Professional Engineers
Ontario

GUIDELINE

Professional Engineers Providing Reports on Mineral Properties

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Notice: *The Professional Practice Committee has a policy of reviewing guidelines every five years to determine if the guideline is still viable and adequate. However, practice bulletins might be issued from time to time to clarify statements made herein or to add information useful to those professional engineers engaged in this area of practice. Users of this guideline who have questions, comments or suggestions for future amendments and revisions are invited to submit these to PEO using the form provided in Appendix 2.*

Vision Statement:
Professional Engineers Ontario strives to meet the needs of Ontario society by licensing and regulating the entire practice of professional engineering in an open, transparent, inclusive manner.

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1. PEO MANDATE AND CRITERIA FOR GUIDELINES

Professional Engineers Ontario produces guidelines for the purpose of educating both licensees and the public about standards of practice. This is done to fulfill PEO's legislated objectives. Section 2(4)2 of the *Professional Engineers Act* states: "For the purpose of carrying out its principal object" PEO shall "establish, maintain and develop standards of qualification and standards of practice for the practice of professional engineering." The association's Professional Practice Committee is responsible for developing practice standards and preparing guidelines.

This guideline has been developed by a task group of the Professional Practice Committee, and reviewed and approved for publication by the full Professional Practice Committee and by PEO Council.

Professional Engineers Ontario produces guidelines to meet the following objectives, which were used to develop the content of this document.

1. Guidelines are intended to aid engineers in performing their engineering role in accordance with the *Professional Engineers Act* and *Regulation 941*.
2. Guidelines are intended to define processes required by regulatory, administrative or ethical considerations associated with specific professional services provided by engineers. They do not aim to be short courses in an engineering subject.
3. Guidelines provide criteria for expected practice by describing the required outcome of the process, identifying the engineer's duty to the public in the particular area of practice, and defining the relationships and interactions between the various stakeholders (government, architects, other engineers, and clients).
4. Guidelines add value to the professional engineer licence for licensed engineers and for the public by establishing criteria for professional standards of competence.
5. Guidelines help the public to understand what it can expect of engineers in relation to a particular task within the practice of professional engineering. By demonstrating that the task requires specialized knowledge, higher standards of care, and responsibility for life and property, guidelines help reinforce the public perception of engineers as professionals.

See Appendix 3 for a list of PEO professional practice guidelines.

2. PREFACE

In 1996, a subcommittee was formed by the Professional Practice Committee to review and update the existing *Guideline for Reporting on Mineral, Oil and Gas Properties*. Since few practitioners report on oil and gas properties in Ontario, the committee decided that the guideline should not cover these areas. This subcommittee then focused on producing the current document, which deals exclusively with reporting of information for mineral properties. During the development period for this document, the Canadian Securities Administrators began work on a replacement for *National Policy Statement No. 2-A, Guide for Engineers, Geologists and Prospectors Submitting Reports on Mining Properties to Canadian Provincial Securities Administrators*. That document, which was to become *National Instrument 43-101*, was expected to be adopted as rules by the various provincial securities administrators. As a result, the subcommittee prepared this guideline to be used in conjunction with *National Instrument 43-101, Standards of Disclosure for Mineral Projects* and its companion documents. Professional engineers intending to seal documents should also be familiar with the recommended use of seal as described in the *Guideline to Professional Practice* and in *Regulatory Practice Bulletin No. 1*.

3. PURPOSE AND SCOPE OF GUIDELINE

The purpose of this guideline is to provide professional engineers preparing reports required by *National Instrument 43-101* with guidance on the level of diligence, methodology and reporting acceptable to Professional Engineers Ontario. Specifically, the guideline outlines the responsibilities of professional engineers undertaking the role of qualified person as described in the standard.

4. INTRODUCTION

The life cycle of mining projects includes exploration, discovery, assessment, development, production and closure. Various types of reports are required for each of the above items. In this guideline, the emphasis is placed on reports required during the pre-production stages: *exploration, discovery, assessment and development*. It is during the pre-production period that intensive studies concerning definition drilling, metallurgical test work, selection of mining methods and site investigations are carried out. These studies are usually conducted under the supervision of engineering personnel who must report their results in a systematic and prescribed manner.

The types of reports that are typically required are exploration reports, scoping studies, pre-feasibility studies, final feasibility studies, due diligence reports and valuation reports.

5. PREPARATION OF REPORTS

5.1 Introduction

Under the rules presented in National Instrument 43-101, *Standards of Disclosure for Mineral Projects*, published by the Canadian Securities Administrators, which came into force on February 1, 2001 (referred to in this guideline as "NI 43-101"), technical reports prepared by a qualified person are required to be filed with Canadian Securities Commissions under a range of circumstances, including the following:

- upon a company becoming a reporting issuer;
- to support disclosure in any prospectus;
- to support disclosure in an annual information form or annual report;
- to support disclosure in an information or proxy circular concerning an acquisition of a material mineral property;
- to support disclosure in an offering memorandum used in connection with a private placement of securities;
- to support disclosure in a rights offering circular;
- to support a valuation required to be prepared and filed under securities legislation;
- to support disclosure in circulars relating to certain take-over bids; and
- to support any other written disclosure that contains first-time disclosure of mineral resources or mineral reserves on a material mineral property, or a change in previously reported resources and reserves, where such disclosure constitutes a material change.

