralogical sampling and mapping; detailed mineralogical study
Drilling, Sampling and Assaying			
Drill Hole Parameters	Wide spaced drilling as appropriate	Initial in-fills of wide spaced drilling; preliminary grid patterns	Close spaced drilling on a detailed grid pattern to support calculated reserve categories
Underground Drilling	Review of existing data	Drilling if accessible	Detailed drilling if accessible
Samples	Preliminary; some outcrop samples	Geophysical and geotechnical sampling; test pits	All sampling programs complete
Drilling/Assay Data	Preliminary check of existing drill hole data	Check of drill holes (coordinates, elevations, angles, etc.), check assays, angled hole vs vertical hole comparison; assay flow diagram, dependable database	Check of drill holes (coordinates, elevations, angles, etc.), check assays, angled hole vs vertical hole etc.), check assays, angled hole vs vertical hole comparison, twin hole drilling; assay flow diagram; validated database
Condemnation Drilling	None	None	Areas under waste dumps, tailings and plant drilled
RESOURCES AND RESERVES (Internationally Recognized Standards [see note 1])			
Resources	Indicated and Inferred	Measured, Indicated, and Inferred	Indicated and Measured
Geologic Controls	Assumed	Established from geologic data and/or variograms	Well established from geologic data
Tonnage Factors	Preliminary assessment if available	Preliminary analysis and determinations	Detailed analysis and determinations
Statistical Analysis	Not performed	Preliminary analysis and determinations	Detailed analysis and determinations
Geostatistical Analysis	Not performed	Preliminary analysis and determinations	Detailed analysis and determinations
Reserves	Only resources estimated	Proven and Probable	Proven and Probable
Calculation Parameters	Usually no reserves are estimated	Known or estimated	Detailed analysis and determinations
Cutoff Grade (COG) Equations	Usually no reserves are estimated	Calculated from floating cone parameters	Optimized using mining/processing parameters
MINING			
Mining Method	Assumed between open pit and underground	Specific method identified	Method and mine plan finalized
Open Pit Mine Plan			
Pit Slopes	Assumed	Preliminary estimates by rock type and basic geotechnical data	Defined by geotechnical data from structural mapping and oriented core holes
Pit Design	Simple outline of final pit	Preliminary pit design from optimized analysis; preliminary haulroad incorporated	Detailed pit designs with phases and access for equipment operation
Waste Dumps	Simple outline of final dumps	Preliminary design for total waste tonnage; incremental and final outline of dumps	Dump sites identified from geotechnical data; final waste tonnages determined with incremental phases, yearly and final dump outlined
Underground Mine Plan	Assumed mining system; general outline of mine plan and development	Preliminary mining system identified from geologic and geotechnical data; preliminary outline of mine plan and development including mine access	Specific mining system identified from geologic and geotechnical data; detailed outline of mine plan and development including mine access
Production Schedule	Basic schedule based on assumed mine life	Yearly and mine life ore and waste tonnages and grade	Detailed annual schedules showing ore / product quality and waste tonnages and grades
Capital Cost Estimate	Order-of-magnitude, factored or from similar operations	Preliminary equipment list; budget or historical price quotes; some factoring	Detailed equipment list; firm price quotes for all major equipment items; all capital items identified
Operating Cost Estimate	Order-of-magnitude; factored or from similar operations	Quantified estimates for labor, power and consumables; budget or historical price quotes for unit prices; some factoring	Detailed engineering estimate by project area based on quotes and studies
PROCESSING			
Ore Sampling and Test Work	Minimal sampling; conduct lab bench scale process characterization tests on collected samples (if available)	Sampling of core; preliminary bench scale testing to determine preliminary recoveries, ore characterization and processing parameters for flow sheet development	Sampling of core for different ore body zones; confirm flow sheet; comprehensive beneficiation test program to determine recoveries, ore/product characterization and finalize processing parameters
Process Engineering and Design			
Production Rate and Product(s)	First estimate of production rate and product(s)	Preliminary mining and processing rates and plant product(s)	Fixed mining and processing rates and plant product(s)
Design Basis	Preliminary using factored estimates	General design basis; preliminary engineering drawings; trade-off studies optional	Complete design basis; basic engineering drawings essentially complete; trade-off studies performed
Design Concept	Outline of design criteria and specifications incorporating area/regional climatic conditions	Design criteria established for construction site incorporating known site climatic conditions	Design specifications defined incorporating known site climatic conditions
Tailings Containment	Identify possible sites and capacities	Identify several options and determine the best site or sites	Finalize sites, location; develop geotechnical data for site and for tailings; generate general arrangement drawings and preliminary specifications
Process Description	General	Narrative; 1 to 2% of detail engineering complete	Detailed; 5 to 15% of detail engineering complete
Layout	Approximate geographic locations and site map; no general arrangement drawings	Optimization of facility locations on site map showing topography; simple general arrangement drawings of major equipment items	Exact geographic locations on site map with topography; detailed general arrangement drawings; detailed layout of all facilities
Flow Sheets	Assumed flow sheet from known processes; simple block diagram	Establishment of probable flow sheet from preliminary test work data; major process flow diagrams; initial determinations of material and heat balances.	Detailed flow sheet based on comprehensive beneficiation test program, detailed equipment list; diagrams for all process flows; material and heat balances finalized
Civil Work	Rough topographic maps; no soil conditions considered or quantities estimated	Rough topographic maps; soil conditions report for foundation determinations; basic preliminary quantities	Detailed topographic maps with soil conditions identified for foundation design, loadings and quantities
Equipment Specifications	Major equipment items listed	Preliminary listing of major equipment items with initial sizings and specifications	Complete listing of major equipment items with detailed sizings and specifications
Architectural	None	Sketches	Exterior elevations only
Piping/HVAC	None	Preliminary P&ID	Major P&ID
Electrical Distribution	None	Basic one-line diagram	All design one-line diagram
Motors	None	General description	Detailed list of major items with horsepower
Instrumentation	None	General description	Detailed list of components
INFRASTRUCTURE			
Facilities	General overview with types of support facilities described	All required support facilities identified, sizes and quantities estimated	All necessary support facilities identified, sized and costed
Communications	Communications requirements identified	Communications systems study	Communications licensing and standards known
Power	Overview of power availability and regional unit power costs	Power sources and requirements identified; unit costs obtained from power source	Power requirements and unit costs derived from detailed engineering study; unit costs from quotes
HYDROLOGY			
Water Sources	Estimated using regional data	Preliminary hydrology study	Specific water source identified
Water Usage	Factored plant volume and unit costs	Required plant water volumes and unit costs estimated	Requisite plant volumes and unit costs derived from detailed engineering/geotechnical studies
Dewatering	Dewatering parameters identified	Dewatering parameters estimated	Dewatering parameters confirmed and plan defined

