

1989 EDITION

# 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



INCORPORATED BY ROYAL CHARTER 1955

FEBRUARY 1989



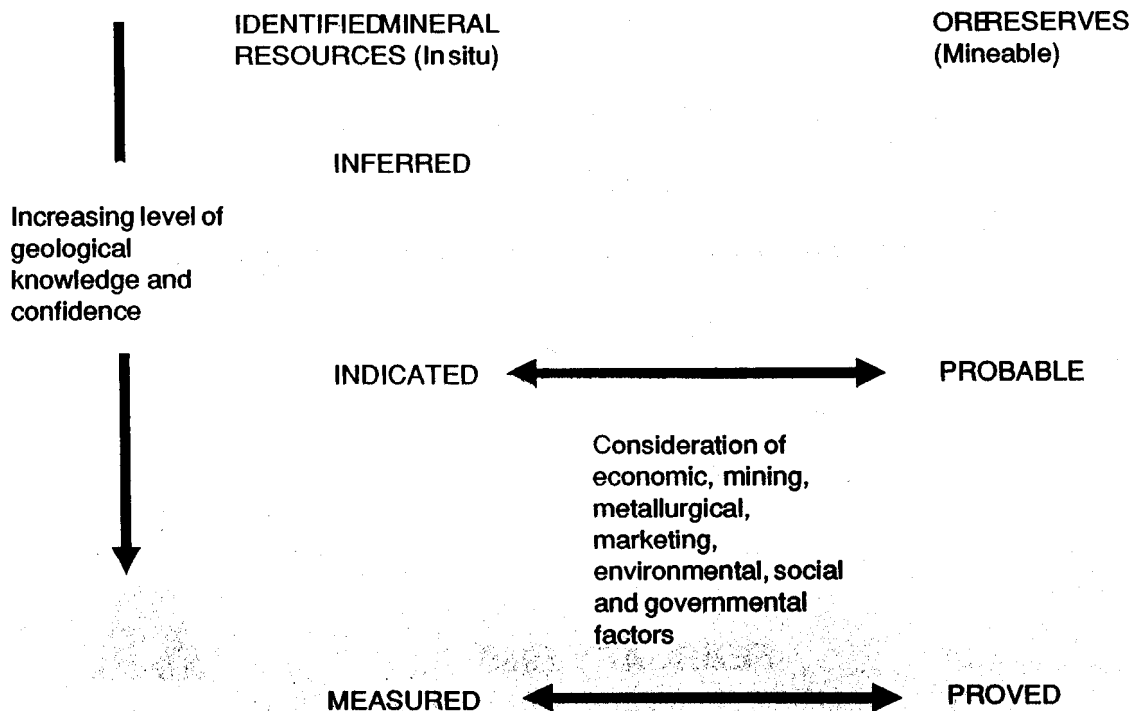
## FOREWORD

1. The Joint Committee was set up in 1971 to consider and make recommendations on stock exchange listing requirements appropriate to mining companies reporting ore reserves. The first report was published in April 1972 and re-published in 1975.
2. The Committee reconvened in 1978 to review developments since the first report and to consider recommending changes. A revised report published in 1981 enlarged the section on pre-ore reserve terminology to recognise the reporting of indicative, qualitative or quantitative estimates of potentially economic mineralisation. The report established ore reserves categories and introduced the concepts of "precision" and "qualification" the latter being further refined in 1983.
3. The 1983 Committee did not attempt to define or classify mineral resources (as distinct from reserves) preferring to regard resource assessment issues as matters primarily of concern to government.
4. The present Committee considers that it is now appropriate to link the reporting of mineral resources with the reporting of ore reserves as shown in Figure 1.
5. The Committee has sought to define a mineral resource and then outline the process by which it may be upgraded to an ore reserve through consideration of technical and economic criteria and data including mining, metallurgy and marketing.
6. The Committee also considers that if the investment community recognises that a mineral resource may be the precursor of an ore reserve then it will find it easier to distinguish mineral resource assessments based on geoscientific and sampling data from ore reserve assessments based on consideration of detailed technical and economic data going beyond basic resource data.
7. The Committee considers this report unifies the industry's reporting of mineral resources and ore reserves and complements the Australian Code for Reporting Identified Coal Resources and Reserves and terminology used by government organisations in Australia which is included with this publication as Appendix 1.