Some of the types of reports that are typically required are the following:

- exploration reports;
- scoping studies;
- pre-feasibility studies;
- final feasibility studies;
- due diligence reports;
- valuation reports.

5.2 Private or Public

Any of the types of reports discussed in this guideline may be written as private or public reports. Private reports often become public, sooner or later, and it is therefore recommended they be written in the same manner as public reports.

The standards for all public disclosure by a reporting company of scientific and technical information concerning mineral properties are presented in NI 43-101, which together with its *Companion Policy 43-101-CP and Form 43-101-F1, Technical Reports* are the principal documents in Canada for disclosure of information on mining projects. Copies of these documents may be found at the following websites:

1. Ontario Securities Commission www.osc.gov.on.ca
2. Alberta Securities Commission www.albertasecurities.com
3. British Columbia Securities Commission www.bcsc.bc.ca

In addition, the Toronto Stock Exchange (TSX) and the Canadian Venture Exchange (CDNX) regulate disclosure by mining companies. Appendix B of the TSE company manual *Disclosure Standards for Companies Engaged in Mineral Exploration, Development and Production* sets out the requirements for TSE-listed companies. CDNX Policy 3.3, *Timely Disclosures*, requires CDNX-listed companies to comply with the requirements of the CDNX's Appendix 3F, *Mining Standards Guidelines*, in addition to those required under NI 43-101. Generally, these requirements of the TSX and CDNX are consistent with the requirements of NI 43-101, but in certain areas, particularly in connection with press releases, are somewhat more detailed. For purposes of preparing technical reports, however, the engineer's primary sources of guidance are NI 43-101 and Form 43-101-F1.

Regardless of its type, any report required to be filed with one or more of the securities commissions in any Canadian province is referred to in NI 43-101 as a "technical report" and ***must*** follow Form 43-101-F1, a copy of which is available on the website referred to above. All technical reports must be prepared by or under the supervision of a qualified person, who, unless the mining company is a "producing issuer", must be independent. A "producing issuer" is a company that had gross revenues of (i) at least CDN$30 million in its most recently completed fiscal year and (ii) at least CDN$90 million during its three most recent fiscal years.

Qualified persons required to be independent must not, among other prohibitions, have been employed by the company or its affiliates, own or expect to receive any shares or other securities of the company or its affiliates, or in any of the proceeding three years have received the majority of their income from the company or its affiliates.

NI 43-101 and Form 43-101-F1 focus on the requirements for reports to be used in Canada. Since some engineers may be required to prepare reports on mineral properties for regulators outside Canada, authors are advised to check with the agency to which the report will be submitted to ensure it will meet all current regulatory requirements.

5.3 Responsibility and Signing—the Qualified Person

All reports described in this guideline should be based on information prepared by a "qualified person" (QP), defined in NI 43-101 as an individual who is an engineer or geoscientist with at least five years of relevant experience in mineral exploration, mining development or operation, or mineral project assessment, and who is a member in good standing of a professional association. All written disclosures must identify the qualified person by name (this may be omitted in press releases for companies that are not listed on the TSX), and must disclose the qualified person's relationship to the reporting company.

When a team prepares reports, it is recommended that each QP accept responsibility for his or her contribution, and the project leader accept responsibility for the overall document, once he or she is satisfied that the other contributors are QPs with respect to the work for which they are taking responsibility. At least one of the QPs preparing the report must visit the property.

5.3.1 Signed Copies

The author(s) of the report should keep an original copy, signed and sealed, attached to the certificates and consents referred to below, from which additional authorized copies can be made as required.

It is recommended that at least the first two copies of the report forwarded to the person who authorized its preparation be sealed, signed and dated (day, month and year) by the professional engineer(s) or engineering firm responsible and that the certificates and consents be attached. These signed reports can be reproduced as required with the consent of the author.

All maps, engineering drawings and engineering diagrams in the two, signed copies should be signed and dated by the responsible engineer. Where information from other sources, either government or private, is used in preparing these maps or diagrams, the source of the information must be acknowledged.

Reports submitted to provincial securities commissions must be filed electronically in PDF format, including all maps, diagrams and other attachments referred to or forming part of the report. Technical reports can be lengthy and may be costly and time consuming to convert for filing, if not initially prepared with electronic filing in mind. For this reason, the securities regulators suggest that reports limit the use of colour, not include photographs, maps or other attachments that are larger than 81/2

inches x 11 inches, and that image resolution not exceed 300 dpi. For purposes of electronic filing, if a person's name appears in the electronic document with "signed by" and "sealed" typed next to the person's name, or there is a similar indication in the document, the regulators will consider the document to have been signed and sealed by that person. Engineers should also bear in mind that all technical reports filed with securities regulators are available to the public.

Generally, feasibility studies (whether preliminary or final) are not submitted in full to the securities regulators, since they provide more technical detail than the investing public requires. Instead, the technical report should include a summary of the material information contained in the study. The regulators, of course, may subsequently request a copy of the full study for their review.

The author should retain electronic copies as required to provide a permanent record of the report.

