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South African guide to the systematic evaluation of coal resources and coal reserves

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Table of changes

Change No.	Date	Scope

Abstract

Provides a detailed framework for reporting on coal resources and coal reserves for the purposes of the Securities Exchange and the National Coal Inventory.

Keywords

coal, coal inventory, coal mining, coal products, coal reserves, coal resources, documentation, mineral resources, minerals, reports, specifications.

Acknowledgement

Standards South Africa wishes to acknowledge the permission granted by the Department of Minerals and Energy to reproduce the National Coal Inventory data capture forms given in annex A.

Foreword

This South African standard was approved by National Committee StanSA SC 5140.20C, *South African committee for solid mineral fuels – Coal classification*, in accordance with procedures of Standards South Africa, in compliance with annex 3 of the WTO/TBT agreement.

A reference is made in 3.1 to “national regulations and statutory requirements” on reporting of coal resources and reserves. In South Africa this means the listings requirements of the Johannesburg Securities Exchange of South Africa and the following Acts (as amended from time to time):

a) the Atmospheric Pollution Prevention Act, 1965 (Act No. 45 of 1965);

b) the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983);

c) the Environmental Conservation Act, 1989 (Act No. 73 of 1989);

d) the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002); and

e) the National Water Act, 1998 (Act No. 36 of 1998).

This standard should be read in conjunction with the *SAMREC Code*.

Annex A forms an integral part of this standard. Annexes B, C, D, E, F, G and H are for information only.

Introduction

General concepts for reporting coal resources and coal reserves were established with the publication of the South African Code for Reporting of Mineral Resources and Mineral Reserves (The *SAMREC Code*), prepared by the South African Mineral Resource Committee under the auspices of the South African Institute of Mining and Metallurgy. The *SAMREC Code* provides the framework and standards for public reporting for the Johannesburg Securities Exchange and contains a clause “commodity specific reporting for coal”. The *SAMREC Code* has been adopted by the South African Institute of Mining and Metallurgy (SAIMM) and SAMREC member organizations and is incorporated in the Johannesburg Securities Exchange listing requirements and continuing reporting obligations.

It was, however, apparent that additional guidelines and parameters were necessary to standardize the reporting of coal resources and coal reserves for both Securities Exchange requirements and for the South African National Coal Resource and Coal Reserve Inventory (also called the “National Coal Inventory”).

The standard was prepared in conjunction with the *SAMREC Code* by the SAMREC Coal Commodity Specific Subcommittee. This standard is the coal commodity’s specific equivalent to the check list in appendix 1 of the *SAMREC Code,* the “Check list of assessment and reporting criteria”.

Contents

Page

Abstract

Keywords

Acknowledgement

Foreword

Introduction 1

1 Scope 7

2 Normative references 7

3 Definitions 8

4 Reporting for Securities Exchange purposes (The public report) 31

4.1 Introduction 31
4.2 Scope of the *SAMREC Code* 31
4.3 Competence and responsibility 31
4.4 Reporting on coal resources and coal reserves 32
4.4.1 Introduction 32
4.4.2 General requirements 33
4.4.3 Reporting of coal resources 34
4.4.4 Reporting of coal reserves 35
4.5 Reporting of exploration results 35
4.6 Reporting of coal in remnants, coal in pillars, discards and reject coal in stockpiles, dumps and tailings ponds 36

5 Reporting for the South African National Coal Inventory 36

5.1 Introduction 36
5.2 Data capture forms 36
5.3 Classification of coal resources and coal reserves 37
5.4 Schematic decision tree 38
5.4.1 General 38
5.4.2 The geological study 38
5.4.3 The economic study 38
5.5 Coal resouce and reserve blocks 40
5.6 Coal reserve exploitation and reconciliation 40
5.7 Seam characteristics 40
5.8 In situ coal resource raw coal quality 41
5.9 Run of mine coal reserve coal quality 41
5.10 Saleable coal reserve coal quality 41
5.11 Coal discards 41
5.12 Obligations by information provider 42

6 Coal resource and coal reserve calculation and reporting 42

6.1 Introduction 42
6.2 Coal resource estimation confidence 42

Contents *(continued)*

Page

6.3 Coal resource reporting categories 43
6.3.1 Introduction to reporting categories 43
6.3.2 Coal occurrence 43
6.3.3 Reconnaissance coal resource 43
6.3.4 Inferred coal resource 45
6.3.5 Indicated coal resource 45
6.3.6 Measured coal resource 45
6.3.7 Pre-feasibility coal resource 46
6.3.8 Feasibility coal resource 46

6.4 Coal reserve reporting categories 46
6.4.1 Introduction 46
6.4.2 Probable coal reserve 47
6.4.3 Proven coal reserve 47

6.5 Calculation of coal resources and coal reserves 47
6.5.1 General 47
6.5.2 Calculation of coal resources 49
6.5.3 In situ coal resources 60
6.5.4 Mineable in situ coal resources 61
6.5.5 Calculation of coal reserves 62
6.5.6 ROM coal reserves 68
6.5.7 Saleable coal reserves 75

7 Evaluation methods and procedures 78

7.1 Introduction 78

7.2 Preliminary surveys 79
7.2.1 Collation of available information 79
7.2.2 Remote sensing surveys 79
7.2.3 Regional mapping 79
7.2.4 Land survey 80

7.3 Geological drilling 80
7.3.1 Small diameter borehole core drilling 80
7.3.2 Open hole drilling 80
7.3.3 Borehole down-hole geophysics 80
7.3.4 Large diameter borehole core drilling 81
7.3.5 Directional and angled borehole drilling 81

7.4 Coal sampling 81
7.4.1 Small diameter borehole core samples 81
7.4.2 Sample preparation, storage and analysis 82
7.4.3 Coal quality 82
7.4.4 Density 84

7.5 Computer processing and coal deposit modelling 84
7.6 Coal processing 85
7.7 Geotechnical aspects 85
7.8 Geohydrology 85

Contents *(continued)*

Page

7.9 Environmental aspects 86
7.10 Legislation 86

8 Economic assessment 86

8.1 General 86
8.2 Phase L1 Geological study 87
8.2.1 Phase L1A: Target generation study (G0) 87
8.2.2 Phase L1B: Detailed geological study (G1) 87

8.3 Phase L2: Conceptual economic study 91

8.4 Phase L3: Pre-feasibility study 91
8.4.1 Economic evaluation 91
8.4.2 Pre-feasibility geological study (G2) 91

8.5 Phase L4: Feasibility study 92
8.5.1 Economic evaluation 92
8.5.2 Feasibility geological study (G3) 93

8.6 Phase L5: Operational phase 93
8.6.1 Mining or operational report 93
8.6.2 Pre-production geological investigation (G4) 93
8.6.3 Production or operational geological investigation (G5) 93

Annex A (normative) National Coal Inventory data capture forms 95

Form 1 – Resource and reserve table 95
Form 2 – Block locality 96
Form 3 – Physical characteristics 97
Form 4 – Coal resource quality table 98
Form 5 – Coal reserve quality table 100
Form 6 – Coal classification 102

Annex B (informative) Alphabetical list of definitions 103

Annex C (informative) Rank determination 106

C.1 Background 106

C.2 Rank parameters 106

C.3 Procedure to establish the rank of coal 108

C.4 Formulae to calculate inferred rank 108

Contents *(continued)*

Page

Annex D (informative) Moisture and moisture reporting bases 110

D.1 Definitions and standard moisture terminology for coal, according to various national and international standards 110
D.2 Definition of standard moisture conversion factors 111

Annex E (informative) Typical format of a coal resource and coal reserve report 112

Annex F (informative) Summary of variables used in coal resource and coal reserve calculations 114

Annex G (informative) Coal quality tests and standards 119

G.1 Some recommended tests and analyses for establishing coal rank and quality 119

G.2 Some recommended tests and analyses for establishing coal quality of product for specific fields of utilization 120

G.3 National and international standardized test methods 121

Annex H (informative) Reporting summary – Coal resource and coal reserve categories, terminology and reporting guidelines 123

Bibliography 129

National and international standards 129
Other publications 139

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South African guide to the systematic evaluation of coal resources and coal reserves

1 Scope

1.1 The standard provides a detailed framework for reporting on coal resources and coal reserves for the purposes of the Securities Exchange and the National Coal Inventory.

1.2 The standard defines common terminology to be used for public reporting in accordance with the *SAMREC Code*.

1.3 The standard details the assessment of coal resources and coal reserves with regard to levels of reliability and confidence and specifically relates to

a) the coal deposit type,

b) evaluation methods and procedures,

c) economic assessment,

d) exploration strategy from the target generation phase to the operational phase,

e) the definitions of coal resources and coal reserves,

f) public reporting for Securities Exchange purposes, and

g) reporting for the National Coal Inventory.

NOTE The standard should be read in conjunction with the *SAMREC Code*. For ease of reference, the more relevant extracts of the *SAMREC Code*, as they apply to the reporting of coal resources and coal reserves, are reproduced in clause 4 of this standard.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this standard. Normative documents are subject to revision and, since any reference to a normative document is deemed to be a reference to the latest edition of that document, parties to agreements based on this standard are encouraged to take steps to ensure the use of the most recent editions of the normative documents indicated below. Information on currently valid national and international standards can be obtained from Standards South Africa.

The South African Institue of Mining and Metallurgy. *South African code for reporting of mineral resources and mineral reserves* (the *SAMREC CODE*). Prepared by the South African Mineral Resource Committee (SAMREC) under the auspices of The South African Institute of Mining and Metallurgy, March 2000.

Intergovernmental Ad Hoc Group of Experts on The Harmonization of Energy reserves/resources Terminology, *United Nations framework classification (UNFC) for energy and mineral resources*, UNECE Energy Committee on Sustainable Energy, 2003.

NOTE This document is available on www.unece.org.ie/se/reserves.html

3 Definitions

For the purposes of this standard, the following definitions apply.

NOTE The definitions are given in a logical order. For an alphabetical list of definitions, see annex B.

3.1
public report
public reporting
report on coal resources or coal reserves, prepared for the purpose of informing investors or potential investors and their advisers, or satisfying national regulations and statutory requirements (see foreword)

3.2
National Coal Inventory
national coal resource and coal reserve inventory
specific report for the evaluation of national coal resources and reserves by the National Department of Minerals and Energy for the purpose of the long-term planning of coal exploitation for national requirements

3.3
competent person
<coal resources and coal reserves>
person who has a minimum of five years' experience in the style of mineralization and type of deposit and is registered with one or more of the following organizations:

a) South African Council for Natural Scientific Professions (SACNASP);

b) Engineering Council of South Africa (ECSA);

c) South African Council for Professional Land Surveyors and Technical Surveyors (PLATO); or

d) any other statutory South African or international body that is recognized by the South African Mineral Resource Committee (SAMREC)(see 4.3 in the *SAMREC Code*)

3.4
economic study

3.4.1
geological study
study to identify a coal deposit, establish physical continuity and coal quality continuity and identify an investment opportunity

NOTE A geological study can be subdivided into two broad categories, i.e. a geological target generation study and a detailed geological study.

3.4.1.1
geological target generation study
initial geological evaluation typically composed of a desktop study, and including a literature review of all available data, with limited fieldwork
cf. detailed geological study (3.4.1.2)

NOTE This study is required for the evaluation of a coal occurrence in order to assess its potential as a coal resource.

