

A Guide for Reporting Exploration Information, Resources and Reserves

Working party #79 of the SME Planning Committee was formed in 1988 with the title "Ore Reserves Definition" to study the issues involved and determine if it would be appropriate for SME to set guidelines for public reporting of ore reserves. The Working Party's report was delivered to the SME Board of Directors on February 24, 1991, during the SME Annual Meeting in Denver, CO. The report is published here in full for the information of the membership, and comments are invited. Comments should be sent to SME Headquarters, Attn.: Ore Reserves Working Party, PO Box 625002, Littleton, CO 80162.

Foreward

In 1988, at the request of members of the Society for Mining, Metallurgy, and Exploration (SME), Inc., the President of SME formed Working Party #79, Ore Reserve Definition with the mission to develop guidelines for the public reporting of exploration information, resources and reserves. A Subcommittee was appointed by the Working Party to draft these guidelines and submit recommendations to SME. This Guide represents the Subcommittee's recommendations.

The Subcommittee recommends preferred terms, and their definitions, for use in public reporting of exploration information, resources and reserves. Wherever possible, the recommended terms and definitions are those adopted by the US Bureau of Mines (USBM) and the US Geological Survey (USGS) (Anon., 1980). Some modifications were made,

however, to reflect industry needs and usage, international practice (Anon., 1988; Anon., 1990) and regulatory guidelines (US SEC). In particular, the Subcommittee recommends that (1) resources be reported as measured, indicated, or inferred, and (2) that reserves be reported as proven or probable.

This Guide provides a format for consideration of all relevant information in the preparation and evaluation of public reports. Adherence to this Guide in the description of significant completed work and future plans should help ensure that an intelligent layman is able to make a reasonable and balanced judgment regarding a project's viability.

Public reports of exploration information, resources and reserves are summary statements that require prior evaluation of a considerable range and amount of information. Table 1 of this Guide presents criteria for use of this information in preparing and evaluating public reports. All the criteria in Table 1 should be considered, although the significance of individual criteria will vary between projects and over time. Specific projects may require additional criteria.

This Guide represents the position and interests of SME, which are not necessarily consistent with current laws and regulations (US SEC) that govern public reporting of exploration information, resources and reserves. Decisions as to when and what information should be publicly reported are the sole responsibility of the individual or company owning the information.

Reporting terminology

The following terms should be used for reporting exploration information, resources and reserves:

- *Exploration information.* Terms such as "deposit" or "mineralization" are appropriate for reporting exploration information. Terms such as "ore," "reserve," and other terms that imply that economic extraction or production has been demonstrated, should not be used.

- *Resource.* A resource can be subdivided into three categories:

Measured resource

Indicated resource

Inferred resource

The term "resource" is recommended over the terms "mineral resource," "identified resource" and "in situ resource." "Resource" as defined herein includes "identified resource," but excludes "undiscovered resource" of the USBM and USGS classification scheme. The "undiscovered resource" classification is used by public planning agencies and is not appropriate for use in commercial ventures.

- *Reserve.* A reserve can be subdivided into two categories:

Probable reserve

Proven reserve

The term "reserve" is recommended over the terms "ore reserve," "minable reserve" or "recoverable reserve."

The terms "measured reserve" and "indicated reserve," generally equivalent to "proven reserve" and "probable reserve," respectively, are not part of this classification scheme and should not be used. The terms "measured," "indicated" and "inferred" qualify resources and reflect only differences in geological confidence. The terms "proven" and "probable" qualify reserves and reflect a high level of economic confidence as well as differences in geological confidence.

The terms "possible reserve" and "inferred reserve" are not part of this classification scheme. Material described by these terms lacks the requisite degree of assurance to be reported as a reserve.

The term "ore" should be used only for material that meets the requirements to be a reserve.

It is recommended that proven and probable reserves be reported separately. Where the term reserve is used without the modifiers proven or probable, it is considered to be the total of proven and probable reserves.

Definitions

There is a sequential relationship between exploration information, resources and reserves. This relationship is represented in Fig. 1. When geological knowledge increases, exploration information may become sufficient to calculate a resource. When economic information increases, it may be possible to convert part of the whole of a resource to a reserve. The double arrows between reserves and resources in Fig. 1

indicate that changes in any number of factors may cause material to move from one category to another.