5.3.2 Certificates and Consents

Technical reports filed with provincial securities commissions must be accompanied by a consent and a certificate of the qualified person(s) who prepared the report.

Addressed to each of the securities commissions with which the report is filed, the consent must give consent to (i) the filing of the technical report and (ii) the written disclosure of the technical report, or extracts, or a summary, in the disclosure document that the company is filing with the commissions. The consent must be signed by the qualified person(s) that prepared the report.

In addition to the consent, the report must contain a certificate dated, signed and sealed by each of the qualified persons primarily responsible for the technical report. This certificate must:

(a) state the name, address and occupation of the author(s);

(b) set out each author's qualifications, including relevant experience, the name of all professional associations to which the author belongs, and that the author is a "qualified person" for the purposes of NI 43-101;

(c) state the date and duration of the QP's most recent visit to the property that is the subject of the report;

(d) where more than one QP is involved, identify the section or sections of the technical report for which each QP is responsible;

(e) state that the QP is not aware of any material fact or material change with respect to the subject matter of the technical report that is not reflected in the technical report, the omission of which makes the technical report misleading;

(f) state that the QP is independent of the company, applying the tests set out in NI 43-101 (if applicable);

(g) describe any prior involvement of the QP with the property that is the subject of the technical report;

(h) state that the QP has read NI 43-101 and Form 43-101-F1 and the technical report has been prepared in compliance with those documents; and

(i) state that the QP has read the written disclosure document (e.g. the prospectus, valuation, etc.) being filed by the company and does not have any reason to believe that there are any misrepresentations in the information derived from the technical report or that the written disclosure contains any misrepresentation of the information contained in the technical report.

Substantial new certificate requirements introduced by NI 43-101 require, among other things, that all QPs involved in preparing technical reports indicate that they have visited the property in question, have reviewed both NI 43-101 and Form 43-101-F1 and prepared the technical reports in compliance therewith, and have reviewed the written disclosure document proposed to be filed by the company to the extent it relates to the technical report and are satisfied that such disclosure document does not misrepresent the material contained in the technical reports.

5.4 Types of Reports

Examples of types of reports were noted previously. A brief definition of each type is presented below. Regardless of the type of report to be submitted to the securities commissions, each report must comply with NI 43-101 and Form 43-101-F1.

5.4.1 Exploration

These reports are typically written to describe a geological occurrence. Normally, capital and operating costs are not part of these reports, and the principal focus is on geology, property ownership, mineral resources, reserves, if any, and ongoing exploration requirements, including work programs and cost estimates, where necessary.

5.4.2 Scoping Studies

These studies will usually describe a conceptual installation that might be built. The purpose is to assess a project to rank it broadly or accept/reject it. Cost estimates are typically based on comparisons to similar installations, not on detailed engineering design.

5.4.3 Pre-feasibility Studies

These studies present preliminary estimates of pre-production capital, ongoing capital, operating costs and operating profits for a specific deposit, to justify further project development.

NI 43-101 defines a "pre-feasibility study" or "preliminary feasibility study" as a comprehensive study of the viability of a mineral project that has been 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 which, if an effective method of mineral processing has been determined, includes a financial analysis based on reasonable assumptions of technical, engineering, operating, and economic factors and the evaluation of other relevant factors that are sufficient for a QP, acting reasonably, to determine if all or part of the mineral resource may be classified as a mineral reserve. NI 43-101 prohibits companies from using the terms "pre-feasibility study" or "preliminary feasibility study" when referring to a study, unless the study satisfies these criteria

5.4.4 Feasibility Studies

A feasibility study is a detailed and comprehensive report prepared by groups of specialists in the numerous and varied aspects of mine development. All engineering aspects are planned and costed in detail. They are accompanied by engineering plans, diagrams and maps of the mine, plant, equipment and infrastructure. Because the underlying basis of the feasibility study is an estimate of the reserves, this estimate should be described in detail.

After-tax cash-flow forecasts, including descriptions of the economic assumptions, must also be included as a basis for estimating the economic potential of the deposit. A final decision on whether to proceed to production is based primarily on estimates of the after-tax measures of profitability.

NI 43-101 defines a "feasibility study" as a comprehensive study of a deposit in which all geological, engineering, operating, economic and other relevant factors are considered in sufficient detail that it could reasonable serve as a basis for a final decision by a financial institution to finance the development of the deposit for mineral production. NI 43-101 prohibits a company from using the term "feasibility study" unless the study satisfies these criteria.

5.4.5 Due Diligence Reports

The purpose of a due diligence study is to perform a sufficiently detailed review of a mineral property (operating or proposed) that all of the significant components are examined, the accuracy and reasonableness of the data is confirmed, the reasonableness and achievability of the concept is confirmed, and any errors, omissions, duplications, or areas of concern are identified. A detailed due diligence review will involve a team of experts representing a number of disciplines. A list of the disciplines, indicating the topics that might be considered by each, is presented below.