3.4.1.2
detailed geological study
study representing the detailed technical work undertaken to produce a physical and a coal quality computer model and associated detailed assessment of a coal resource in order to assess its economic potential
cf. geological target generation study (3.4.1.1)

3.4.2
conceptual economic study
preliminary economic assessment of a coal deposit

NOTE 1 The results of the conceptual economic study indicate whether there is a case for further investigation, such as further geological exploration, laboratory test work, market research or a more detailed engineering study. The conceptual economic study gives a preliminary indication of the order of magnitude of the capital costs, operating costs and revenue and also allows preliminary comparison of alternatives, and a recommendation for further work, shelving or rejection of a project.

NOTE 2 The net confidence of estimations within the conceptual economic study is usually within plus or minus 30 %, and needs to be stated or qualified.

3.4.3
pre-feasibility study
preliminary assessment of the economic viability of a deposit and forms the basis for justifying further investigations

NOTE 1 A pre-feasability study usually follows a geological exploration campaign and summarises all geological, geotechnical, mining, coal processing, engineering, environmental, marketing, legal and economic information accumulated on the project. A pre-feasibility study is normally carried out before a feasibility study (see 3.4.4.) to be able to evaluate alternatives, determine the preliminary economic feasibility of the project and assist in defining the scope of the feasibility study, or is used as motivation for the shelving or rejection of a project.

A pre-feasibility study is suitable for a detailed comparison of alternatives, meaningful economic evaluations, indication of areas in need of further detailed technical investigation, and decision to go ahead with detailed environmental studies. The outcome of a pre-feasibility study determines whether the coal resource may be reclassified as a probable coal reserve and is used for ranking the coal resource in the market place. If the project is marginal for any reason, further assessment may be postponed or the project could be rejected.

NOTE 2 The net confidence of estimations within the pre-feasibility study is usually within plus or minus 15 % to 25 %, and needs to be stated or qualified. Certain key components of the estimate, such as exchange rate variability and inflation rate, may be no different to that of a conceptual study.

3.4.4
feasibility study
detailed assessment of the technical soundness and economic viability of a mining project

NOTE 1 A feasibility study represents a detailed economic evaluation that serves as a basis for the investment decision and allows for the preparation of a bankable document for project financing. The study constitutes an audit of all geological, geotechnical, mining, coal processing, engineering, environmental, marketing, legal and economic information accumulated on the project. The feasibility study provides a basis for evaluating the potential viability of the project and serves as a reference for board approval for a project to proceed. The outcome of a feasibility study determines whether the coal resource may be reclassified as a proven or probable coal reserve.

A feasibility study is seldom undertaken unless there is a reasonable assurance that the proposal is feasible and is usually preceded by a pre-feasibility study (3.4.3).

NOTE 2 The net confidence of estimations within the feasibility study is usually within plus or minus 10 % to 15 %, and needs to be stated or qualified. Certain key components of the estimate, such as exchange rate variability and inflation rate will not be different from that of a conceptual study or a pre-feasability study.

3.4.5
mining report
operational report
report that reflects the state of development and exploitation of a deposit during its economic life, including current mining plans

NOTE The mining report presents the status of the deposit, providing accurate detailed up-to-date statements on the remaining coal reserves and coal resources. The mining report takes into account any reconciliation exercises that have been undertaken and compares what has been mined with the original coal reserve estimates. The remaining coal reserves and coal resources are based on the updated reserve discount factors or modifying factors, or both.

3.5
coal
carbonaceous sedimentary rock with an ash content of less than 50 % (by mass fraction on a dry basis)

NOTE Coal includes both humic and sapropelic coals.

3.6
coal seam
laterally continuous layer of coal (3.5), with or without included non-coal bands, which form a coherent and distinct geological stratigraphic unit
cf. composite coal seam (3.7)

3.6.1
full coal seam
laterally continuous layer of coal from the roof of the coal seam to the floor of the coal seam that forms a coherent and distinct geological stratigraphic unit

3.6.2
roof of the coal seam
upper contact of the coal seam with the adjacent rock

3.6.3
floor of the coal seam
lower contact of the coal seam with the adjacent rock

3.7
composite coal seam
coal seam (3.6) that consists of alternating coal and rock bands with an average ash content of less than 65 % (by mass fraction on a dry basis)

NOTE For reporting purposes, composite coal seams are equivalent to coal seams (see 3.6).

3.8
burnt coal
coal that is in contact or in close proximity with igneous intrusions, and which undergoes chemical change, particularly the loss of volatiles, due to heating

NOTE Anthracite and lean coal could have formed as a result of the coal seams being in close proximity to the igneous intrusions, but are not to be classified as burnt coal or devolatilized coal (see 3.9). The competent person needs to make the appropriate judgement (see the note to 3.9).

3.9
devolatilized coal
bituminous coal that has a dry ash-free (3.16.15) volatile content of less than 24 % (by mass fraction on a dry ash-free basis) but more than 16,5 % (by mass fraction on a dry ash-free basis) due to the thermal effect of igneous intrusions

NOTE Anthracite and lean coal could have formed as a result of the thermal effect of igneous intrusions on the coal seams, but are not to be classified as burnt coal (3.8) or devolatilized coal. The competent person needs to make the appropriate judgement.

3.10
coal occurrence
coal that can not be defined as a coal resource (3.25) owing to insufficient geological information available to define the aerial extent of the coal seam or because the available geological data indicates that the coal seam does not have reasonable and realistic prospects for economic extraction (3.22)

3.11
coal deposit
occurrence of coal of economic interest which forms the physical envelope that encompasses a coal resource or coal reserve, or both, and includes reconnaissance, inferred, indicated and measured coal resources, together with any associated probable coal reserves and proven coal reserves

NOTE A coal deposit might, in addition, include adjacent coal occurrences (see 3.10).

3.12
coal deposit type
generic classification of a coal deposit (3.11)

NOTE There are two basic coal deposit types, which are representative of South African coal deposits, i.e. multiple seam and thick interbedded seam deposit types, as defined in 3.12.1 and 3.12.2.

3.12.1
multiple seam deposit type
coal deposit type, characterized by a discrete number of coal seams (3.6), typically between 0,5 m and 7,0 m in thickness, separated by inter-burden units of thickness generally significantly exceeding the thickness of the individual coal seams
cf. thick interbedded seam deposit type (3.12.2)

NOTE The coal seams in the Witbank coalfield and Highveld coalfield in South Africa are characteristic of this coal deposit type (see figure 1).

3.12.2
thick interbedded seam deposit type
thick coal deposit type, characterized by a succession of multiple, thinly interbedded coal and non-coal layers with a total thickness of typically between 40 m and 70 m
cf. multiple seam deposit type (3.12.1)

NOTE The coal deposits of the Grootgeluk formation in the Waterberg coalfield in South Africa are typical of this type (see figure 2).

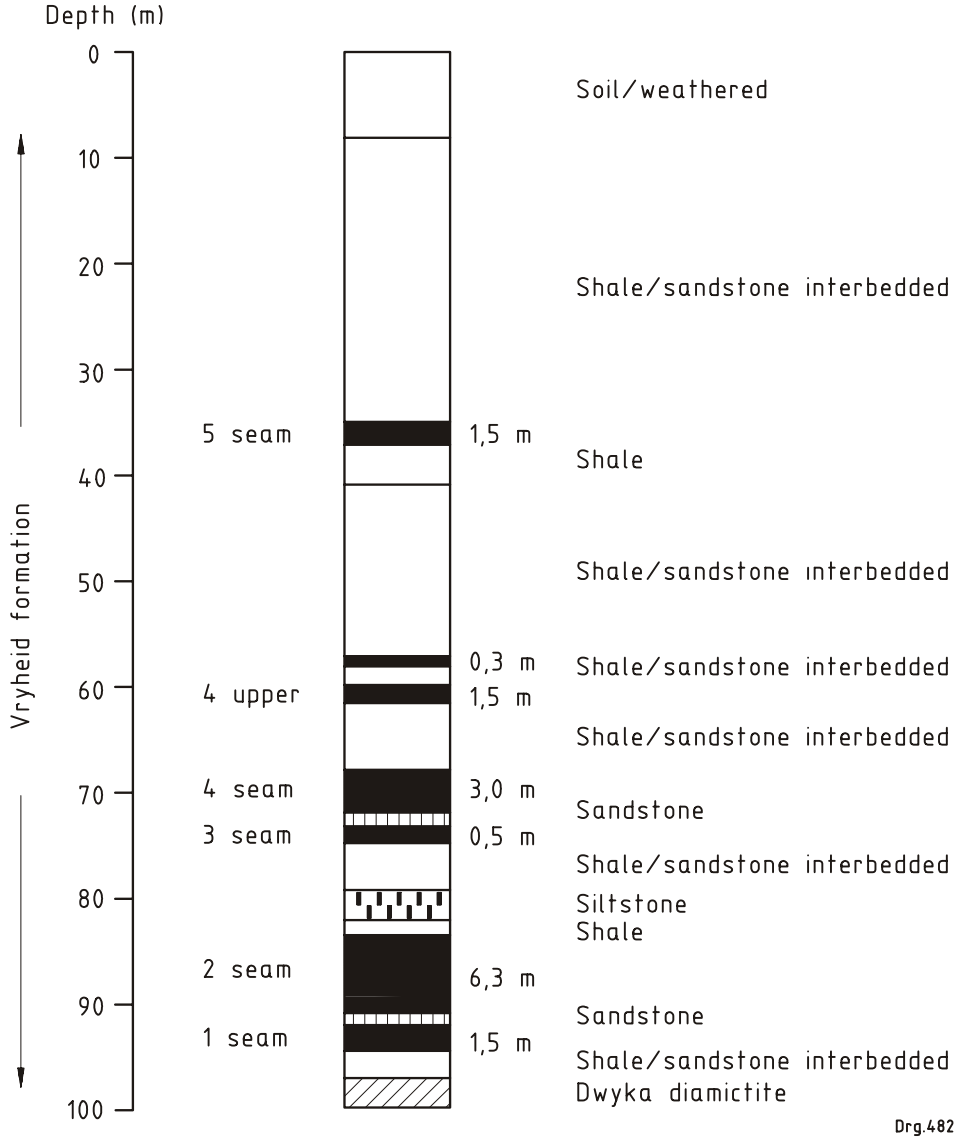


Figure 1 — Multiple seam deposit type: generalized stratigraphic column

3.13
coal quality
the presence of a suite of physical and chemical characteristics of a coal seam, which might indicate the potential utilization of the coal, whether as a raw coal product, a sized coal product, a washed coal product, or a combination of the above
cf. coal quality point of observation (3.17.2)

NOTE 1 Coal quality characterization is based on a single or on multiple quality constituents that depend(s) on the particular product type (such as raw coal, sized coal or washed coal or a combination of all three) and on the potential utilization in industrial applications (such as power stations, gasifiers, smelting reduction works, etc.). In the simplest terms, most coal types can be characterized by the ash content (grade) or the heat (energy) content.

NOTE 2 A list of standard coal quality constituents is presented in table G.1 and a list of the more specialized coal quality constituents with respect to various industrial utilization applications is presented in table G.2.