Minimum Report Contents (continued)

DESCRIPTION	Conceptual (Scoping) Study	Prefeasibility Study	Feasibility Study
ENVIRONMENTAL			
Setting	Preliminary evaluation of project setting for potentially significant environmental or permitting constraints for site data	Preliminary evaluation of the project's impact on the environment; schedule of environmental and/or other permitting requirements; evaluate project setting for potentially significant environmental and/or permitting constraints from site data	Characterization of all the project's potential impacts on the environment; finalize schedule of environmental and/or other permitting requirements; evaluate project setting for potentially significant environmental and/or permitting constraints
Data	Collect and review all available, existing data for environmental studies, assessments or audits; regulatory inspections, waste handling practices, management plans, and all applicable environmental laws and regulations; no social, training or safety programs identified	Collect and review available environmental data from existing databases for environmental studies, assessments or audits; regulatory inspections, waste handling practices; management plans; and all applicable environmental laws and regulations; plans; initiate baseline data gathering; social, training, and health /safety programs identified	All requisite environmental data for project are identified; site sampling and analyses are complete; detailed review of the type, scope and schedule for producing environmental and/or government reports; comprehensive gathering and evaluation of baseline environmental conditions; social, training, and health/safety programs confirmed
EIS/EA	None	Draft EIS/EA initiated	Draft EIS/EA submitted to regulatory authorities
Reporting and Plans	Conceptual plans for managing any identified environmental issues	Preparation of environmental plans and monitoring programs; preliminary sediment and erosion control plan; conceptual reclamation plan; evaluation of acid rock drainage; geotechnical stability review of waste dumps and tailings dam; preliminary impact mitigation plan; preliminary spill and emergency response plan	Environmental characteristics used in project design; environmental plans and monitoring programs are finalized; sediment and erosion control plan; management plan finalized for solid and hazardous wastes; finalize impact mitigation plan; geotechnical stability analysis of all major facilities; finalize reclamation plan; final analysis of acid rock drainage; finalize spill and emergency response plan
Monitoring	Not considered	Outline of a site environmental monitoring plan	Complete environmental monitoring plan
PERMIT REQUIREMENTS	General overview	Comprehensive overview and listing of required permits	Detailed evaluation of all pertinent environmental and permitting requirements and schedule for obtaining operating license
PROJECT DEVELOPMENT SCHEDULE			
Development Plan	Development period and mine life estimated	Development period and overall schedule estimated; mine life determined; development schedule set	Detailed development schedule; mine life known; development schedule finalized
Project Master Schedule	Estimated showing start and end of construction; Gantt bar chart of major work elements	Gantt bar chart with overall time frames; schedule outline for detailed engineering; QA/QC program outlined; preliminary construction schedule; preliminary project execution plan	Gantt bar chart with overall time frames and project flow planning; detailed project level schedule showing project deliverables and detailed engineering; CP schedule; major milestones identified; project control system outlined; QA/QC and safety program finalized; preliminary project procedures manual; project design basis finalized
CAPITAL COST ESTIMATE			
Basis	Order-of-magnitude based historic data or factoring	Estimates from historical factors, percentages and vendor quotes based on materials volumes	Detailed from estimates; engineering 15 to 25% complete; multiple vendor quotes