- **Accounting:** assets, balance sheets, earnings, depreciation debt, pension fund obligations (often a major liability), employee obligations, accounts payable and receivable.
- **Taxation:** tax depreciation pools, back taxes, special tax situations that may cease for a new owner, tax losses.
- **Legal:** land and mineral rights titles, current and pending litigation, ownership complications, royalties, legislation changes, environmental liabilities, water rights.
- **Management:** current employee relations, management systems, quality of management and employees, commitment of management to remain with the new owner.

- **Country Risk:** political, geographic, social risk, economic risks.
- **Marketing:** supply and demand, competitive position, selling prices, sales contracts, fees, commissions.
- **Social:** an assessment of social issues, local and regional issues.
- **Environmental:** environmental permits, issues, health and safety, closure plans.
- **Technical:** resources, reserves, mining, processing, infrastructure, geotechnical, environmental, capital costs, operating costs, revenue. This is often referred to as the technical audit or technical due diligence.

5.4.6 Valuation Report

Reports expressing the author's opinion concerning the fair market value of a mining company or mineral asset are sometimes required. Such opinions are required for such purposes as mergers, acquisitions, taxation, transfer values, determination of vendor's consideration and so on. Sometimes, such reports must meet the requirements of such securities policies as Ontario Securities Commission Rule 61-501 (which replaced OSC Policy 9.1 on May 1, 2000), which governs insider bids, doing private transactions and related party transactions. Rule 61-501 requires that the valuator be independent and outlines certain requirements as to the content of a valuation report. The rule does not deal specifically with mineral valuations and there are no references in the rule to mineral valuations, methodology or valuation standards.

NI 43-101 requires that where a valuation is required to be prepared and filed under securities legislation (e.g. pursuant to Ontario Securities Rule 61-501) the valuation must be accompanied by a technical report, prepared by an independent QP, that complies with Form 43-101-F1. Other than these requirements, NI 43-101 does not offer specific guidance on preparing a valuation. However, on February 19, 2002, the CIM released *Draft Standards and Guidelines for Valuation of Mineral Properties*, which could be accessed at the time of this guideline's printing at http://www.cim.org/committees/CIMVal_Standards_Guidelines.pdf. The draft was prepared by the CIM's Special Committee on Valuation of Mineral Properties, which was formed in 1999 on the recommendation of the Mining Standards Task Force of the TSE and OSC. Once these draft valuation standards are finalized, it is expected that they will be adopted as formal valuation guidelines by the securities commissions.

5.5 Report Preparation

National Instrument 43-101 sets out the circumstances in which a written technical report must be filed with the securities commission (see 2.1 Introduction, above). The contents of all technical reports filed with securities commissions must follow Form 43-101-F1.

The Companion Policy 43-101-CP requires that exploration programs be carried out and reported in accordance with the *Mineral Exploration Best Practices Guidelines*, developed by a committee of industry professionals and regulators. These best practices guidelines were adopted and published by CIM in the summer of 2000 and are available on its website.

Appendix 1 of this guideline is a "Checklist of Assessment Criteria" prepared for the Society for Mining, Metallurgy and Exploration Inc. in the United States. This checklist outlines the work required to confirm exploration data and justify using the term mineral resource or mineral reserve. While a useful guide, in the case of any differences between the checklist and the requirements of Form 43-101-F1, the latter document must be followed for all technical reports to be filed in Canada.

While much of the information Form 43-101-F1 requires to be included in a technical report is factual, the QP is required to perform some compulsory procedures and analysis and express in the report certain opinions and conclusions, which require the exercise of professional judgment. For example:

- The QP must express an opinion on the adequacy of sampling and sample preparation, security and analytical procedures.
- The report must discuss the adequacy of data density and reliability and any uncertainty of the data.
- A technical report concerning exploration information must include the conclusions of the QP and a discussion of whether the completed project met its original objectives.
- A technical report that recommends expenditures on exploration or development work must include a statement that in the QP's opinion the property is of sufficient merit to justify the program recommended.

6. DEFINITION AND CLASSIFICATION OF MINERAL RESOSURCES AND RESERVES

6.1 Introduction

Although the choice of methods and procedures to be used to estimate mineral resources and reserves is the responsibility of the QP, the classification system to be used in reporting mineral resources and reserves is based on a report prepared by the Canadian Institute of Mining and Metallurgy's Petroleum Standing Committee on Reserve Definitions. Entitled *CIM Standards on Mineral Resources and Reserves, Definitions and Guidelines*, the report was adopted by CIM Council on August 20, 2000.

6.2 Mineral Resources

Mineral resources are subdivided, in order of increasing geological confidence, into three categories: inferred, indicated and measured. An inferred mineral resource has a lower level of confidence than that applied to an indicated mineral resource. An indicated mineral resource has a higher level of confidence than an inferred mineral resource but has a lower level of confidence than a measured mineral resource.

The CIM standards defines a mineral resource as "a concentration or occurrence of natural, solid, inorganic or fossilized organic material in or on the Earth's crust in such form and quantity and of such a grade or quality that it has reasonable prospects for economic extraction. The location, quantity, grade, geological characteristics and continuity of a mineral resource are known, estimated or interpreted from specific geological evidence and knowledge".