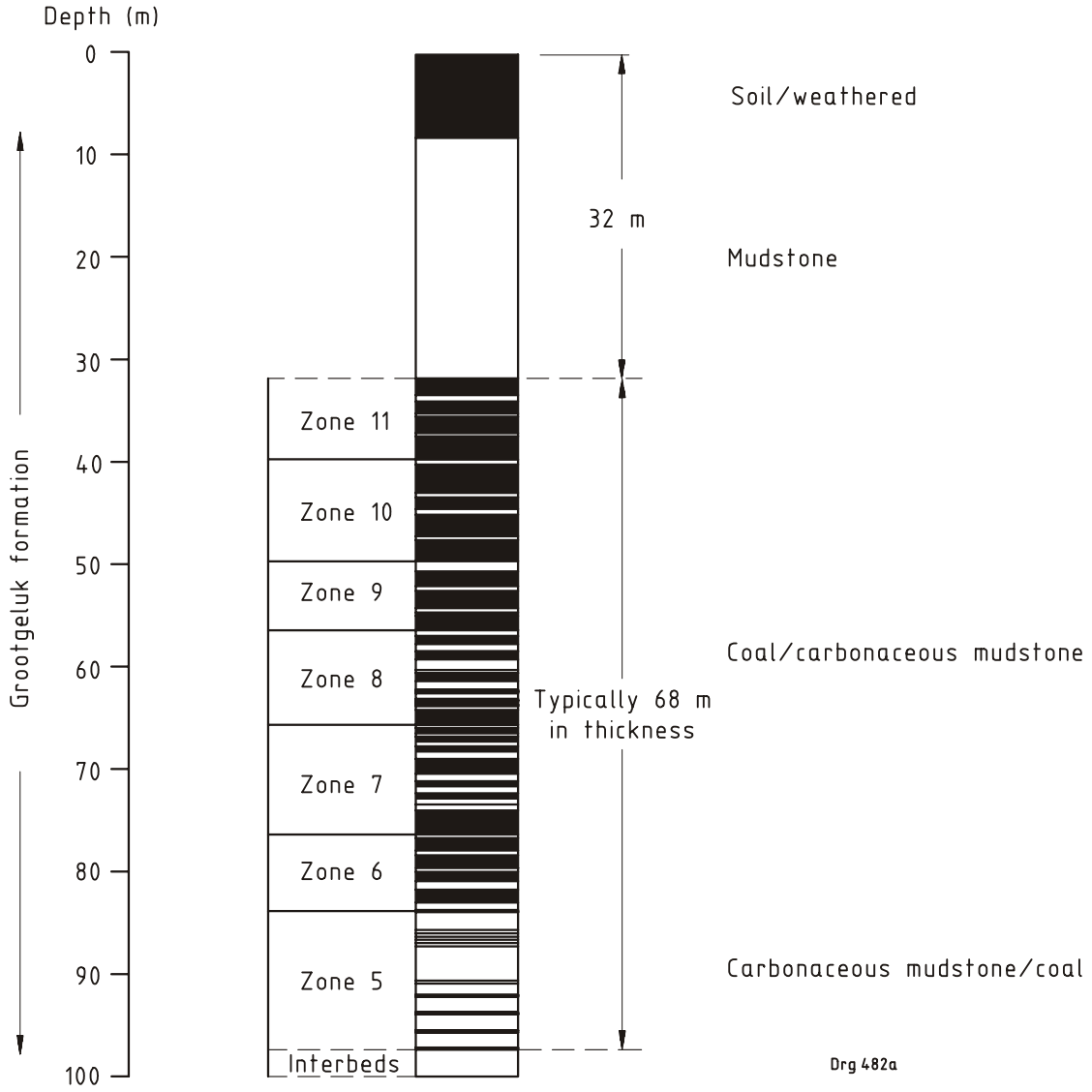


Figure 2 — Thick interbedded seam deposit type: generalized stratigraphic column

3.14
rank
classification of coal that indicates the degree of metamorphosis, or progressive alteration from lignite to anthracite
cf. apparent rank (3.14.1) and inferred rank (3.14.2)

The four main rank categories, low-rank (lignite), low-rank (sub-bituminous), medium-rank (bituminous) and high-rank (anthracitic), are defined in table 1.

Table 1 — Definition of main rank categories

1	2
Low-rank B and C – Lignite/brown coals	Bed moisture $\leq$ 75 % and $\overline{R}_r$ [a] < 0,4 %
Low-rank A – Sub-bituminous coals	0,4 % $\leq \overline{R}_r$ < 0,5 %
Medium-rank – Bituminous coals	0,5 % $\leq \overline{R}_r$ < 2,0 %
High-rank – Anthracites	2,0 % $\leq \overline{R}_r$ < 6,0 % $\overline{R}_{v\ max}$ < 8,0 %
[a] $\overline{R}_r$ is the mean vitrinite random reflectance (see 3.57.3) determined in accordance with AS 2434.1 and $\overline{R}_{v\ max}$ is the mean vitrinite maximum reflectance (see 3.57.1).	

NOTE 1 The most modern classification systems use “mean vitrinite random reflectance” as the prime indicator of rank to classify lignites, sub-bituminous coals, bituminous coals and anthracites (low-rank, medium-rank and high-rank coals, respectively). In the ISO draft standard for classification of coals, “mean random vitrinite reflectance” is used to delineate the medium and high-rank boundaries and the higher category of coal. Bed moisture (ash-free basis) is the prime rank parameter for the two lowermost rank subdivisions of coal. In order to classify further within the rank divisions stated, it is recommended the guidelines of the ISO draft for classification of coal (ISO/DIS 11760) be followed.

NOTE 2 Information to date indicates that South African coal resources are predominantly bituminous in rank, followed by some anthracitic coals and negligible lignites.

NOTE 3 For more information on rank, see annex C.

3.14.1
apparent rank
classification of coal based only on the volatile matter content (by mass fraction on a dry ash-free basis) and defined as either medium-rank or high-rank coals

NOTE 1 Volatile content is not used to establish the apparent rank of low-rank coals.

NOTE 2 Classification systems that opted for parameters such as the volatile matter content and the fixed carbon content are only reliable for vitrinite-rich coals. Further, the precision of classifying coals rich in minerals may be impaired by the effect the minerals have on the determination of volatile matter, calorific value, fixed carbon and on the calculation to a mineral-free or ash-free basis.

3.14.2
inferred rank
classification of coal based only on calculated or estimated data where the direct measurement of the vitrinite mean random reflectance has not been undertaken for the purpose of classifying coal resources

NOTE Inferred rank may be estimated using the formulae presented in C.2.

3.15
cut-off value
minimum or maximum value for a range of parameters that may be used for the physical and chemical characterization of the coal seam

NOTE The parameters include coal seam thickness and coal quality.

3.15.1
coal seam thickness cut-off value
minimum value for (true or apparent) coal seam thickness

NOTE 1 This value may be used for the physical characterization of the full coal seam.

NOTE 2 This value is required for the definition of a coal deposit.

3.15.2
coal quality cut-off value
minimum or maximum value of the relevant coal quality parameter(s) where the value differs from the value in the definition of coal (3.5)(i.e. an ash content less than 50 % on dry basis) or the standard definition of a composite coal seam (3.7) (i.e. an ash content less than 65 % on a dry basis)

NOTE 1 The reporting basis for coal quality cut-off values is stated.

NOTE 2 This value is required for the definition of a coal deposit only if it is different from the standard definitions.

3.15.3
incremental strip ratio cut-off value
maximum value of the ratio of the incremental overburden volume to incremental coal tonnes (in situ, run of mine or sales) in the mineable coal seam (on an in situ, run of mine or sales tonnage basis)

NOTE 1 The value is measured in bank cubic metres/tonne (bcm/tonne).

NOTE 2 The value is required for the definition of a coal resource (see 3.25) block or coal reserve (see 3.31) block, typically for areas with opencast potential.

3.16
moisture

NOTE More information on moisture and moisture reporting is given in annex D.

3.16.1
air-dried moisture
Madb
moisture in the analysis sample (as determined) (MASadet) or the residual moisture (Mrm) in equilibrium with the prevailing laboratory conditions

NOTE 1 The air-dried moisture value is primarily required for the calculation of other analyses on a dry basis.

NOTE 2 Although most coal qualities analysed in South Africa are done on air-dried bases, they are not necessarily reported on a consistent moisture basis. Although this methodology is not internationally recommended, it is acceptable for the reporting of most coal qualities in South Africa, provided that the in situ bed moisture is proven to be close to the air-dried moisture.

3.16.2
bed moisture
in situ moisture
Mbm
natural moisture content of the coal in situ in the seam, that exists as an integral part of the coal seam in its natural state

NOTE In the case of most South African coals it can be erroneously assumed that the air-dried moisture of the coal approximates the in situ moisture content or bed moisture content of the coal seam. The relationship between air-dried moisture and bed moisture should be established for the area being investigated before this assumption is made.

3.16.3
equilibrium moisture
moisture-holding capacity
Meqm
moisture in a coal sample after attaining equilibrium at a temperature of 30 °C and a humidity of 97 % (by mass fraction)

NOTE When determined on samples obtained by sampling as indicated in ASTM D1412, at the coal face and free of visible moisture, the moisture is equivalent to the bed moisture (3.16.2) or the inherent moisture (3.16.5) of the coal.

3.16.4
free moisture
Mfm
moisture that is lost by the coal in the course of attaining approximate equilibrium with the atmosphere to which it is exposed

NOTE 1 Free moisture is referred to as surface moisture (3.16.11) by ASTM, and it corresponds to the portion of total moisture that is in excess of the inherent moisture (3.16.5) or equilibrium moisture (Meqm) (3.16.3).

NOTE 2 The following equations can be used to calculate free moisture:

a) in the case of AS, BS, ISO and SANS standards,

$Mfm = Mas - Mrm$

or

b) in the case of ASTM standards,

$Mfm = Mas - Meqm$

where

Mfm is the free moisture content;

Mas is the total moisture as sampled (3.16.12.1);

Mrm is the residual moisture content (3.16.10);

Meqm is the equilibrium moisture content (3.16.3).

The two equations ((a) and b)) are not equivalent and this can lead to significant confusion.

3.16.5
inherent moisture
Mim
moisture that exists as part of the coal seam in its natural state

NOTE 1 In the case of most coals, the inherent moisture, if sampled at the coalface and subjected to conditions stated in ASTM D1412 may be equated to the bed moisture (Mbm) (3.16.2) and to the total moisture (Mas) (3.16.12). In the ASTM system it is considered equivalent to bed moisture (Mbm) (3.16.2)

NOTE 2 In South Africa however, the term "inherent moisture" generally refers to the moisture in the analysis sample (MASadet) (3.16.7) or the residual moisture (Mrm) (3.16.10), in equilibrium with the prevailing laboratory conditions (air-dried moisture (Madb) (3.16.1)).

3.16.6
moisture-holding capacity
equilibrium moisture
Meqm
MHC
moisture in a coal sample after attaining equilibrium at a temperature of 30 °C and a humidity of 97 %
cf. equilibrium moisture (3.16.3.)

3.16.7
moisture in analysis sample
MASadet
moisture content in equilibrium (as-determined basis) with the prevailing laboratory conditions of temperature and humidity, when the analysed sample has been ground to pass through a test sieve of 250 µm (ASTM) or 200 µm to 212 µm (AS, BS, ISO, SANS)

3.16.8
moisture as received
Mar
moisture determined on the as-received coal

NOTE If the sample has been maintained in a sealed state so that there has been no gain or loss, the as-received moisture (Mar) is equivalent to the as-sampled moisture (Mas) (3.16.12.2).