Civil Structural Architectural Piping/HVAC Electrical Instrumentation Construction Labor Construction Labor Productivity Material Volumes/Amounts Material/Equipment Pricing Infrastructure			
Contractors	Included in unit cost or as a percentage of total cost	Percentage of direct cost by cost area for contractor; historic for subcontractors	Written quotes from contractor and subcontractors
EPCM	Percentage of estimated construction cost	Percentage of detailed construction cost	Calculated estimate from EPC(M) firm
Pricing	FOB mine site including all taxes and duties	FOB mine site including all taxes and duties	FOB mine site including all taxes and duties
Owner's	Historic estimate	Estimate from experience factored for similar project	Estimate prepared from detail zero based budget
Environmental Compliance	Factored from historic experience	Estimate from experience factored for similar project	Estimate prepared from detail zero based budget for design engineering and specific permit requirements
Escalation	Typically not considered	Based on company's current budget percentage	Based by cost area with risk
Working Capital	Factored from historic experience	Estimate from experience factored for similar project	Estimate prepared from detail zero based budget
Accuracy	+/- 50%	+/- 25%	+/- 15%
Contingency	25%	15%	10%
OPERATING COST ESTIMATE			
Basis	Order-of-Magnitude estimate	Estimates for unit rates and quantified estimates with some factoring	Detailed from zero-based budget; minimal factoring
Operating Quantities	General	Quantified by estimates with some factoring	Detailed estimates
Unit Costs	Historic unit costs and factoring	Estimates for labor, power and consumables; some factoring	Letter quotes from vendors; minimal factoring
Accuracy	+/- 35%	+/- 25%	+/- 15%
ECONOMIC EVALUATION			
Financial Analysis	Preliminary assessment of principal economic parameters	Assessment of the principal economic parameters	Full assessment of all principal economic parameters
Commodity Price(s)	Estimated based on 3yr average minimum	Estimated based on 3yr average minimum	Estimated based on 3yr average minimum or detailed market studies
Royalties and Taxes	Preliminary assessment	Preliminary analysis	Detailed analysis with tax authority opinion
Smelting, Refining and Freight	Historic data	Budgetary quotes	Firm quotes
Cash Flow Analysis	Simple cash flow	Preliminary cash flow	Formal, detailed cash flow
Economic Criteria	Simple IRR and NPV (pre- and after-tax)	Preliminary IRR and NPV (pre- and after-tax)	Fully defined IRR, NPV, ROI, and payback period (pre- and after-tax)
Sensitivity Analysis	Basic analysis to minimal amount of project variables	Preliminary to selected key project variables	Numerous analysis to all key project variables
RISK EVALUATION			
Risk Assessment	General overview	Fatal flaw analysis	Formal Monte Carlo analysis and fatal flaw analysis
Project	Preliminary overview of geology, engineering, and environmental	Preliminary environmental, country, permitting, technology, and business; detailed geology and engineering	Detailed geology, engineering, environmental, legal, permitting, country, technology, business, and financial

Note 1: Internationally Recognized Standards include:

1. Canadian National Instrument 43-101 and 43-101 CP.
2. Australasian Code for Reporting of Mineral Resources and Ore Reserves - prepared by the Joint Ore Reserve Committee (JORC)
3. U.S. Securities & Exchange Commission Industry Guide 7
4. SME Guide for Reporting Exploration Information, Mineral Resources and Mineral Reserves
5. Environmental aspects should consider applicable local, national and international guidelines including IFC and Equator Principle standards.

Pincock, Allen & Holt is a consulting and engineering firm serving the international mineral resource industry. Your comments and suggestions are always welcome. Contact Pincock, Allen & Holt • 165 S. Union Blvd., Suite. 950, Lakewood, Colorado 80228 • TEL 303.986.6950 • FAX 303.987.8907 • www.pincock.com