The term mineral resource covers mineralization and natural material of intrinsic economic interest, which has been identified and estimated through exploration and sampling and within which mineral reserves may subsequently be defined by considering and applying technical, economic, legal, environmental, socioeconomic and governmental factors. The phrase "reasonable prospects for economic extraction" implies a judgment by the qualified person in respect of the technical and economic factors likely to influence the prospect of economic extraction. A mineral resource is an inventory of mineralization that under realistically assumed and justifiable technical and economic conditions might become economically extractable. These assumptions must be presented explicitly in both public and technical reports.

6.2.1 Inferred Mineral Resource

The CIM standards defines an inferred mineral resource as "that part of a mineral resource for which quantity and grade or quality can be estimated on the basis of geological evidence and limited sampling and reasonably assumed, but not verified, geological and grade continuity. The estimate is based on limited information and sampling gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes".

Due to the uncertainty that may attach to inferred mineral resources, it cannot be assumed that all or any part of an inferred mineral resource will be upgraded to an indicated or measured mineral resource as a result of continued exploration. Confidence in the estimate is insufficient to allow the meaningful application of technical and economic parameters or to enable an evaluation of economic viability worthy of public disclosure. Inferred mineral resources must be excluded from estimates forming the basis of feasibility or other economic studies.

6.2.2 Indicated Mineral Resource

The CIM standards defines an indicated mineral resource as "that part of a mineral resource for which quantity, grade or quality, densities, shape and physical characteristics, can be estimated with a level of confidence sufficient to allow the appropriate application of technical and economic parameters, to support mine planning and evaluation of the economic viability of the deposit. The estimate is based on detailed and reliable exploration and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes that are spaced closely enough for geological and grade continuity to be reasonably assumed".

A qualified person may classify mineralization as an indicated mineral resource when the nature, quality, quantity and distribution of data are such as to allow confident interpretation of the geological framework and reasonable assumption of the continuity of mineralization. The qualified person must recognize the importance of the indicated mineral resource category to the advancement of the feasibility of the project. An indicated mineral resource estimate is of sufficient quality to support a preliminary feasibility study that can serve as the basis for major development decisions.

6.2.3 Measured Mineral Resource

The CIM standards defines a measured mineral resource as "that part of a mineral resource for which quantity, grade or quality, densities, shape, physical characteristics are so well established that they can be estimated with confidence sufficient to allow the appropriate application of technical and economic parameters, to support production planning and evaluation of the economic viability of the deposit. The estimate is based on detailed and reliable exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill holes that are spaced closely enough to confirm both geological and grade continuity".

A qualified person may classify mineralization or other natural material of economic interest as a measured mineral resource when the nature, quality, quantity and distribution of data are such that the tonnage and grade of the mineralization can be estimated to within close limits and that variation from the estimate would not significantly affect potential economic viability. This category requires a high level of confidence in, and understanding of, the geology and controls of the mineral deposit.

6.3 Mineral Reserves

Mineral Reserves are subdivided in order of increasing confidence into probable mineral reserves and proven mineral reserves. A probable mineral reserve has a lower level of confidence than a proven mineral reserve.

The CIM standards defines a mineral reserve as "the economically mineable part of a measured or indicated mineral resource demonstrated by at least a preliminary feasibility study. This study must include adequate information on mining, processing, metallurgical, economic and other relevant factors that demonstrate, at the time of reporting, that economic extraction can be justified. A mineral reserve includes diluting materials and allowances for losses that may occur when the material is mined".

Mineral reserves are those parts of mineral resources that, after the application of all mining factors, result in an estimated tonnage and grade which, in the opinion of the qualified person(s) making the estimates, is the basis of an economically viable project, after taking account of all relevant processing, metallurgical, economic, marketing, legal, environment, socioeconomic and government factors. Mineral reserves are inclusive of diluting material that will be mined in conjunction with the mineral reserves and delivered to the treatment plant or equivalent facility. The term "mineral reserve" need not necessarily signify that extraction facilities are in place or operative or that all governmental approvals have been received. It does signify that there are reasonable expectations of such approvals.

6.3.1 Probable Mineral Reserve

The CIM standards defines a probable mineral reserve as "the economically mineable part of an indicated, and in some circumstances a measured mineral resource demonstrated by at least a preliminary feasibility study. This study must include adequate information on mining, processing, metallurgical, economic, and other relevant factors that demonstrate, at the time of reporting, that economic extraction can be justified".

6.3.2 Proven Mineral Reserve

The CIM standards defines a proven mineral reserve as "the economically mineable part of a measured mineral resource demonstrated by at least a preliminary feasibility study. This study must include adequate information on mining, processing, metallurgical, economic, and other relevant factors that demonstrate, at the time of reporting, that economic extraction is justified".

Application of the proven mineral reserve category implies that the qualified person has the highest degree of confidence in the estimate with the consequent expectation in the minds of the readers of the report. The term should be restricted to that part of the deposit where production planning is taking place and for which any variation in the estimate would not significantly affect potential economic viability.

6.4 Relationship Between Mineral Resources and Mineral Reserves

Technical reports dealing with estimates of mineral resources and mineral reserves must use only the terms and the definitions contained herein. Figure 1 displays the relationship between the mineral resource and mineral reserve categories.