3.16.9
moisture as determined
Madet
moisture content as determined in equilibrium with prevailing laboratory conditions of temperature and humidity

3.16.10
residual moisture
Mrm
moisture content that remains in the coal after it has been air-dried at room temperature and that can be removed by heating at 105 °C

3.16.11
surface moisture
Msm
the difference between total moisture and residual moisture, defined

1) in the case of ISO and Australian standards, as

$$Msm = Mas - Mrm$$

or

2) in the case of ASTM and British standards, as

$$Msm = Mas - Mim$$

where

Msm is the surface moisture content;

Mas is the total moisture as sampled (3.16.12.1);

Mrm is the residual moisture content (3.16.10);

Mim is the inherent moisture content (3.16.5).

3.16.12
total moisture
< sampling methodology>

3.16.12.1
Mas
total moisture content of the coal as sampled

3.16.12.2
(Mar(as))
total moisture content of the coal as received

3.16.12.3
Mt
bed moisture
inherent moisture
total moisture determined on coal sampled at the coalface and free of visible moisture (as defined in ASTM D 1412)
cf. bed moisture (3.16.2), inherent moisture (3.16.5)

3.16.13
water of constitution
Woc
water chemically bound to the mineral matter that remains after the determination of the total moisture

3.16.14
dry basis
moisture-free basis
db
condition of the coal analysis sample when all the moisture has been driven from the sample by heating the analysis sample, or by calculation

NOTE For definitions and moisture reporting bases, see annex D.

3.16.15
moisture reporting basis for tonnage, density and coal quality
mass basis on which the moisture content for tonnage, density and coal quality is quoted, is typically one of the following:

a) **total moisture basis** (as): moisture content equivalent to the total moisture basis or to the bed moisture basis, as sampled;

b) **in situ (bed) moisture basis** (bm): moisture content equivalent to the bed moisture basis, as sampled;

c) **as received moisture basis** (ar): moisture content equivalent to the as-received moisture content;

d) **equilibrium moisture basis** (eqm): moisture content in equilibrium with defined constant humidity and temperature conditions, as defined by the equilibrium moisture determination (3.16.3);

e) **air-dried moisture basis** (adb): moisture equivalent to the moisture in the analysis sample (as determined) (MASadet) (3.16.7) or the residual moisture (Mrm) (3.16.10) in equilibrium with the prevailing laboratory conditions;

f) **dry basis** (db): reporting basis equivalent to the analytical data calculated to zero moisture, or moisture-free basis (3.16.14);

g) **dry ash-free basis** (daf): calculated reporting basis equivalent to the analytical data excluding the moisture content and the ash content by calculation;

h) **moisture, ash-free basis** (m, af): calculated moisture reporting basis equivalent to the bed moisture (determined as moisture-holding capacity (3.16.6) or equilibrium moisture (3.16.3)) but excluding the ash content by calculation.

NOTE For definitions and moisture reporting bases, see annex D.

3.17
point of observation
coordinated position that can be used for the physical characterization of the full coal seam, with or without considering the coal quality

3.17.1
physical point of observation
coordinated position from which an accurate measurement of the roof and floor of the full coal seam can be made

NOTE 1 A physical point of observation can be an intersection of the full coal seam defined by borehole core drilling, an intersection of the full coal seam in a trench or in mine workings, or an intersection of the full coal seam in an open hole that has been geophysically logged (with at least density and calliper geophysical electric logs).

NOTE 2 Airborne or surface geophysical techniques, such as magnetic, electromagnetic or seismic surveys, are not direct physical points of observation, but can increase the confidence in the continuity and structure of the coal seam between physical points of observation.

3.17.2
coal quality point of observation
coordinated position from which accurate sampling and appropriate analyses of the coal seam over the full coal seam intersection, or combination of sampled subseam, or selected mining horizon is carried out, such that the combination covers the full coal seam
cf. coal quality (3.13), physical point of observation (3.17.1)

3.18
seam thickness
thickness that can be measured in terms of either apparent thickness or true thickness

3.18.1
apparent seam thickness
physically measured thickness of coal seam intersected in the borehole or excavation, normally in the vertical plane

NOTE The true seam thickness (3.18.2) is the product of the apparent thickness and the cosine of the average dip of the coal seam at that point of observation.

3.18.2
true seam thickness
distance measured between the roof and floor contacts of the coal seam at right angles to the average dip of the seam

3.19
extrapolation distance
distance from a point of observation to the edge of a defined coal resource block on the perimeter of the data set

NOTE The distance is usually not more than a third of the average distance between adjacent points of observation for the relevant coal resource category.

3.20
density
true density
true specific gravity (deprecated)
measure of the concentration of matter, expressed as mass per unit volume

NOTE In the case of coal, density is the ratio of the mass of a certain volume of finely ground coal to that of an equivalent volume of water, where the coal is ground to a size such that the impact of pores or voids is eliminated. This represents the true density or true specific gravity and is reported as grams per cubic centimetre. In effect the true density represents the density of the coal matrix without the modifying effect of pores or voids since the comminution of the particles changes the structure of each particle.

3.20.1
relative density
ratio of the mass of a certain volume of coal (or rock) to that of an equivalent volume of water (also previously termed specific gravity (3.20))

3.20.2
apparent relative density
ratio of the mass of a certain volume of a particle of coal or rock to that of an equivalent volume of water

NOTE The apparent relative density includes the effect of pores and voids enclosed within the particle. This value is the average of the specific gravity of the coal matrix and the included pores and voids (whether water-filled or gas-filled).

3.20.3
bulk density
in the case of coal loaded in a truck, in stockpile, or in a dump, the ratio of the mass of loose particles and intervening voids to that of an equivalent volume of water

NOTE The bulk density represents the net mass of packed coal particles in a specific volume.

3.21
geological loss factor
discount factor applied in the case of gross in situ tonnage to account for as yet unobserved geological features that can occur between points of observation

3.21.1
physical geological loss
GL_p
loss due to as yet unobserved physical factors that can occur between points of observation

NOTE Points of observation include localized thinning of the coal seam, weathering, faulting, dyke and sill intrusions, areas of burnt or devolatilized coal, amongst others.

3.21.2
geological model estimation error
GL_m
function of the mathematical interpolation methodology in the three-dimensional geological computer model which compensates for changes in the degree of confidence in the volumetric estimates, or coal quality estimates derived from the three-dimensional geological computer model with respect to the density of the points of observation

NOTE 1 The geological model estimation error may be positive or negative and should be calibrated.

NOTE 2 The geological model estimation error should be evaluated independently for physical points of observation (3.17.1) and for coal quality points of observation (3.17.2).

3.22
reasonable and realistic prospect of economic extraction
coal seam that is potentially economically mineable to produce a raw coal product or beneficiated saleable coal product

NOTE Such coal should be marketable at the time of the valuation, or should be marketable within a time frame of 50 years, based on current technology.

3.23
marginally economic coal resource
coal resource that at the time of determination is not economically mineable, but borders on being so

NOTE 1 A marginally economic coal resource can become economic in the future as a result of changes in technological, coal processing, marketing, economic, environmental and other relevant factors or conditions.

NOTE 2 A marginally economic coal resource may be quoted as either a pre-feasibility coal resource (3.25.5) or a feasibility coal resource (3.25.6), depending on the level of the associated economic study (3.4).

3.24
sterilized coal resource
coal resource that is potentially economic but is unlikely to be exploited due to external factors

NOTE External faxtors include losses associated with surface structures, urban development, legal, governmental or environmental reasons, or any other modifying factor (3.30).

3.25
coal resource
occurrence of coal of economic interest in or on the earth's crust in such form, quality and quantity that there are reasonable and realistic prospects for eventual economic extraction (3.22)

NOTE 1 The location, quantity, coal quality, continuity and other geological characteristics of a coal resource are known, estimated from specific geological evidence and knowledge, or interpreted from a well-constrained and portrayed geological model. Coal resources are subdivided, in order of increasing geological confidence and in respect of geoscientific evidence, into reconnaissance, inferred, indicated and measured categories (derived from the *SAMREC Code*, 5.4.1; see also 4.4.3.1 in this standard).

NOTE 2 A coal resource includes the full coal seam above the minimum thickness cut-off and coal quality cut-off, as defined by the competent person. Usually a minimum seam thickness of 0,5 m is used to define the maximum physical lateral extent of a coal resource.

3.25.1
reconnaissance coal resource
coal in the full seam where the coal seam is of economic interest and the distribution of physical points of observation is such that physical continuity may be assumed at a low level of confidence, and there is limited coal quality data, such that the available coal quality data includes coal quality of economic interest

3.25.2
inferred coal resource
part of a coal resource for which tonnage, densities, shape, physical characteristics and coal quality can be estimated with a low level of confidence. The resource is inferred from geological evidence and assumed, but not verified physical continuity with or without coal quality continuity. It is based on exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and boreholes which are limited or of uncertain quality and reliability (See the *SAMREC Code*, 6.2.1.)

NOTE An inferred coal resource is defined by the coal in the full seam above the minimum thickness cut-off and relevant coal quality cut-offs, as defined by the competent person, which meets the criteria for reasonable and realistic prospects of economic extraction.

3.25.3
indicated coal resource
part of a coal resource for which tonnage, densities, shape, physical characteristics and coal quality can be estimated with a moderate level of confidence. It is based on exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and boreholes. The locations are appropriate to confirm physical continuity, while the locations are too widely or inappropriately spaced to confirm coal quality continuity. However, such locations are spaced closely enough for coal quality continuity to be assumed (See the *SAMREC Code*, 6.2.2.)

NOTE An indicated coal resource is defined by the coal in the full seam above the minimum thickness cut-off and relevant coal quality cut-offs, as defined by the competent person, which meets the criteria for reasonable and realistic prospects of economic extraction.

3.25.4
measured coal resource
part of a coal resource for which tonnage, densities, shape, physical characteristics, and coal quality can be estimated with a high level of confidence. It is based on detailed and reliable exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and boreholes. The locations are spaced closely enough to confirm physical continuity and coal quality continuity (See the *SAMREC Code*, 6.2.3.)

NOTE A measured coal resource is defined by coal in the full seam above the minimum thickness cut-off and relevant coal quality cut-offs, as defined by the competent person, which meets the criteria for reasonable and realistic prospects of economic extraction.

3.25.5
pre-feasibility coal resource
part of an indicated coal resource and in some cases a measured coal resource that has been shown, after a pre-feasibility study (3.4.3) has been carried out, to be marginally economical

NOTE 1 The pre-feasibility study will have included consideration of realistically assumed mining, coal processing, economic, marketing, legal, environmental, social and governmental factors, but will have demonstrated at the time of reporting that extraction is not presently justified.

NOTE 2 This coal resource is identified as being possibly economically viable subject to changes in technological, economic, environmental or other relevant factors or conditions. A pre-feasibility coal resource has a lower level of confidence than a feasibility coal resource (3.25.6).

NOTE 3 See also UNE 32101.

3.25.6
feasibility coal resource
part of a measured coal resource that has been shown, after a feasibility study (3.4.4) has been carried out, to be not economically mineable

NOTE 1 The feasibility study will have included consideration of realistically assumed mining, coal processing, economic, legal, environmental, social and governmental factors, but will have demonstrated at the time of reporting that extraction is not presently justified.

NOTE 2 This coal resource is identified as being possibly economically viable subject to changes in technological, economic, environmental or other relevant factors or conditions. A feasibility coal resource has a higher level of confidence than a pre-feasibility coal resource (3.25.5).

NOTE 3 See also UNE 32101.