Exploration information

Exploration information. Information that results from activities designed to locate economic deposits and to establish the size, composition, shape and grade of these deposits. Exploration methods include geological, geochemical, and

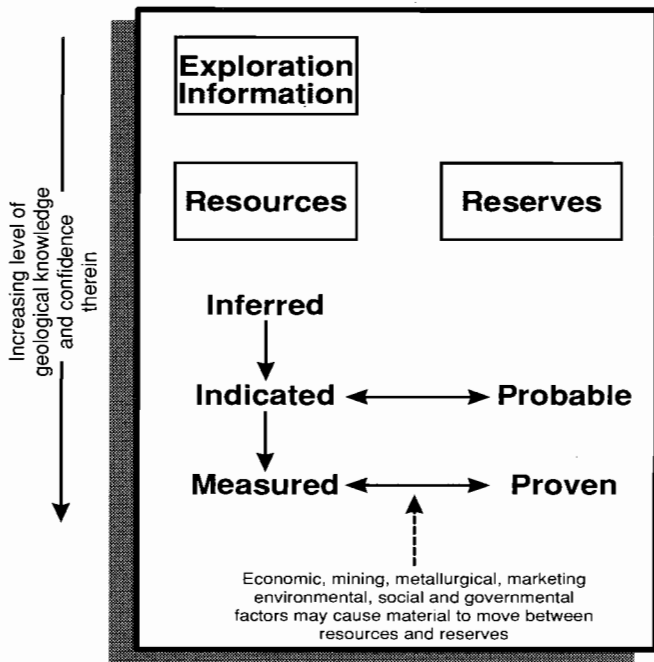


Fig. 1 — Reporting terminology for, and relation between, exploration information, resources and reserves.

geophysical surveys, drill holes, trial pits and surface and underground openings.

Resource

Resource. A concentration of naturally occurring solid, liquid or gaseous material in or on the Earth's crust in such form and amount that economic extraction of a commodity from the concentration is currently or potentially feasible. Location, grade, quality, and quantity are known or estimated from specific geological evidence. To reflect varying degrees of geological certainty, resources can be subdivided into measured, indicated, and inferred.

- **Measured.** Quantity is computed from dimensions revealed in outcrops, trenches, workings or drill holes; grade and (or) quality are computed from the result of detailed sampling. The sites for inspection, sampling and measurement are spaced so closely and the geological character is so well defined that size, shape, depth and mineral content of the resource are well established.

Project evaluation and reporting are closely related. Any public disclosure of exploration information, resources or reserves, whether made formally or informally, should be made with the intention to inform so that an intelligent layman is able to make a reasonable and balanced assessment of the mineralization being reported.

Table 1 supplies a list of items that should be considered when evaluating a project. The importance of each item will vary with the project and it is recognized that for some projects items may be relevant that are not on the list. The Table should be considered a guide to facilitate a rational and orderly approach to evaluation.

However, the need remains for exploration and mining professionals to make difficult decisions, such as the classification of material as a resource or a reserve. Decisions remain a matter of professional judgment based on knowledge, experience and industry practices.

The relative importance of the items in Table 1 will vary

- **Indicated.** Quantity and grade and (or) quality are computed from information similar to that used for measured resources, but the sites for inspection, sampling, and measurements are farther apart or are otherwise less adequately spaced. The degree of assurance, although lower than that for measured resources, is high enough to assume geological continuity between points of observation.

- **Inferred.** Estimates are based on geological evidence and assumed continuity in which there is less confidence than for measured and (or) indicated resources. Inferred resources may or may not be supported by samples or measurements but the inference must be supported by reasonable geo-scientific (geological, geochemical, geophysical, or other) data.

Reserve

Reserve. A reserve is that part of the resource that meets minimum physical and chemical criteria related to the specified mining and production practices, including those for grade, quality, thickness and depth; and can be reasonably assumed to be economically and legally extracted or produced at the time of determination. The feasibility of the specified mining and production practices must have been demonstrated or can be reasonably assumed on the basis of tests and measurements. The term reserves need not signify that extraction facilities are in place and operative.