The CIM standards provides for a direct relationship between indicated mineral resources and probable mineral reserves and between measured mineral resources and proven mineral reserves. In other words, the level of geoscientific confidence for probable mineral reserves is the same as that required for the in situ determination of indicated mineral resources. For proven mineral reserves, it is the same as that required for the in situ determination of measured mineral resources.

Each category of mineral resources and reserves must be reported separately and it is therefore not permissible to report only total mineral resources or reserves. Because mineral reserves are in effect a subcategory of resources, if both mineral resources and mineral reserves are being disclosed, the extent to which mineral reserves are included in total mineral resources must also be stated so as to avoid any double counting. It is not permissible to add inferred mineral resources to any other category of resources.

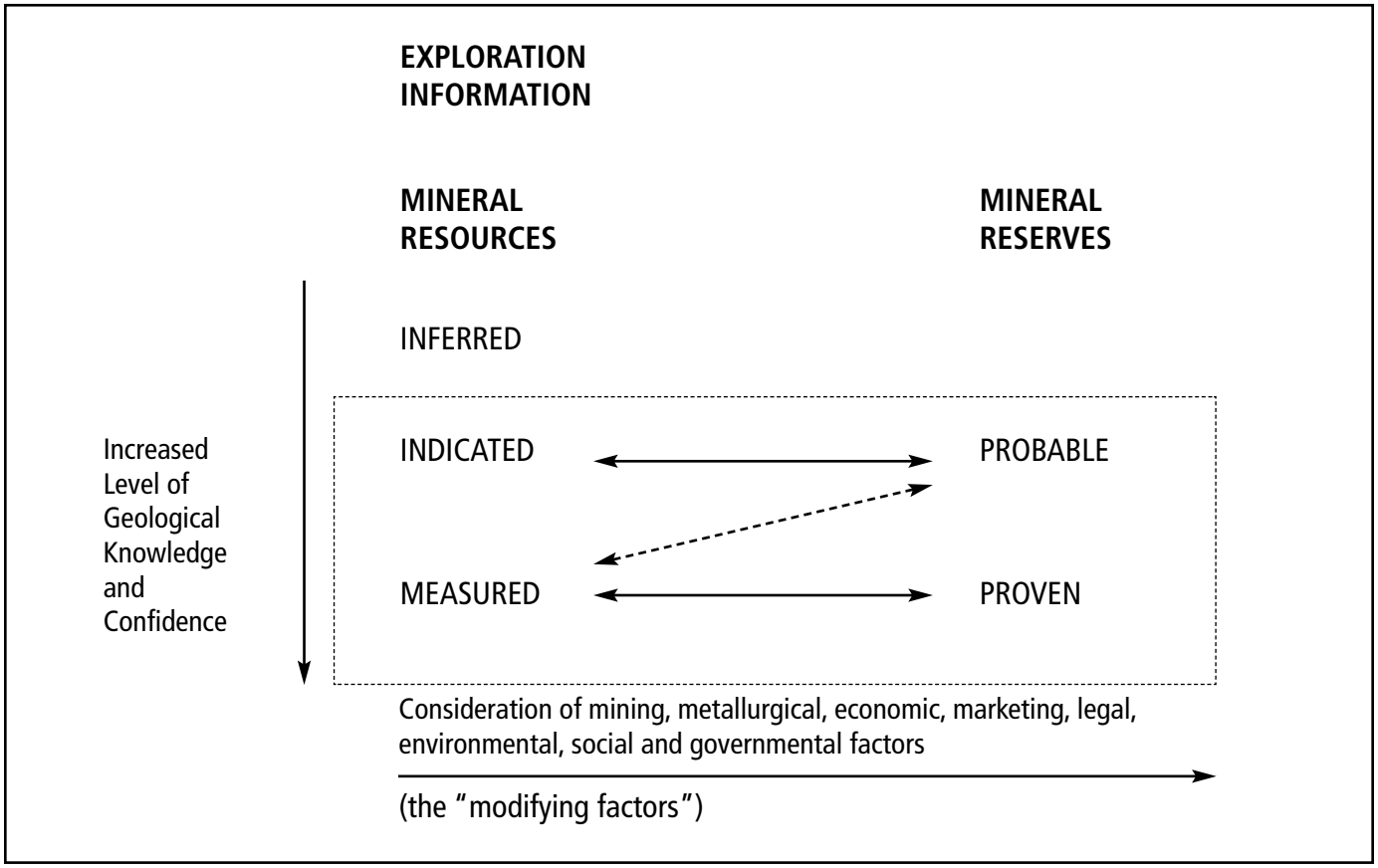

Figure 1. Relationship between mineral resources and mineral reserves

Figure 1 sets out the framework for classifying tonnage and grade estimates so as to reflect different levels of geological confidence and different degrees of technical and economic evaluation. With input from those in other disciplines as necessary, a qualified person can estimate mineral resources on the basis of geoscientific information and reasonable assumptions of technical and economic factors likely to influence the prospect of economic extraction. Mineral reserves, which are a modified subset of the indicated and measured mineral resources (shown within the dashed outline in Figure 1) require consideration of factors affecting profitable extraction, including mining, processing, metallurgical, economic, marketing, legal, environmental, socioeconomic and governmental factors, and should be estimated with input from a range of disciplines. Additional testwork, e.g. metallurgy, mining, environmental, is required to classify a resource as a reserve.