3.26
gross in situ coal resource
GTIS
tonnage and coal quality, at specified moisture content, contained in the full coal seam above the minimum thickness cut-off and relevant coal quality cut-off parameters, as defined by the competent person
cf. in situ coal resource (3.27)

NOTE The seam height does not include any external dilution or contamination material. No loss factors shall be applied to a gross in situ coal resource.

3.27
in situ coal resource
TTIS
tonnage and coal quality, at specified moisture content, contained in the full coal seam above the minimum thickness cut-off and quality cut-off parameters, as defined by the competent person
cf. gross in situ coal resource (3.26)

NOTE The seam height does not include any external dilution or contamination material. The geological loss factors are applied to the tonnage in an in situ coal resource.

3.28
theoretical mining height
height of the full seam or the optimal selected part of the seam, based on a geological assessment, that is expected to be mined
cf. practical mining height (3.35)

NOTE 1 The theoretical mining height does not include any external dilution (external to the height of the selected coal zone) or any contamination material, but may include dilution due to internal defined partings within the selected coal zone.

NOTE 2 The mining method is reported, as well as the maximum and minimum mineable thickness cut-offs.

3.29
mineable in situ coal resource
MTIS
tonnage and coal quality, at a specified moisture content, contained in the coal seams, or sections of the seams, which are proposed to be mined at the theoretical mining height (3.28), excluding dilution and contamination material, with a specific mining method and after the relevant minimum and maximum mineable thickness cut-off and relevant coal quality cut-off parameters have been applied
cf. gross in situ coal resource (3.26)

NOTE 1 The geological loss factor (3.21) is applied to the mineable in situ coal resource tonnage.

NOTE 2 Mineable in situ coal resources are subdivided into inferred, indicated and measured mineable in situ coal resources.

3.30
modifying factor
appropriate assessment, which can include a feasibility study, that has been carried out, including the consideration of realistically assumed mining, geotechnical, coal quality, coal processing, economic, marketing, legal, environmental, social and governmental factors

NOTE These assessments demonstrate at the time of reporting that extraction is reasonably justifiable and these factors are used to modify the coal resources in the conversion from coal resources to coal reserves.

3.31
coal reserve
economically mineable coal derived from a measured or indicated coal resource, or both. It is inclusive of diluting and contaminating materials and allows for losses that can occur when the material is mined. Appropriate assessments, which may include feasibility studies, have been carried out, including consideration of, and modification by, realistically assumed mining, coal processing, economic, marketing, legal, environmental, social and governmental factors. These assessments demonstrate at the time of reporting that extraction is reasonably justifiable. Coal reserves are subdivided in order of increasing confidence into probable coal reserves and proven coal reserves (See the *SAMREC Code*, 5.5.1.)

NOTE 1 A coal reserve refers only to that part of the coal seam that will be mined, either the full seam or a selected part of the seam. A coal reserve is based on an evaluation that demonstrates that extraction of a coal resource is justified at the time of the valuation and that an economic mine plan has been defined.

NOTE 2 A coal reserve may be reported on a mineable in situ basis, but is usually quoted on a "run of mine" (ROM) basis and a saleable basis.

3.31.1
probable coal reserve
economically mineable coal derived from a measured or indicated coal resource, or both. It is estimated with a lower level of confidence than a proven coal reserve. It is inclusive of diluting and contaminating materials and allows for losses that may occur when the material is mined. Appropriate assessments, which may include feasibility studies, have been carried out, including consideration of, and modification by, realistically assumed mining, coal processing, economic, marketing, legal, environmental, social and governmental factors. The assessments demonstrate at the time of reporting that extraction is reasonably justified (See the *SAMREC Code*, 5.5.2.)

NOTE A probable coal reserve is demonstrated to be economically mineable by a pre-feasibility study (3.4.3) (See the *SAMREC Code*, 6.3.1.).

3.31.2
proven coal reserve
economically mineable coal derived from a measured coal resource. It is estimated with a high level of confidence. It is inclusive of diluting and contaminating materials and allows for losses that may occur when the material is mined. Appropriate assessments, which may include feasibility studies that have been carried out, including consideration of and modification by realistically assumed mining, coal processing, economic, marketing, legal, environmental, social and governmental factors. The assessments demonstrate at the time of reporting that extraction is reasonably justified (See the *SAMREC Code*, 5.5.3.)

NOTE A proven coal reserve is demonstrated to be economically mineable by a feasibility study (see 3.4.4) or actual mining activity (see mining report (3.4.5)). (See the *SAMREC Code*, 6.3.2.)

3.32
mining layout loss factor
MLL
discount factor required to account for the expected loss of coal reserves due to actual mining activities not reaching the defined boundary of the mineable in situ coal resource block. The mining layout loss factor includes boundary pillar and other fringe or limit losses on the extremity of the planned mining operations, between the coal resource block boundary and the mining layout, but does not include internal barrier pillars and support pillars. The mining layout loss factor is a measure of the efficiency of the practical aerial extraction of coal reserves within a defined coal resource block

3.33
mineable in situ coal reserve (theoretical mining height)
coal of tonnage and quality, at a specified moisture content, contained in coal seams, or sections of seams, which are proposed to be mined at the theoretical mining height (3.28), excluding dilution and contamination material**,** after a mine plan with a specific mining method has been developed and the relevant minimum and maximum cut-off mineable thickness and relevant coal quality cut-off parameters have been applied. The geological loss factors and mine layout losses are applied to the tonnage in the calculation of a mineable in situ reserve. Sufficient information is available for conceptual or detailed mine planning and such mine planning has been undertaken
cf. practical mining height (3.35) and mineable in situ coal resource (3.29)

3.34
dilution material
d
non-coal or coal (in the case where only a selected part of the seam is mined) outside the theoretical mining height (3.28), that is intentionally added in as part of the planned mining section to obtain a practical mining horizon, based on geological, geotechnical and mining engineering assessments, in order to recover the mineable coal seam, or for specific safety reasons

3.35
practical mining height
height of the full seam or the optimal selected mineable part of the seam, based on geological assessment, that is expected to be mined including any planned dilution material, added in due to practical mining considerations, for safety reasons or for minimum or optimum mining height reasons. The practical mining height does not include any external contamination material. The mining method is reported, as well as the maximum and minimum mineable thickness cut-off parameters

3.36
mineable in situ coal reserve (practical mining height)
coal of tonnage and quality, at specified moisture content, contained in coal seams, or sections of seams, which are proposed to be mined at the practical mining height (3.35), with the application of the geological loss, mine layout loss and dilution factors. Sufficient information is available to enable conceptual or detailed mine planning and such mine planning has been undertaken. (See the *SAMREC Code*, 6.3.3.) The mine plan has a specific mining method and the relevant minimum and maximum mineable thickness cut-off and coal quality cut-off parameters have been applied
cf. mineable in situ coal reserve (theoretical mining height) (3.33)

3.37
mining layout extraction factor
MLE
discount factor used to account for the loss of coal reserves due to the selection of mining method and associated mine layout
cf. mining layout loss factor (3.32)

NOTE The mining layout extraction factor includes support pillar, internal barrier pillar and other layout losses in the case of underground mining operations, and includes planned mining layout losses at cut extremities in the case of opencast mining operations.

3.38
extractable coal reserve
ETIS
discounted mineable in situ coal reserves at the practical mining height within a practical mining layout, depending on the mining method

NOTE 1 The extractable coal reserves are tonnage estimates obtained by applying the mining layout loss factor, dilution factor and mining layout extraction factor to a mineable in situ coal reserve at the practical mining height (3.36). The extractable coal reserves include dilution material, but exclude any contamination material.

NOTE 2 The extractable coal reserve tonnage and coal quality are calculated on an uncontaminated air-dried basis or on an uncontaminated in situ bed moisture basis.

NOTE 3 The calculation of the extractable coal reserves is an intermediate step and is usually not reported.

3.39
mining recovery efficiency factor
MR
factor used to account for the net losses of coal reserves due to the mining equipment and mining method inefficiency

NOTE The net losses represent coal not extracted by not reaching the planned theoretical mining limits (as defined by the mining layout), by not reaching the planned mining height, or by not reaching the planned aerial mining extraction percentage. In the case of underground mining operations, the net losses include losses due to not achieving the planned extraction factor or not reaching the planned panel extremities, while in the case of opencast mining operations this include unplanned losses between adjacent mining cuts.

3.40
contamination material
contaminant
c
extraneous coal and non-coal material unintentionally added to the practical mining horizon as a result of mining operations

3.41
run of mine moisture content correction factor
MCR_{ROM}
factor obtained by calculation to account for the change in the coal reserve tonnage from the contaminated in situ moisture or air-dried moisture run of mine coal reserves (at the actual mining height with included dilution and contamination) to a run of mine (as delivered) basis as a result of moisture addition during mining operations (including the impact of transportation on the coal moisture content and moisture addition for dust suppression purposes)

3.42
run of mine (as delivered) coal reserve
ROM
tonnage and coal quality of mineable in situ coal reserves that are expected to be recovered after all geological losses, dilution, mining losses (mining layout loss, mining layout extraction loss, mining recovery efficiency factor), contamination and moisture content correction factors have been applied (See the *SAMREC Code*, 6.3.4.)

NOTE The run of mine (as delivered) coal reserve tonnage is therefore calculated on a moisture corrected, contaminated basis. The assessments demonstrate that at the time of reporting, economic extraction is reasonably justified. ROM (as delivered) coal reserves are a specific reporting requirement and the associated contamination and moisture correction factors are reported. The ROM coal reserves are subdivided in order of increasing confidence into probable ROM coal reserves and proven ROM coal reserves. The ROM coal reserves are reported for the Securities Exchange and the National Coal Inventory.

3.43
run of mine coal reserve reporting basis
the run of mine (ROM) reserve can be reported on the following different bases:

a) **ROM (uncontaminated, in situ):** in situ bed moisture basis without added contamination;

b) **ROM (uncontaminated, air-dried):** air-dried basis without added contamination;

c) **ROM (contaminated, in situ):** in situ bed moisture basis with added contamination;

d) **ROM (contaminated, air-dried):** air-dried basis with added contamination;

e) **ROM (contaminated, wet):** wet basis with added contamination and is usually equivalent to the ROM (as delivered) reporting basis, although can be at a different moisture content;

f) **ROM (as delivered):** wet basis with added contamination and represents the expected tonnage delivered to the tip, or stockpile, or coal processing plant.

NOTE ROM (as delivered) is the correct basis for reporting ROM coal reserves in public reports and for the National Coal Inventory.

3.44
theoretical product yield (uncontaminated basis)
laboratory estimate of the yield (derived by density separation or size separation, or both) of the target product at a specific coal quality, or at a specific cut-point density, with reference to a specific coal particle size range, on an uncontaminated basis, expressed in percentage

NOTE The specific particle size at which the theoretical product yield is obtained, is specified. The theoretical product yield is based on the results from borehole core or channel sample data and is quoted on an air-dried to air-dried moisture basis or on an in situ to in situ moisture basis (3.16.15).

3.45
theoretical product yield (contaminated basis)
theoretical laboratory estimate of the yield (derived by density separation or size separation, or both) of the target product at a specific coal quality, or at a specific cut-point density, with reference to a specific coal particle size range, on or adjusted to a contaminated and diluted basis, expressed as a percentage

NOTE The specific particle size at which the theoretical product yield is obtained, is specified. The theoretical product yield is based on the results from borehole core or channel sample data adjusted for the expected dilution and contamination and is quoted on an air-dried to air-dried moisture basis or on an in situ to in situ moisture basis (3.16.15).