The term *economic* implies that profitable extraction or production under defined investment assumptions has been established or analytically demonstrated. The assumptions made must be reasonable including assumptions concerning the prices and costs that will prevail during the life of the project.

The term *legally* does not imply that all permits needed for mining and processing have been obtained or that other legal issues have been completely resolved. However, for a reserve to exist, there should not be any significant uncertainty concerning issuance of these permits or resolution of legal issues.

Reserves relate to resources as follows:

- **Proven reserve.** That part of a measured resource that satisfies the conditions to be classified as a reserve.
- **Probable reserve.** That part of an indicated resource that satisfies the conditions to be classified as a reserve.

It should be stated whether the reserve estimate is of in-place material or of recoverable material. Any in-place estimate should be qualified to show the anticipated losses resulting from mining methods and beneficiation or preparation.

Discussion

with each project, depending on geological environment, technical constraints, as well as economic and legal conditions pertaining at the time of evaluation. When evaluating a project, the relative importance of each item should be weighed. All relevant information must be given careful consideration before deciding which information should be reported to the public.

For a variety of reasons, including the need for confidentiality, all data used to evaluate a project need not be made public. However, the public can reasonably assume that all necessary information is available to support public statements at the time they are made.

No economic feasibility is required before reporting exploration information or resources. However, particular attention should be given to all relevant information that increases or decreases the chances that the project will result in economic exploitation. Demonstration of economic feasibility is required for reporting of reserves.

It is recognized that reserve estimates, being predictions of what will occur in the future based on imperfect knowledge of the present, will be inaccurate to some degree. It is also recognized that different individuals analyzing the same data may arrive at somewhat differing interpretations and conclusions. The fact that a reserve estimate is proven inaccurate at a later date, when additional information is available or economic conditions have changed, does not necessarily mean that the estimate was made incompetently or fraudulently. Statements concerning reserve estimates must have a reasonable basis and be made in good faith.

References

- Anon., 1980, "Principles of a Resource/Reserve Classification for Minerals," Geological Circular 831, US Bureau of Mines and US Geological Survey, 5 pp.
- Anon., 1988, "Australasian Code for Reporting of Identified Mineral Resources and Ore Reserves," report of the Joint Committee of the Australasian Institute of Mining and Metallurgy and Australian Mining Industry Council, June, 8 pp.
- Anon., 1990, "Guidelines to the Australasian Code for Reporting of Identified Mineral Resources and Ore Reserves," prepared by the Joint Committee of the Australasian Institute of Mining and Metallurgy and the Australian Mining Industry Council, May, 5 pp.
- US Securities and Exchange Commission (US SEC), "Form S-18, Registration Statement Under the Securities Act of 1933," Item 17A.

Table 1— Guidelines and criteria for evaluation of exploration information, resources and reserves

Estimates of the value of mineral projects are expressions of judgment predicated on knowledge and experience. Such estimates are more than arbitrary determinations; they seek to attach value as a consequence of method. The methods employed must be scientifically valid, tested, employing accepted scientific definitions of terms and accepted procedures, and best suited to the making of reliable estimates for the project in question. Evaluation of mineral projects requires periodic examination and evaluation of all new and existing data. The dynamic nature of the evaluation of mineral projects implies that a valid estimate made at a given time may be significantly changed when new information becomes available. Evaluation of a mineral project should consider all the criteria listed below and such additional criteria that may be viewed as significant. The relative importance of the criteria will vary with the particular project and the legal and economic conditions pertaining at the time of evaluation. When information is publicly reported, it must be sufficient to enable an intelligent layman to make a reasonable and balanced assessment of the significance of this information. When and whether information should be publicly released is subject to current laws and regulations.