In certain situations, measured mineral resources could convert to probable mineral reserves because of uncertainties associated with the modifying factors, which are taken into account in the conversion from mineral resources to mineral reserves. The relationship is shown by the dashed arrow in Figure 1. (Although the trend of the dashed arrow includes a vertical component, it does not, in this instance, imply a reduction in the level of geological knowledge or confidence.) In such a situation, these modifying factors should be fully explained. Under no circumstances can indicated resources convert directly to proven reserves.

In certain situations, previously reported mineral reserves could revert to mineral resources. It is not intended that re-classification from mineral reserves to mineral resources should be applied as a result of changes expected to be of a short-term or temporary nature, or where company management has made a deliberate decision to operate in the short term on a non-economic basis. Examples of such situations might be a commodity price drop expected to be of short duration, mine emergency of a non-permanent nature, transport strike, etc.

7. USE OF COMPUTERS

If PEO members are responsible for reports on reserves that incorporate computer-assisted calculations, spreadsheets, etc., they should be satisfied that the software used to prepare the reports is both adequate and applied according to the association's *Guideline for the Use of Computer Software Tools by Professional Engineers and the Development of Computer Software Affecting Public Safety*.

8. REPORTING OF COAL RESERVES

Coal resource and reserve estimates should conform to the definitions and guidelines presented in Paper 88.21 of the Geological Survey of Canada, *A Standardized Coal Resource/Reserve Reporting System for Canada*.

9. REPORTING OF INDUSTRIAL MINERALS

When reporting mineral resource and mineral reserve estimates relating to an industrial mineral site, a qualified person(s) must make the reader aware of certain special properties of these commodities. The CIM standards defines an industrial mineral as "any rock, mineral or other naturally occurring substance of economic value, exclusive of metallic ores, mineral fuels and gemstones; that is one of the non-metallic minerals". To assist qualified persons, the following guidelines are presented.

The quality of industrial mineral deposits is typically measured by physical and/or chemical properties. The properties may be defined by standard industry specifications that must be considered in the classification of mineral resources and/or mineral reserves

Before a tonnage and quality and/or value per tonne estimate of an industrial mineral deposit can be classified as a mineral resource, the qualified person preparing the tonnage and quality estimate must recognize that there is a viable market for the product or that a market can be reasonably developed.

Before any part of an industrial mineral deposit can be classified as a mineral reserve, the qualified person preparing the tonnage and quality and/or value per tonne estimate must review specific and identifiable markets for the product to be assured that the mineral can be sold at a profit.

When the quality of industrial minerals is defined by standard industry specifications and these specifications are used to estimate the value of a tonne of product or products, the industry standard used must be identified. The methods for estimating the value must be explained.

10. REPORTING OF DIAMONDS AND GEMSTONES

Mineral resource and reserves estimates of diamonds or gemstones must conform to the definitions and guidelines found in *Reporting of Diamond Exploration Results, Identified Mineral Resources and Ore Reserves*, published by the Association of Professional Engineers, Geologists and Geophysicists of the Northwest Territories.

Reports of diamonds or gemstones recovered from sampling programs must specify the number and total weight of stones recovered (in carats for diamonds). Details of the type and size of the samples that produced the diamonds must also be specified, including the lower cut-off sieve size and type of sieve used in the recovery. Of equal or greater importance to the total weight of diamonds is diamond value, which depends on the colour, size, and proportion of gem and near gem quality of stones recovered. The weight of diamonds recovered may only be omitted from the report when the diamonds are less than 0.5mm in size (i.e. when the diamonds recovered are microdiamonds).

For technical reports dealing with diamond or other gemstone mineralization, it is also a requirement of the CIM standards that, if a valuation(s) of a parcel of diamonds or gemstones is reported, the person(s) or organization valuing the parcel must be named in the report and their professional valuation experience, competency and independence must be stated. If a valuation of a parcel of diamonds is reported, the weight in carats and size range of the contained diamonds must be stated and the value of the diamonds must be estimated in US dollars per carat. If the valuation(s) is not independent, this must be clearly stated.

Diamond valuation is a highly specialized process and value can only be reliably estimated for large parcels of diamonds (at least 2000 carats) from a single deposit. The reliability of valuations of parcels smaller than 2000 carats decreases as the size of the parcels decreases to the point where valuations placed on a small number of diamonds from exploration samples are likely to be misleading.

APPENDIX 1. CHECKLIST OF ASSESSMENT CRITERIA *

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, use 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 as 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 sufficient to enable an intelligent layperson to make a reasonable and balanced assessment of the significance of the information When and whether information should be publicly released is subject to current laws and regulations in the relevant jurisdictions.

*** Reference: *A Guide for Reporting Exploration Information, Mineral Resources and Mineral Reserves*, SME, March 1998**

	Evaluation Criteria	Exploration Information	Mineral Resource	Mineral 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 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.
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 down-hole surveys.	See Exploration Information. Particular attention should be given to drill hole and other sample survey information, including down-hole surveys. If the sample locations are not well known, the effect on the resource estimates should be considered.	See Mineral Resource. The location of samples and other relevant features (property lines, mine workings, etc.) should be well-known. The location of drill hole collars should be accurate and the adequacy of the down-hole surveying technique should be reviewed and commented on.