3.46
practical product yield
net yield of a target product (derived by density separation or size separation, or both) due to coal processing operations at a specific coal quality or a specific cut-point density, with reference to a specific coal particle size range, after applying the coal processing discount factors (amongst others: liberation, organic efficiency, fines loss) to the theoretical product yield, expressed as a percentage

NOTE The specific particle size at which the practical product yield is obtained, is specified. The basis on which the practical product yield is calculated, is quoted, and is preferably on an air-dried basis.

3.47
saleable moisture correction factor
$MCF_{saleable}$
factor obtained by calculation applied to the respective saleable product tonnages to account for the change in moisture content from the saleable air-dried coal reserve tonnage as a result of coal processing operations (including moisture addition for dust suppression)

3.48
saleable coal reserve
tonnage and coal quality that will be available for sale, either in the raw ROM state (raw saleable) at a specified moisture content, or after beneficiation resulting from coal processing operations of the ROM coal reserves to produce a product or products, at a specified coal quality, moisture content and size range

The assessments demonstrate that at the time of reporting, the marketing of the products is reasonably justified. The basis of the predicted practical product yield to achieve the saleable coal reserve is stated. The moisture basis of reporting is stated. In the case of raw saleable products the practical product yield is typically 100 %.

Saleable coal reserves are subdivided in order of increasing confidence into probable saleable coal reserves and proven saleable coal reserves categories. The saleable coal reserves are reported for the Securities Exchange and the National Coal Inventory (See the *SAMREC Code*, 6.3.5.)

3.49
saleable coal reserve reporting basis (reserve not beneficiated)
where the saleable reserve is not beneficiated and sold on a raw coal basis, it is equivalent to the ROM reserve and can be reported on one of the following bases:

a) **ROM (contaminated, in situ)**: in situ bed moisture basis with added contamination;

b) **ROM (contaminated, air-dried):** air-dried basis with added contamination;

c) **ROM (as delivered):** wet basis with added contamination and represents the expected tonnage delivered to the tip or stockpile.

3.50
saleable coal reserve reporting basis (reserve beneficiated)
where the saleable reserve is beneficiated, it can be reported on one of the following product bases:

a) **product (air-dried):** on an air-dried basis with the tonnage on the as sold moisture basis adjusted to an air-dried moisture basis;

b) **product (in situ):** on an in situ basis with the tonnage on the as sold moisture basis adjusted to an in situ moisture basis. Product (in situ), can be used for intermediate calculation purposes but not for reporting purposes;

c) **product (as delivered):** on a wet as sold or as delivered basis

3.51
coal in remnants
coal in pillars
coal that remained in previously mined underground workings, which may be potentially economic, where there are reasonable and realistic prospects for eventual economic extraction in the case of coal resources and where economic extraction is justifiable in the case of coal reserves

3.52
discards and reject coal
coal or carbonaceous material with or without associated or included stone, that result(s) from mining operations or coal processing operations and with coal quality parameters that fall outside the current saleable product range

3.53
stockpile
accumulation of coal with an intrinsic economic or commercial value

3.54
dump
accumulation of discards and reject coal with no present commercial value

3.55
national survey reference grid
spatially referenced grid to enable coordinated points to be correctly positioned on the surface of the earth

3.56
strip ratio
sr
ratio of overburden volume to coal tonnes in the mineable coal seam (on an in situ, run of mine, or sales tonnage basis), typically in opencast mineable areas and measured in bank cubic metres/tonne (bcm/tonne)

NOTE Where coal reserve discount factors result in losses above the lowermost mineable coal seam, these volumetric losses are added back into the overburden volume.

3.56.1
average strip ratio
ratio of the total overburden volume to total coal tonnes in the mineable coal seam (on an in situ, run of mine, or sales tonnage basis) in a coal block, measured in bcm per tonne

NOTE The total overburden volume is the product of the average depth and the total block area.

3.56.2
incremental strip ratio
ratio of the incremental overburden volume to incremental coal tonnes in the mineable coal seam (on an in situ, run of mine, or sales tonnage basis) on a particular limit line, generally on the margin of a coal block, measured in bcm per tonne

3.57
vitrinite reflectance
percentage of normal incident light reflected from the polished surface of vitrinite

NOTE In the context of petrography, reflectance refers to measurements made on the vitrinite under oil.

3.57.1
vitrinite maximum reflectance
$\overline{R}_{v\ max}$
highest value of reflectance obtained on vitrinite, when any polished section of a particle or lump of coal is rotated in its own plane in linearly polarized light

3.57.2
vitrinite minimum reflectance
$\overline{R}_{v\ min}$
lowest value of reflectance obtained on vitrinite, when any polished section of a particle or lump of coal is rotated in its own plane in linearly polarized light

3.57.3
vitrinite random reflectance
$\overline{R}_{r}$
reflectance of vitrinite of any polished section of a particle or lump of coal when determined in unpolarized light without rotation of the specimen

4 Reporting for Securities Exchange purposes (The public report)

4.1 Introduction

For ease of reference, paragraphs presented in this clause are extracts from the *SAMREC Code*. The equivalent clause in the *SAMREC Code* is given in brackets.

In the *SAMREC Code*, guidelines have been included in the respective subclauses to provide assistance and guidance to readers on interpretation of the *SAMREC Code*. These guidelines have not been reproduced in this standard and it is recommended that the reader refer to the *SAMREC Code* for further guidance.

In addition, the reader is referred to the clauses on the calculation and reporting of coal resources and coal reserves detailed in clause 6.

The format of a typical coal resource and reserve report is presented in annex E.

4.2 Scope of the *SAMREC Code*

4.2.1 The *SAMREC Code* sets a required minimum standard for public reporting. Reference in the *SAMREC Code* to a public report or public reporting is to a report or reporting on exploration results, coal resources or coal reserves prepared for the purpose of

a) informing investors or potential investors and their advisers, or

b) satisfying regulatory requirements.

Companies are encouraged to provide information which is as comprehensive as possible in their public reports (see the *SAMREC Code*, 3.1).

4.2.2 The main principles governing the operation and application of the *SAMREC Code* are transparency, materiality and competence. Transparency requires that the reader of a public report is provided with sufficient, clear and unambiguous information to understand the report and is not misled. Materiality requires that a public report contain all the information, which investors and their professional advisers would reasonably require and reasonably expect to find in the report, for the purpose of making a reasoned and balanced judgement regarding the coal resources and coal reserves being reported. Competence requires that the public report be based on the work of a suitably qualified, responsible and experienced person who is subject to an enforceable professional code of ethics (see the *SAMREC Code*, 2.3).

4.2.3 Public reports shall provide all relevant and material information necessary for a reasonable and balanced judgement of the exploration results, coal resources or coal reserves to be made (see the *SAMREC Code*, 3.2).

4.3 Competence and responsibility

4.3.1 Documentation detailing exploration results, coal resources and coal reserves estimates from which a public report on exploration results, coal resources and coal reserves is compiled, shall be prepared by or under the direction of, and signed by, a competent person (see the *SAMREC Code*, 4.1).

4.3.2 A public report concerning a company's exploration results, coal resources and/or coal reserves shall be the responsibility of the company acting through its board of directors. Any such

report shall be based on, and fairly reflect, a coal resource and/or coal reserve report and supporting documentation prepared by a competent person. A public report shall disclose the name of the competent person, his qualifications, professional affiliations and relevant experience. The competent person's written approval is required for the relevant parts of his/her work included in the report (see the *SAMREC Code*, 4.2).

4.3.3 A competent person (3.3) should have a minimum of five years' experience, which is relevant to the style of mineralization and type of deposit under consideration and to the activity which that person is undertaking. If the competent person is estimating, or supervising the estimation of coal resources, the relevant experience shall be in the estimation, assessment and evaluation of coal resources. If the competent person is estimating, or supervising the estimation of coal reserves, the relevant experience shall be in the estimation, assessment, evaluation and economic extraction of coal reserves (see the *SAMREC Code*, 4.3).

4.4 Reporting on coal resources and coal reserves

4.4.1 Introduction

4.4.1.1 The general reporting sections of the *SAMREC Code* are detailed in parts 1 to 5 of the *SAMREC Code*, while the commodity specific reporting requirements for coal are defined in part 6 of the *SAMREC Code*. Part 6 of the *SAMREC Code* addresses matters specific to the public reporting of coal resources and coal reserves. The reader is referred to this standard (SANS 10320) for the definitions of the relevant terms and for the methodology for evaluating coal deposits (see the *SAMREC Code*, 6.1.2).

4.4.1.2 When reporting on commodity specific requirements for coal resources and coal reserves, reference shall be made to part 6 of the *SAMREC Code*, which contains amendments and additions, which will take precedence over all common clauses in parts 1 to 5 (*SAMREC Code*, 5.2.3). Unless otherwise stated in part 6 (*SAMREC Code*, part 6), parts 1 to 5 (*SAMREC Code*, parts 1 to 5) shall, with the following modifications, apply to public reporting on coal resources and coal reserves:

a) references to the "Code" are changed to the "*SAMREC Code*";

b) the term " coal" shall replace the term " mineral" ;

c) "coal deposit" shall replace "mineralization" ;

d) "coal quality" shall replace "grade and mineral content" where applicable, including the guidelines; and

e) in the case of coal reserves, all references to "metallurgical" modifying factors shall be replaced by "coal processing" modifying factors (see the *SAMREC Code*, 6.1.1).

4.4.1.3 Any reference to appendix I shall be substituted by reference to this standard (SANS 10320). (See the *SAMREC Code*, 6.1.2.)

4.4.1.4 All references to figure 5.1 in the *SAMREC Code* have been replaced by reference to figure 3 in this standard (SANS 10320). (See the *SAMREC Code*, 6.1.3.)

4.4.1.5 In 4.4.2, 4.4.3, 4.5 and 4.6, certain clauses of the *SAMREC Code* have been amended by combining the coal specific reporting requirements (in the *SAMREC Code*) with the general reporting requirements (in the *SAMREC Code*) so that relevant extracted clauses are specifically focussed on coal resource and coal reserve reporting.

4.4.2 General requirements

4.4.2.1 Public reporting concerning a company's exploration results, coal resources or coal reserves should include a description of the style and nature of the coal deposit (see the *SAMREC Code*, 5.2.1).

4.4.2.2 A company shall disclose relevant information concerning the status and characteristics of a coal deposit, which could materially influence the economic value of that deposit, and promptly report any material changes in its exploration results, coal resources or coal reserves (see the *SAMREC Code*, 5.2.2).

4.4.2.3 Public reports for Securities Exchange reporting purposes dealing with coal resources and coal reserves shall only use the terms set out in figure 3 below. Any reference to figure 5.1 in the *SAMREC Code* shall be substituted by a reference to figure 6.1 in the *SAMREC Code* (equivalent to figure 3 in this standard) (see the *SAMREC Code*, 6.1.3).

4.4.2.4 Figure 3 gives the relationship between coal resources and coal reserves, showing the effect of increasing geological confidence on the coal resource classification category on the vertical axis and the impact of the relevant modifying factors on the conversion of coal resources to coal reserves on the horizontal axis.