Evaluation criteria	Exploration information	Resource	Reserve
A. General			
1. Purpose of report	Statement of person for whom the report was prepared, whether it was intended as a full or partial evaluation, what work was conducted, what work remains to be done.	See Exploration information	See Exploration information
2. Project description	Description of commodity, magnitude of project, background, and business arrangement.	See Exploration information	See Exploration information
3. Project location	Description of location (country, state or province, county, township, and range, easting and northing, etc.); a map showing location and access should exist.	See Exploration information	See Exploration information
4. Property ownership	Description of ownership of surface rights, mineral rights, access rights, leases, concessions, royalties, and other encumbrances and liabilities.	See Exploration information	See Exploration information
B. Project data			
1. Location of project data	Maps and cross sections or other two- or three-dimensional representation of information should exist, showing location of samples, drill holes, exploration pits, underground workings, geological data, etc. When evaluating drill hole information, consideration should be given to depth to top and bottom of mineralization, to total length and average grade of intercepts, and to the accuracy of survey information including downhole surveys.	See Exploration information. Particular attention should be given to drill hole and other sample survey information including downhole surveys. If the sample locations are not well known, the effect on the resource estimates should be considered.	See Resource
2. Geological data	Description of the nature, detail, and reliability of geological information (rock types, structure, alterations, mineralizations, and relation to known mineralized zones). Description of geophysical and geochemical data. Reliable geological maps and cross sections should exist to support interpretations.	See Exploration information. Particular attention should be given to drill hole logging and other sample information used in resource evaluation. Description of the thoroughness with which all significant lithologic, structural, mineralogical, alteration, or other geological or geotechnical characteristics were recorded. Significant data are data that could materially influence the estimated quantity and quality of the resource.	See Resource

Evaluation criteria	Exploration information	Resource	Reserve
3. Sampling			
a. Method	Description of sample type and sample collection method (hand, grab, trench, channel, or chip sample; core hole, rotary hole, or reverse circulation; bulk sample). Discussion of sample quality and representativeness (sample recovery, high grading, selective losses or contamination, and any other factors that may have resulted in sample biases). Discussion of whether duplicate samples or alternative methods of sampling were used to verify sample quality. If indirect methods of measurement were used (geophysical methods), these should be described with attention given to errors in interpretation.	See Exploration information. The quantity and quality of sample information is critical to the reliability of resource estimates. Particular attention should be given to this information.	See Resource
b. Preparation	Description of laboratory and method used for sample preparation, subsampling and size reduction, and likelihood of inadequate or nonrepresentative sample (improper size reduction, contamination, etc.). Discussion of whether tests were performed to verify the suitability of sample preparation.	See Exploration information	See Exploration information
c. Analysis	Identification of laboratory and analytical method (fire assay, AA assay, emission spectroscopy, etc.). Discussion of precision and accuracy, including the use of check assays, quality control programs, and submission of samples to other laboratories for verification.	See Exploration information	See Exploration information
d. Specific gravity and bulk tonnage	Generally not determined.	Discussion of how the tonnage factor was determined (assumed or measured). If assumed, which assumptions were made and on which basis. If measured, by what method and how frequently. Discussion of whether different tonnage factors were used in different parts of the deposit and why.	See Resource
C. Interpretation			
1. Geological interpretation and model	Description of geological model and inferences made from this model. Discussion of adequacy of data density and reliability, and whether the quality and quantity of information are sufficient to support statements made or inferred concerning potential for significant economic discovery.	See Exploration information. Discussion of sufficiency of data density to assure continuity of mineralization and provide an adequate data base for the estimation procedure used. Discussion of the extent to which the interpretation is based on data or on assumptions and whether consideration was given to alternative interpretations or models.	See Resource
2. Numerical model	Generally not determined.	Detailed description of the method used and the assumptions made to estimate tonnages and grades (section, polygon, inverse distance, geostatistical or other method). Description of how the geological interpretation was used to control the resource estimates. If a computer method was chosen, description of programs and parameters used. Geostatistical methods are extremely varied and should be described in detail. The method chosen should be justified. The geostatistical parameters, including the variogram, and their compatibility with the geological interpretation should be discussed. Experience gained in applying geostatistics to similar deposits should be taken into account.	See Resource
D. Extraction			
1. Mining			
a. Method	Description of any obvious mining factors that could have a significant impact on the project feasibility.	Description of any mining factors that could have a significant impact on the project feasibility. Discussion of possible mining methods.	Description and justification of mining method(s) to be used. Discussion of mining rate, equipment selected, ore control methods, geotechnical and hydrological considerations, personnel requirements, dilution and mine recovery. For open-pit mines, discussion of pit slopes, slope stability and strip ratio. For underground