## CONCLUSIONS

8. The Committee believes that, in its efforts to:
  - define and distinguish between mineral resources and ore reserves;
  - subdivide identified mineral resources into categories of "inferred", "indicated" and "measured";
  - subdivide ore reserves into categories of "probable" and "proved"; and
  - discard the use of the terms "in situ reserves" and "possible ore";
 it has provided a code that will promote standardised reporting of a company's mineral assets.

**Figure 1. - REPORTING TERMINOLOGY**



## DISCUSSION

9. A "RESOURCE" is an in situ (meaning as it occurs on surface or underground) mineral occurrence quantified on the basis of geological data and a geological cut-off grade only.

The term "ORE RESERVE" will only be used if a study of technical and economic criteria and data relating to the "RESOURCE" has been carried out and it will be stated in terms of mineable tonnes or volume and grade.

10. The Committee reaffirms its strong belief that the public release of information concerning mineral resources and ore reserves and related estimates must derive from reports prepared by appropriately qualified persons.
11. In an endeavour to encourage competent, professional reporting of resources and ore reserves and to eliminate unsatisfactory reporting the Committee recommends to the industry and to the Australian Stock Exchange Limited that resource and ore reserve reports conform to the Code set out below.

The Committee recommends to the Australian Stock Exchange Limited that a declaration of conformity or otherwise with this code be a requirement for prospectus listings, regular reporting to stock exchanges, press releases or other information made available to the public.

12. The Committee is conscious of the fact that this Code has been the subject of considerable discussion and debate and that positive recommendations will continue to be received. This Code has been made in the knowledge that it will require review from time to time.

### Competence

13. A "Competent Person" is a person who is a Corporate Member of The Australasian Institute of Mining and Metallurgy with a minimum of five years' experience in

the relevant Resource and Ore Reserve assessment field.

### Responsibility

14. A "Resource Report" or "Ore Reserve Report" giving technical facts, interpretations or assessments of Resources or Ore Reserves must be prepared under the direction of, and signed by a Competent Person or Persons.
15. While the public release of information concerning a company's Resources and Ore Reserves remains the responsibility of its Board of Directors any such release must be based on, and fairly reflect, a Resource and/or Ore Reserves Report prepared by a Competent Person. Companies must review and report on Resources and Ore Reserves annually.
16. A Company must disclose basic information concerning the status and characteristics of a mineral deposit which could materially influence the economic value of that deposit.
17. The Competent Person responsible for the reporting must also include a statement relating the reported mineralisation to its mode of occurrence.

Mineralisation may be established in a surface outcrop, costean, mine opening, or drill hole before there is any certainty or even likelihood that it could constitute part of a resource.

### Pre-Resource Reporting

18. A Company, when reporting Pre-Resource mineralisation, should disclose available data relating to its source, including drill intersections where appropriate. In reporting such mineralisation which may be isolated, sporadic or discontinuous, full information on the nature of the sampling, sample intervals, assay data and positions must be given. (Refer Table 1).

## REPORTING OF IDENTIFIED MINERAL RESOURCES

### Resource Terminology

19. The term "Resource" is defined as an identified in situ mineral occurrence which excludes "Pre-Resource" mineralisation, from which valuable or useful minerals may be recovered. A resource may be reported as:

- an Inferred Resource;
- an Indicated Resource; or
- a Measured Resource.

In defining a resource, the competent person will only take into consideration geoscientific data. It must be appreciated, however, that in reporting a resource, there is an implication that there are reasonable prospects for eventual economic exploitation.

20. The term "Inferred Resource" is an estimate, inferred from geoscientific evidence, drill holes, underground openings, or other sampling procedures and before testing and sampling information is sufficient to allow a more reliable and systematic estimation.
21. The term "Indicated Resource" means a Resource sampled by drill holes, underground openings, or other sampling procedures at locations too widely spaced to ensure continuity but close enough to give a reasonable indication of continuity and where

geoscientific data are known with a reasonable level of reliability.

22. The term "Measured Resource" means a Resource intersected and tested by drill holes, underground openings, or other sampling and procedures at locations which are spaced closely enough to confirm continuity and where geoscientific data are reliably known.
23. The appropriate Resource category must be determined by a Competent Person.