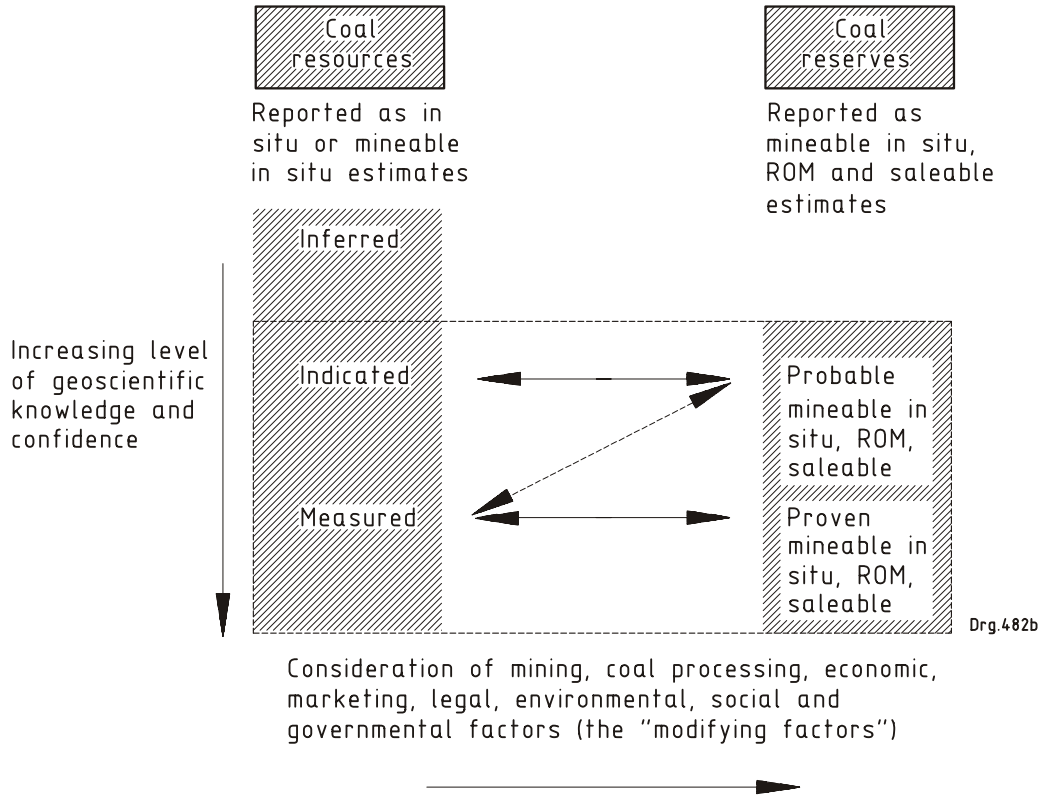


Figure 3 — Relationship between coal resources and coal reserves
(derived from the *SAMREC Code*, figure 6.1)

4.4.2.5 This standard provides the main criteria that should be considered when preparing reports on coal resources and coal reserves. The evaluation criteria shall not be discussed in a public report unless they materially affect estimation or classification of the coal resources and coal

reserves. However, changes in economic or political factors alone may be the basis for significant changes in coal reserves and should be reported accordingly (see the *SAMREC Code*, 6.1.4).

4.4.2.6 In situations where figures for both coal resources and coal reserves are reported, a clarifying statement shall be included in the report which clearly indicates whether the coal resources are inclusive of, or are additional to, those coal resources which have been modified to produce coal reserves (see the *SAMREC Code*, 5.5.7).

4.4.2.7 The appropriate coal quality shall be reported for all coal resource and coal reserve categories. The basis of reporting of the coal quality parameters shall be reported, as for example on an air-dried moisture basis or dry basis. Where applicable, saleable coal reserves shall be subdivided into the relevant coal product types.

4.4.2.8 The quality of the coal should be expressed according to parameters relevant to specific applications, for example, steam coal, types of metallurgical coal, etc. The selection of parameters shall be the responsibility of the competent person and would include coal quality parameters such as ash, volatile matter, sulphur, coking properties, calorific value, amongst others (see the *SAMREC Code*, 6.3.6).

NOTE For the purposes of this standard, “sulphur” is deemed to be equivalent to “sulfur” (the International Union for Pure and Applied Chemistry preferred spelling).

4.4.3 Reporting of coal resources

4.4.3.1 In order to report on coal resources (see 3.25), the location, quantity, coal quality, continuity and other geological characteristics of a coal resource are known or estimated from specific geological evidence and knowledge, or interpreted from a well-constrained and portrayed geological model. Coal resources shall be subdivided, in order of increasing confidence, in respect of geoscientific evidence, into inferred, indicated and measured categories (see figure 3).

4.4.3.2 A coal deposit (see 3.11) is a concentration of material of possible economic interest in or on the earth's crust. Portions of a coal deposit that do not have reasonable and realistic prospects for eventual economic extraction shall not be included in a coal resource (see the *SAMREC Code*, 5.4.1).

4.4.3.3 Coal 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. Reporting of tonnage and coal quality figures shall reflect the order of accuracy of the estimate by rounding off to appropriately significant figures and, in the case of inferred coal resources, by qualification with terms such as “approximately” (see the *SAMREC Code*, 5.4.2).

4.4.3.4 The choice of the appropriate category of coal resource, whether it is an inferred coal resource (3.25.2), an indicated coal resource (3.25.3), or a measured coal resource (3.25.4), shall depend upon the quantity, distribution and quality of data available and the level of confidence attached to the data. The appropriate coal resource category shall be determined by a competent person (see 3.3 in this standard and 5.4.6 in the *SAMREC Code*).

4.4.3.5 Public reports of coal resources shall specify one or more of the categories of inferred, indicated or measured resources. Reports shall not contain coal resource figures combining two or more of the categories unless figures for the individual categories are also provided (see the *SAMREC Code*, 5.4.8).

4.4.4 Reporting of coal reserves

4.4.4.1 In order to report on coal reserves (see 3.31), appropriate assessments, which may include feasibility studies, shall have been carried out, including consideration of, and modification by, realistically assumed mining, coal processing, economic, marketing, legal, environmental, social and governmental factors. These assessments shall demonstrate at the time of reporting that extraction is reasonably justifiable. Coal reserves are subdivided in order of increasing confidence into probable coal reserves and proven coal reserves (see the *SAMREC Code*, 5.5.1).

4.4.4.2 A coal reserve shall be categorized as a proven coal reserve (see 3.31.2) or a probable coal reserve (see 3.31.1) (see figure 3) depending on the quantity, distribution and quality of data available and the level of confidence attached to the data. The choice of the appropriate coal reserve category is determined primarily by the relevant level of confidence and shall be made by the competent person (see 3.3 in this standard and 5.5.4 in the *SAMREC Code*).

4.4.4.3 Coal reserve estimates are not precise calculations and the tonnage and coal quality figures in the reports shall be expressed so as to convey the order of accuracy of the estimates by rounding off to appropriately significant figures (see the *SAMREC Code*, 5.5.5).

4.4.4.4 Coal reserve reports shall specify one or other of the categories of proven coal reserves and probable coal reserves. Reports shall not contain combined proven coal reserves and probable coal reserve figures unless the relevant figures for the categories are also provided (see the *SAMREC Code*, 5.5.6).

4.4.4.5 The assessment shall demonstrate that at the time of reporting of mineable in situ coal reserves (see 3.36) and ROM coal reserves (see 3.42), extraction is reasonably justified. The assessment of saleable coal reserves (see 3.48) shall demonstrate that at the time of reporting, the marketing of the coal products is reasonably justified.

4.4.4.6 Mineable in situ coal reserves (see 3.36) shall be subdivided in order of increasing confidence into probable mineable in situ coal reserve and proven mineable in situ coal reserve categories (see figure 3). The mineable in situ coal reserves may be reported (see the *SAMREC Code*, 6.3.3). Mineable in situ coal reserve estimates shall be quoted separately for surface and underground extraction and an outline of the proposed mining method shall be provided.

4.4.4.7 The ROM coal reserves (see 3.42) shall be subdivided in order of increasing confidence into probable ROM coal reserves and proven ROM coal reserves (see figure 3). The ROM coal reserves shall be reported (see the *SAMREC Code*, 6.3.4). The ROM coal reserves are equivalent to the mineral reserves in part 5 of the *SAMREC Code*. ROM coal reserve estimates shall be quoted separately for surface and underground extraction and an outline of the proposed mining method shall be provided.

4.4.4.8 Saleable coal reserves (see 3.48) shall be subdivided in order of increasing confidence into probable saleable coal reserve and proven saleable coal reserve categories (see figure 3). The saleable coal reserves shall be reported (see the *SAMREC Code*, 6.3.5). Where applicable, saleable coal reserves should be subdivided into the relevant coal product types.

4.5 Reporting of exploration results

4.5.1 If a company reports exploration results in relation to coal deposits not classified as coal resources or coal reserves, then estimates of tonnage and associated coal quality shall not be reported (see the *SAMREC Code*, 5.3.1).

4.5.2 Public reports of exploration results relating to mineralization not classified as a coal resource or coal reserve must contain sufficient information to allow a considered and balanced

judgement of the significance of the results. This must include all relevant prospecting information. The reporting of exploration results must not be presented so as to unreasonably imply potentially economic mineralization has been discovered (see the *SAMREC Code*, 5.3.2).

4.6 Reporting of coal in remnants, coal in pillars, discards and reject coal in stockpiles, dumps and tailings ponds

4.6.1 The *SAMREC Code* applies to the reporting of all potentially economic coal deposits including coal in pillars and remnants (see 3.51), discards and reject coal (see 3.52) presently contained in stockpiles (see 3.53), dumps (see 3.54) and tailings, where there are reasonable and realistic prospects for eventual economic extraction in the case of coal resources, and where economic extraction is justifiable in the case of coal reserves. Unless otherwise stated, the reports shall comply with parts 1 to 6 of the *SAMREC Code* and all other relevant requirements contained in this standard (see the *SAMREC Code*, 6.4.1).

4.6.2 Discards and reject coal produced as part of future production from a coal processing plant, or from mining operations, may be reported as an additional product, as a saleable coal reserve, only if economic extraction is justified (see the *SAMREC Code*, 6.4.1).

5 Reporting for the South African National Coal Inventory

5.1 Introduction

The National Coal Inventory (see 3.2) report is being prepared with the objective of understanding the distribution of available coal resources and coal reserves with reasonable and realistic prospects of economic extraction within South Africa, in order to obtain an understanding of the geographic location, the future infrastructure requirements and to be able to do long-term energy planning.

It is expected that the National Coal Inventory report will be updated on a periodic basis so that trends in the extraction and utilization of the national coal resource and reserve bases can be identified. This will ensure timely and appropriate future national planning for the main coal utilization sectors.

All the reporting requirements that apply to public reporting for Securities Exchange purposes apply to reporting for the National Coal Inventory, with the addition of a number of specific requirements detailed in 5.2 to 5.12.

5.2 Data capture forms

Forms to capture the required data for the National Coal Inventory are presented in annex A. These data capture forms indicate the data types required for the compilation of a report that will detail the current knowledge of the coal resources and coal reserves of the South African coal industry.

In addition the reader is referred to clause 6 of this standard for the calculation and reporting of coal resources and coal reserves (see the *SAMREC Code*, part 6).