Evaluation criteria	Exploration information	Resource	Reserve
			mines, discussion of mining method, rock mechanics considerations, mine design characteristics, and ventilation.
b. Costs	Generally not determined.	Generally not determined.	Description and justification of capital and operating costs.
2. Processing a. Method	Description of any obvious processing factors that could have a significant impact on the project feasibility.	Description of any processing factors that could have a significant impact on the project feasibility. Discussion of possible processing methods.	Description and justification of processing method(s) to be used, equipment, plant capacity and personnel requirements. Justification of estimated recovery (proportion of material sent to the processing plant that will be recovered) whether based on historical information, laboratory test or pilot plant results.
b. Costs	Generally not determined.	Generally not determined.	Description and justification of capital and operating costs.
3. Recovery	Generally not determined.	Generally not determined.	Discussion of whether the reported tonnages and grades consist of material in place or whether recoveries are included. Reserves represent that part of the resource that can be economically and legally extracted or produced. If in place, values are reported; information must be supplied concerning expected mining and processing losses or recoveries.
4. Environmental compliance and reclamation.	Description of obvious environmental factors likely to stop the project.	Description of any environmental factors that could have a significant impact on the project feasibility. Discussion of possible means of mitigation.	Property required for project is available for use. Description of environmental compliance methods and costs.
5. Cutoff grade	Generally not determined.	Justification of the cutoff grade used to report resources.	Description of methods used to calculate cutoff grades.
E. Feasibility			
1. Other economic considerations	Description of valuable and potentially valuable product(s) including suitability of products to market.	See Exploration information. A resource represents material from which economic extraction of a product is currently or potentially feasible. Before reporting resources, consideration should be given to this definition.	Description of the product to be sold. Discussion of whether there exists a ready market for the product, whether contracts for the sale of the product are in place or expected to be readily obtained. Justification of assumptions made concerning production cost and value of product. Transportation, marketing, and other costs should be considered.
2. Valuation methods	Generally not applied.	Generally not applied.	Detailed description of the method used to determine the economic feasibility of the project.
F. Assurance classification	Data to support estimates with a sufficient degree of assurance is lacking. Specific quantities and grades cannot be reported.	Description and justification of criteria used to classify the resource. When reported, a resource should be classified as measured, indicated or inferred. Measured and indicated resources can be grouped and need not be reported separately. To classify a resource as measured or indicated, there must be a reasonably high level of confidence with respect to the quality of the information used to calculate this resource, as well as the interpretation of this information.	Description and justification of criteria used to classify the reserves. Reserves are classified as proven or probable to reflect relative degrees of geological assurance. Proven and probable may be combined. There should not be significant uncertainty concerning the economic viability of the project. Only measured and indicated resources can be considered for inclusion in the reserve. Resources classified as inferred lack the requisite degree of assurance to be included in the reserve.
G. Other considerations	Description of any other significant information that is likely to prevent or facilitate	Description of any other material information that could prevent or facilitate the economic viability of the	While any other significant information affecting the project should be discussed, no

Evaluation criteria	Exploration information	Resource	Reserve
	the economic viability of the project. Identification of work or conditions required to demonstrate the presence of a resource or to evaluate this resource.	resource. Identification of work or conditions required to convert the resource to a reserve. A resource represents material that has the potential of being of economic value. No specific economic criteria need be assumed when evaluating a resource. However, known information that significantly reduces or increases the probability of economic feasibility should be reported.	significant impediments to the profitable exploitation of the property should exist. All significant uncertainties about the geology, extraction, processing, marketing, and legal requirements have been eliminated. It is not required that all permits be issued or that mining and processing facilities have been constructed. However, there should not be any significant uncertainty concerning the issuance of permits or the construction of the necessary facilities.
H. Qualification of estimator(s)	Name and qualification of the person(s) preparing and reviewing the foregoing.	See Exploration information	See Exploration information

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D.M. Hausen, editor; 1990, 576 pages, illus., index, hard cover, order No. 091-X

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