### Resource Report

24. A mineral resource identified during exploratory investigations should only be reported as a Resource to the stage where a significant probability of economic viability has been established and where relevant mine planning, metallurgical testing and other criteria, as shown in Figure 1, may indicate that the resource could be categorised as a Reserve.

25. Resource reports should be made more informative by dividing Resources into the three categories which reflect the quantity and quality of data available and the degree of correlation or continuity assigned and thus reflect the confidence level of the assessment.
26. An Inferred Resource (the least reliable assessment) is a category for any identified resource, on which testing and sampling information has inferred a resource but not defined it sufficiently to classify it as indicated. Estimates should be expressed in round figures that do not imply precise estimation; be suitably qualified with terms such as "approximately"; and include a statement indicating the data on which the estimate is based. (See Table 1)
27. An Indicated Resource estimate will be based on more data than an Inferred Resource, and will therefore be more reliable.
28. A Measured Resource estimate (the most reliable resource estimate) will be based on a substantial amount of data competently collected, interpreted and evaluated which allows a clear outline of shapes, sizes, densities and grades to be estimated.
29. Any public release of information in a report concerning a company's Resources should state the pertinent data on which the Report is based and contain a qualification drawing attention to any assessment criteria from Table 1 for which inadequate data are available.
30. The words "ore" and "reserves" should not be used in stating Resource estimates as the terms imply technical feasibility and economic viability and are only appropriate when technical and economic factors have been considered. Reports and statements should continue to refer to the appropriate category or categories of identified Resources until technical feasibility and economic viability have been established. If re-evaluation indicates that the Reserves are no longer viable, the Ore Reserves must revert to the "Resource" category.
31. Resource estimates are not precise calculations, being dependent on the interpretation of limited information on the location, shape and continuity of the occurrence and on the available sampling results. Tonnage and grade should reflect the order of accuracy of the estimate by rounding off to appropriately significant figures.

**Table 1**

Resource assessment criteria	Explanation
Data density	Whether sample density is sufficient to ensure continuity as well as provide an adequate data base for the estimating procedure used.
Accuracy of location of sampling points	This variable refers to how well the location of a sample position is known and its effect on the resource estimate.
Drilling technique	Whether core, rotary, percussive or percussion and if non-core, whether open hole or reverse circulation.
Sampling technique	If core, whether cut or chisel broken and whether quarter, half or all core taken. If non-core, whether riffled, section cut, tube sampled, or whatever, and whether sampled dry or wet. If wet, what precautions taken to maximise recovery and minimise fines loss.
Proportion of core recovery in mineralised zone	
Tonnage factor (SG)	Whether assumed or determined, and if determined, by what method and how frequently. If assumed, are assumptions valid and the basis for those assumptions.
Quality of assay data	Whether reproducible and whether representative. Substantial quality control and umpire assaying is necessary to identify any deficiencies in assay quality.
Quality of data description	Whether core logged in detail; whether all significant lithologic, structural, mineralogical, alteration or other geological or geotechnical characteristics and properties recorded competently.
Geological interpretation	If underground chip samples, whether channel cut or chipped lineally or whether randomly taken from a face. If linear, whether horizontal or vertical.
Estimation techniques	Whether based on sufficient data or postulated assumptions, whether constrained by one model or whether consideration given to alternative possible interpretations.
Cut-off grades	A clear description of estimation techniques and key assumptions.
	Assumptions regarding cut-off grades.

## REPORTING OF ORE RESERVES

### Ore Reserve Terminology

32. The term "Ore Reserve" means that part of a Measured or Indicated Resource, which could be mined including dilution and from which valuable or useful minerals could be recovered economically under conditions realistically assumed at the time of reporting. Ore Reserves should be reported as:
- Probable Ore Reserves or
  - Proved Ore Reserves.
33. The term "Probable Ore Reserves" means Ore Reserves stated in terms of mineable tonnes/volumes and grades where the conditions are such that ore will probably be confirmed but where the in situ identified Resource has been categorised as "Indicated" and has not been defined with the precision necessary for the "Measured" category. Probable Ore Reserves includes ore that has been sampled on a pattern too widely spaced to ensure continuity.
34. The term "Proved Ore Reserves" means Ore Reserves stated in terms of mineable tonnes/volumes and grades in which the identified in situ resource has been defined in three dimensions by excavation or drilling, and should include additional minor extensions beyond actual openings and drill holes, where the geological factors that limit the ore body are known

with sufficient confidence, that it is categorised as a "Measured Resource".