	Evaluation Criteria	Exploration Information	Mineral Resource	Mineral Reserve
2.	Geological Data	Description of the nature, detail, and reliability of geological information (rock types, structure, alterations, mineralizations, and relation to known mineralized zones, etc.). 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, or data that could materially influence the estimated quantity and quality of the resource, should be discussed.	See Mineral Resource.
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, etc.). 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, etc.). 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 Mineral Resource. Adequate sampling verification techniques, including appropriate numbers of duplicates and appropriate statistical analyses of duplicates are required.
(b)	Preparation	Description of laboratory and method used for sample preparation, sub-sampling and size reduction, and likelihood of inadequate or non-representative samples (improper size reduction contamination, etc.). Discussion of whether tests were performed to verify the suitability of sample preparation.	See Exploration Information.	See Exploration Information. Verification of the suitability of sample preparation is required.
(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. Verification of analytical techniques and quality control programs are required.

	Evaluation Criteria	Exploration Information	Mineral Resource	Mineral Reserve
(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 Mineral Resource. The specific gravity and bulk tonnage must have been measured by methods that adequately account for void spaces (vugs, porosity, etc.) and for differences between rock and alteration zones within the deposit.
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 database 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 Mineral 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. Discussion of basis for using or not using grade cutting or capping. 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 Mineral Resource.

	Evaluation Criteria	Exploration Information	Mineral Resource	Mineral Reserve
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 mines, discussion of mining method, rock mechanics considerations, mine design characteristics, and ventilation.
(b)	Costs	Generally not determined.	Stated reasonable assumptions.	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.	Stated reasonable assumptions.	Description and justification of capital and operating costs.
3.	Recovery			
(a)	Mining	Generally not determined.	Stated reasonable assumptions.	Reported tonnages, grades and mineral contents must take into account mining dilution and losses. Description and justification of mining dilution and losses is required.
(b)	Processing	Generally not determined.	Stated reasonable assumptions.	Discussion of whether the reported tonnages and grades consist of material in place or whether processing recoveries are included. If in-place values are reported, information must be supplied concerning expected processing losses or recoveries. Justification of processing recoveries is required.
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.	The necessary permits have been obtained, or there is reasonable basis to believe that all permits required for the project can be obtained in a timely manner. 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.

	Evaluation Criteria	Exploration Information	Mineral Resource	Mineral Reserve
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 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.	Stated reasonable assumptions.	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. Depending on materiality, measured and indicated resources may be combined 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. Depending on materiality, proven and probable reserves 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 the economic viability of the project. Identification of work or conditions required to demonstrate the presence of a resource or to evaluate this resource.	Description of any other material information that could prevent or facilitate the economic viability of the 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.	While any other material information affecting the project should be discussed, no material impediments to the profitable exploitation of the property should remain. Material 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 be a reasonable basis to believe that permitting and construction of the necessary facilities can be accomplished in a timely manner.
H.	**Qualification of Estimator(s)**	Name and qualification of the Competent Person(s) preparing and reviewing the foregoing.	See Exploration Information.	See Exploration Information.

APPENDIX 2. AMENDMENT AND REVISION SUBMISSION FORM

Guideline:

Statement of proposed amendment or revision:

Reason:

Submitted by:

Date:

Mail: Professional Engineers Ontario
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Attention: Bernard Ennis, P.Eng., Manager, Professional Practice

Fax: (416) 224-8168 or (800) 268-0496

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APPENDIX 3. PEO PROFESSIONAL PRACTICE GUIDELINES

1. Acting as Contract Employees (2001)
2. Acting as Independent Contractors (2001)
3. Acting Under the Drainage Act (1988)
4. Acoustical Engineering Services in Land-Use Planning (1998)
5. Building Projects Using Manufacturer-Designed Systems & Components (1999)
6. Commissioning Work in Buildings (1992)
7. Communications Services (1993)
8. Engineering Services to Municipalities (1986)
9. Environmental Site Assessment, Remediation and Management (1996)
10. General Review of Construction as Required by the Ontario Building Code (1996)
11. Geotechnical Engineering Services (1993)
12. Guideline to Professional Practice (1998)
13. Human Rights in Professional Practice (2000)
14. Land Development/Redevelopment Engineering Services (1994)
15. Mechanical and Electrical Engineering Services in Buildings (1997)
16. Professional Engineer as an Expert Witness (1997)
17. Professional Engineer's Duty to Report
18. Project Management Services (1991)
19. Providing Mineral Property Reports (2002)
20. Reports for Pre-Start Health and Safety Reviews (2001)
21. Roads, Bridges and Associated Facilities (1995)
22. Selection of Engineering Services (1998)
23. Solid Waste Management (1993)
24. Structural Engineering Services in Buildings (1995)
25. Temporary Works (1993)
26. Transportation and Traffic Engineering (1994)
27. Use of Agreements between Client and Engineer for Professional Engineering Services (including sample agreement) (2000)
28. Use of Computer Software Tools Affecting Public Safety or Welfare (1993)

NOTES

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