35. The choice of the appropriate category of Ore Reserve depends upon the quantity and quality of data available and the level of confidence that is attached to those data.
36. The appropriate Ore Reserve categories must be determined by a Competent Person.

### Ore Reserve Reports

37. Any public release concerning a company's Ore Reserves should state the nature of the data on which the Report is based and contain a qualification drawing attention to any assessment criteria from Table 1 for which inadequate data are available. Economic or political factors alone may be the basis for significant changes in Ore Reserves and should be reported accordingly.
38. Ore Reserve estimates are not precise calculations, being derived from the estimates of Resources and modified by economic, mining, metallurgical, marketing, environmental, social and governmental factors. Tonnage/volume and grade figures in reports should be expressed so as to convey the order of accuracy of the estimates by rounding off to appropriately significant figures.

## REPORTING OF COAL RESOURCES AND RESERVES

39. The Committee has not given detailed consideration to the question of coal reserve reporting and recommends that when public statements on coal resources and reserves are being made, the

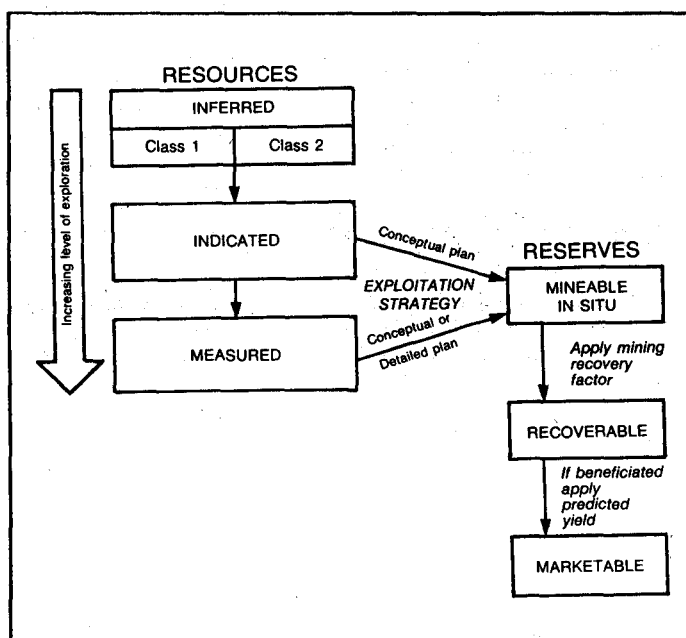
recommendations outlined in the "Australian Code for Reporting Identified Coal Resources and Reserves (February 1986)" published in Appendix I be adopted.

## APPENDIX 1

# AUSTRALIAN CODE FOR REPORTING IDENTIFIED COAL RESOURCES AND RESERVES (FEBRUARY 1986)

Following a request from the Australian Minerals and Energy Council (AMEC) for the development of a national approach to the reporting of coal resources and reserves, the Government Geologists' Conference in 1984 established a subcommittee to examine the issue and report back to the Conference on its findings. The subcommittee consisted of A.G. Galligan, Chief Coal Geologist, New South Wales Department of Mineral Resources, and D.C. Mengel, Director, Fossil Fuels, Geological Survey of Queensland.

The Subcommittee used the "Code for Calculating Coal Resources and Reserves" (Fifth Edition, June 1984) of the Standing Committee on Coalfield Geology of New South Wales as the base document, and modified this code to meet the requirements of both industry and government in other states, and the Bureau of Mineral Resources. The new code was ratified by the Government Geologists' Conference in April 1986 and has been adopted by the Standing Committee on coalfield Geology of New South Wales. The Code is published in full on the following pages.



## INTRODUCTION

This code outlines general concepts for reporting Identified Coal Resources and Reserves. It is broad in nature to accommodate the wide range of coal deposits, in terms of rank, quality, and geological environment, that are present in Australia.

In this Code, the term Resources is used to refer to all of the coal in situ which may have potential for use, and the various categories indicate the level of confidence of the

assessment. Reserves are those resources which are planned to be mined and for which such planning has been undertaken. The Code sets only minimum guidelines for evaluating Resources and Reserves and the estimator is required to state clearly the criteria used in any assessment.

Additional guidelines and parameters may be required for reporting coal Resources and Reserves from specific basins or regions

# DEFINITIONS

## Coal Resources

Coal Resources are all of the potentially usable coal in a defined area, and are based on points of observation and extrapolations from those points. Potentially usable coal is defined as coal which has, or could be beneficiated to give a quality acceptable for commercial usage in the foreseeable future and excludes minor coal occurrences. The estimator should state both the quality and thickness limits to define potentially usable coal in any resource evaluation.

## Coal Reserves

Coal Reserves are those parts of the Coal Resources for which sufficient information is available to enable detailed or conceptual mine planning and for which such planning has been undertaken.

## Points of Observation

A Point of Observation is an intersection, at a known location, of coal-bearing strata, which provides information about the strata by one or more of the following methods:

- Observation, measurement and testing of surface or underground exposures.
- Observation, measurement and testing of bore core.
- Observation and testing of cuttings, and use of down-hole geophysical logs of non-cored boreholes.

A point of observation for coal quantity may not be used necessarily for coal quality. The most reliable quality information is provided by testing of surface or underground exposures or by testing of bore core.

Geophysical techniques such as seismic surveys are not direct points of observation but may increase confidence in the continuity of seams between points of observation, especially in the broader Resource categories.

The distances between points of observation and extrapolations from points of observation quoted for each Resource category are normally the maximum under favourable geological conditions. More closely spaced points of observation will be required in areas where faulting, intrusion, seam splitting and other breaks in seam continuity are known to occur, or where the seam is subject to significant variation in thickness or quality.

# CATEGORIES OF RESOURCES

Measured Resources are those for which the density and quality of points of observation are sufficient to allow a reliable estimate of the coal thickness, quality, depth and in situ tonnage.

Points of observation should provide a level of confidence sufficient to allow detailed planning, costing of extraction and specification of a marketable product.

The points of observation generally should be not more than 1 km apart. Where geological conditions are favourable it may be possible to extrapolate known trends a maximum distance of 0.5 km from points of observation.

Indicated Resources are those for which the density and quality of points of observation are sufficient to allow a realistic estimate of the coal thickness, quality, depth and in situ tonnage and for which there is reasonable expectation that the estimate of resources will not vary significantly with more detailed exploration.

Points of observation should provide a level of confidence sufficient to enable conceptual planning of extraction and to determine the likely quality of the product coal.

Points of observation generally should be not more than 2 km apart. Where geological conditions are favourable, it may be possible to extrapolate known trends a maximum distance of 1 km from points of observation.

Inferred Resources are those for which the points of observation are widely spaced and as a result, assessment of this type of resource may be unreliable.

Points of observation should allow the presence of coal to be unambiguously determined..

Inferred Resources Class 1 are those resources for which the points of observation allow an estimate of the coal thickness and general coal quality to be made, and the geological conditions indicate continuity of seams between the points of observation.

Points of observation generally should not be more than 4 km apart. Extrapolations of trends should not extend more than 2 km from the points of observation.

Inferred Resources Class 2 are those for which there is limited information and as a result the assessment of this type of resource may be unreliable.

Provided the coal thickness can be determined, the order to magnitude of Inferred Resources Class 2 may be expressed within the following ranges:

1-10	million tonnes
10-100	million tonnes
100-500	million tonnes
500-1000	million tonnes
> 1000	million tonnes

If a more specific quantitative estimate is made to determine exploration priorities etc., it should not be quoted in public reports or in any prospectus.

# TYPE OF RESERVES

Mineable In situ Reserves are the tonnages of in situ coal contained in seams or sections of seams for which sufficient information is available to enable detailed or conceptual mine planning and for which such planning has been undertaken.

Mineable In situ Reserves may be calculated only from Measured and Indicated Resources. Measured Resources are required for detailed mine planning, and are the preferred basis for Mineable In situ Reserves. Indicated

Resources may be used for conceptual mine planning. In general, further exploration will be required prior to commencement of mining operations.

Mineable In situ Reserves should be quoted separately for surface and underground mines and an outline of the proposed mining method(s) should be provided.

Recoverable Reserves are the tonnages of Mineable In situ Reserves that are expected to be recovered, i.e. that proportion of the seam(s) which will be extracted. If dilution

is added to the Recoverable Reserves tonnage, the total equates to the "run-of-mine" tonnage. If allowance is made for dilution it should be stated.

In calculating Recoverable Reserves a Mining Recovery Factor must be applied to the Mineable In situ Reserves. This factor will depend on the mining method to be used. Unless a specific factor has been determined for conceptual studies, the historically proven Mining Recovery Factor should be used. If such information is not available, a Mining Recovery Factor of 50% for underground reserves

and 90% for surface reserves may be applied. An outline of the proposed mining method should accompany any statement of Recoverable Reserves.

**Marketable Reserves** are the tonnages of coal that will be available for sale.

If the coal is to be marketed raw, the Marketable Reserves will be the same as the Recoverable Reserves plus dilution, i.e. the "run-of-mine" tonnage. If the coal is to be beneficiated, Marketable Reserves are calculated by applying the predicted yield to the Recoverable Reserves. The basis of the predicted yield should be stated, e.g. 200 mm cores, slim cores, pretreated cores.

## REPORTING OF RESOURCES AND RESERVES

All factors used to limit Resources and Reserves and necessary to verify the calculations (including the types of observations, e.g. cored hole, outcrop) must be stated explicitly. The relative density value adopted in calculating the coal tonnage should be noted, together with the evidence on which it is based. Tonnage estimates always should be rounded, commensurate with the accuracy of estimation.

Resources and Reserves should be stated

- for each seam
- on a depth basis, in regular depth increments if sufficient information is available
- on a seam thickness basis, the minimum thickness used should be stated and separate tonnages should be quoted for seams less than 1.5 m thick and seams equal to or greater than 1.5 m (this limit may be greater for brown coal e.g. 3 m). The maximum thickness of any included non-coal bands should be stated. Normally where a seam contains a non-coal bands thicker than 0.3 m the two coal splits should be considered as separate seams and tonnages should be reported for each (the limit for non-coal bands may be greater for brown coal sequences, e.g. 1 m).
- on a quality basis, maximum raw coal ash should be stated and only that coal which can be used or beneficiated at an acceptable yield (to be stated) should be included in the estimate. Other raw coal

quality parameters, particularly those which affect utilization behaviour, should be stated and further subdivision of the resources made if significant variations occur, e.g. heat affected coal, oxidized coal.

In addition, for reporting of Reserves the following information is required, as a minimum

- an outline of the proposed mining method
- physical criteria limiting mining such as maximum and minimum working section, thickness, minimum separation of seams, maximum dip, geological structure, areas of prohibition
- quality criteria limiting mining such as ash content, volatile matter, yield, etc.
- for Recoverable Reserves, the Mining Recovery Factor used
- for Marketable Reserves, the predicted yield if the coal is to be beneficiated and the quality specification of the product coal
- the overburden ratio expressed as bank cubic metres of overburden to tonnes of coal in situ for reserves amenable to surface mining
- the depth of planned mining
- the percentage of the Resources which are the Mineable In situ Reserves within the area(s) proposed to be mined

## MAPS

Any report of Resources and/or Reserves must be substantiated, to the relevant Government authority, by maps at scales appropriate to the accuracy claimed for the Resources and/or Reserves, showing all relevant data

including the areas considered for each category of Resources and/or Reserves, the limits imposed (e.g. cover lines, seam isopachs, isoashes), the areas of prohibition, and seam thickness at points of observation.

## A PUBLIC STATEMENT

A Public Statement of Resources and/or Reserves claiming the authority of this Code should be in the format described

in the section "Reporting of Resources and Reserves". The qualifications of the person(s) responsible for this "Reporting" should be stated.

## REFERENCE

For guidance in determining coal quality from bore cores, reference should be made to Australian Standard

2519-1982: Guide to the evaluation of hard coal deposits using borehole techniques.