5.3 Classification of coal resources and coal reserves

5.3.1 The classification of coal resources and coal reserves for the National Coal Inventory Report closely follows the requirements for Securities Exchange Reporting purposes as detailed in the *SAMREC Code* (see clause 4 of this standard (SANS 10320)). However, there are a number of additional requirements, i.e. the reporting of reconnaissance coal resources (3.25.1) and sterilized coal resources (3.24), and the inclusion of the pre-feasibility coal resource category (3.25.5) and the feasibility coal resource category (3.25.6) for marginally economic coal resources.

5.3.2 The coal resources and coal reserves shall be separated into the various coal resource or coal reserve categories based on the level of the economic assessment undertaken, whether a geological study (3.4.1), a pre-feasibility study (3.4.3), a feasibility study (3.4.4) or a mining report (3.4.5) is done (see figure 4 and clause 8).

5.3.3 A coal seam that does not comply with the definition of a reasonable and realistic prospect of economic extraction (3.22) or does not comply with the minimum requirements for a reconnaissance coal resource (3.25.1) is in fact a coal occurrence (3.10) and shall not be included in the coal resource tabulation for the National Coal Inventory.

Exploitable
Of economic interest
Not of economic interest

			1	2	3	4	5
			Geological study level				
			G3/4/5	**G2**	**G1**	**G1**	**G0**
			Operational/ Pre-production/ Feasibility study	**Pre-feasibility study**	**Detailed geological investigations**		
Economic study level	**L5**	Mining report	Proven reserve				
	L4	Feasibility study	Feasibility resource				
	L3	Pre-feasibility study	Probable reserve				
			Pre-feasibility resource				
	L2	Conceptual economic study					
	L1B	Geological study	Measured resource	Indicated resource	Inferred resource	Reconnaissance resource	
	L1A	Target generation					Coal occurrence

Figure 4 — Matrix showing the relationship between the geological study level and the economic study level with the relevant coal resource and coal reserve categories

5.3.4 The in situ coal resources for the National Coal Inventory shall be subdivided into reconnaissance resource, inferred resource, indicated resource, measured resource, pre-feasibility coal resource, and feasibility coal resource categories, based on the level of geological confidence in the coal resource estimate and the associated level of study, whether a geological, a pre-feasibility or a feasibility study. The coal resource estimates shall be quoted on an in situ coal resource basis after geological loss has been applied.

5.3.5 Coal resources for the National Coal Inventory shall be reported exclusive of the coal resources that have been modified to produce coal reserves (on an exclusive basis).

5.3.6 The coal reserves for the National Coal Inventory shall be based on a mining report, a feasibility study or a pre-feasibility study and shall be subdivided into proven and probable coal reserve categories. The coal reserves shall be stated on a mineable in situ (see 3.33, 3.36), ROM (3.42) and saleable coal reserve (3.48) basis.

5.3.7 The probable reserve, proven reserve, feasibility resource and pre-feasibility resource estimates shall have had a mining plan applied, and the associated mining method (opencast or underground) shall be stated.

5.3.8 A sequential schematic decision tree for the categorization of coal resources and coal reserves based on an initial geological study and then subsequent economic studies, is illustrated in figure 5.

5.4 Schematic decision tree

5.4.1 General

In order to classify a coal occurrence, a coal resource, or a coal reserve into the relevant reporting category, a number of key decisions need to be made, as detailed in 5.4.2 and 5.4.3.

5.4.2 The geological study

At the geological study stage (see figure 5), the following decisions are relevant:

a) Does the coal resource have the minimum number of boreholes with structural data and coal quality data? If not, then the coal associated with the particular block or area shall not be reported as a coal resource and is designated as a **coal occurrence** (with no need to report to the National Coal Inventory).

b) Is the coal resource encumbered by infrastructure such that there is very little likelihood of exploitation? If so, then the coal resource shall be reported as a **sterilized coal resource**.

c) Does the coal resource comply with the minimum requirements for indicated resources or measured resources? If not, then report as a **reconnaissance coal resource** or an i**nferred coal resource**, depending on the level of confidence.

5.4.3 The economic study

At the economic study stage (see figure 5), the following decisions are relevant:

a) Does the coal resource have the minimum number of structural data and coal quality data points to give a moderate to high level of confidence in the coal resource? If not, then the coal resource should be reported as an **inferred coal resource**.

b) Has a mining method been identified and has the theoretical mineable in situ coal resources been calculated taking into consideration the planned mining height? If not, then the coal resource shall be reported as an **indicated coal resource** or a **measured coal resource**, depending on the level of confidence.

c) Has a mine plan been defined for the selected mining method? If not, then the coal resource shall be reported as an **indicated coal resource** or a **measured coal resource**, depending on the level of confidence.

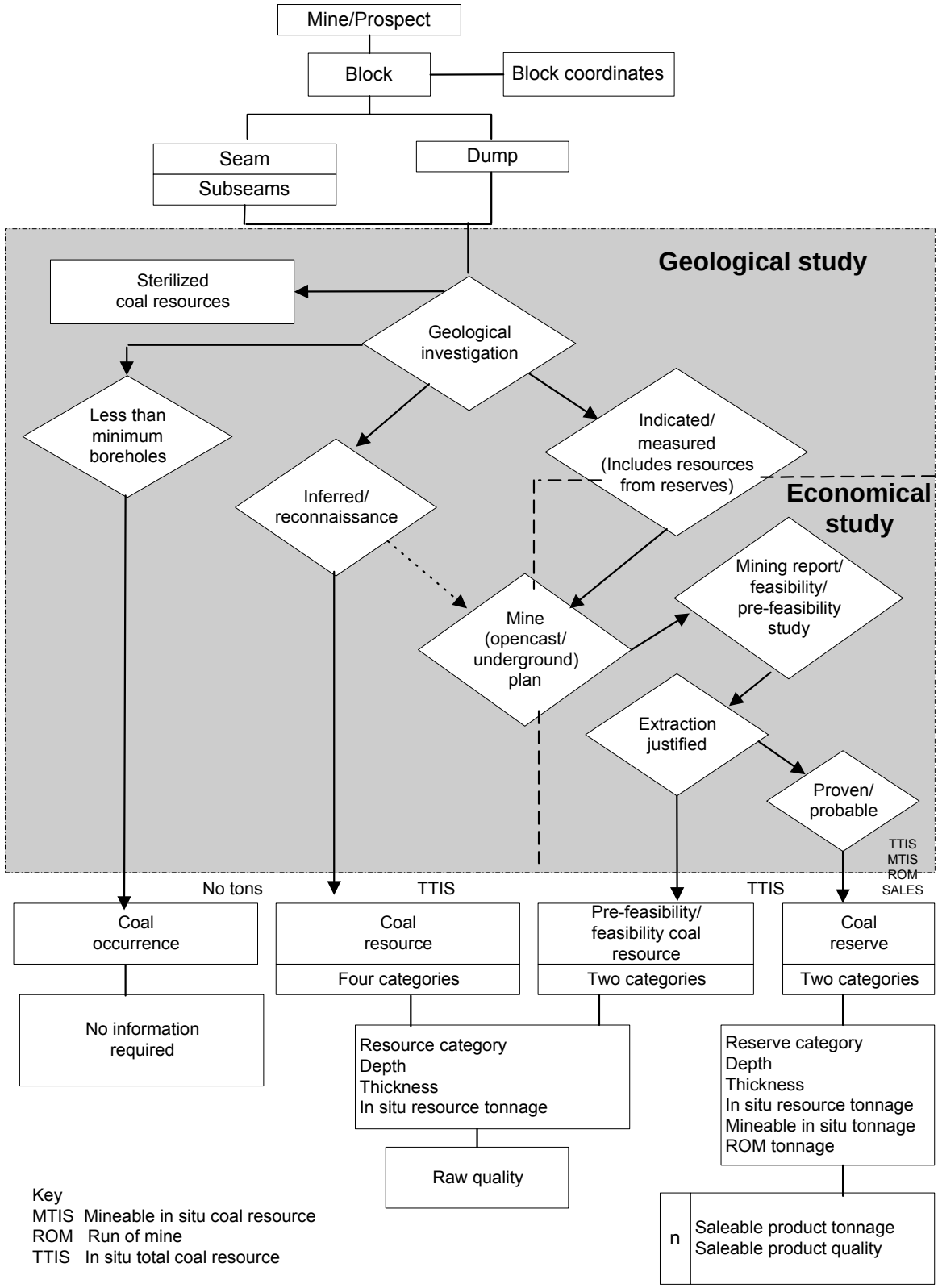


Figure 5 — Diagram that illustrates the sequential schematic decision tree for the categorization of coal resources and coal reserves based on an initial geological study and the subsequent economic studies to prove that the coal reserve is in fact economic

d) Has a pre-feasibility or feasibility study been undertaken, or is actual mining taking place? If not, then the coal resource shall be reported as an **indicated coal resource** or a **measured coal resource**, depending on the level of confidence.

e) Based on the results of the pre-feasibility study, or the feasibility study or the mining report, is economic extraction justified? If not, the coal resource shall be reported as a **pre-feasibility coal resource** or a **feasibility coal resource**, depending on the level of economic study.

f) If there is a defined mine plan and economic extraction is justified, then report as a **probable coal reserve** or a **proven coal reserve**, depending on a combination of both the level of confidence in the associated coal resource and the relevant modifying factors.

NOTE No equivalent coal resources are reported for any coal reserves.

5.5 Coal resource and reserve blocks

5.5.1 The coal resources and coal reserves shall be subdivided into logical blocks based on the geometry of the coal deposit and the mineral rights holding. The coal blocks for which the mineral rights are held shall be reported on a coalfield basis and a seam basis. Each coal seam needs to be unique within each block and shall be reported on separately. The main coal seam name, as well as any local coal seam name (for example No. 1, No. 2, No. 4, No. 5, Gus, Alfred, amongst others) shall be entered, to allow for regional correlation.

5.5.2 The blocks shall be coordinated with respect to a recognized survey projection (either latitude and longitude, or coordinates on the LO Cape Datum or the WGS84 Hartebeesthoek Datum survey system). A map(s) at a scale of 1:50 000, and if required, on an alternative scale, to show the required detail, should be attached to show the extent of the relevant economic coal seams and the locations of the relevant coal resource and coal reserve blocks.

5.5.3 In the case of mines and project areas, a composite block that covers a number of farm portions or mineral right areas can be used for reporting purposes on a seam-by-seam basis.

5.6 Coal reserve exploitation and reconciliation

5.6.1 The amount of coal previously mined from the property and the associated product(s) sales up to the end of the previous financial or calendar year shall be stated.

5.6.2 The budgeted ROM tonnage and product sales shall be stated for the current financial year or calendar year. If the financial year reporting period is chosen, then the start of the reporting period shall be stated.

5.6.3 The amount of sterilized coal resources (see 3.24) that occur within or adjacent to the relevant coal resource blocks shall be quantified separately and shall be separated into losses associated with surface structures, urban development, governmental, legal or environmental reasons, amongst others.

5.7 Seam characteristics

5.7.1 The coal seam or subseam thickness parameters, with any relevant thickness cut-off values and coal quality cut-off values, shall be stated for the in situ coal resources on a full seam basis. It is recommended that a minimum seam thickness of 0,5 m be used to define the maximum lateral extent of a coal deposit.

5.7.2 The coal resource blocks may be subdivided into relevant depth increments and the range in depth to the top of the coal seam should be reported. The interburden or parting thickness between coal seams or subseams shall be reported.

5.7.3 The practical mineable thickness with associated coal thickness, parting and coal quality cut-off values shall be stated for the mineable in situ coal reserves.

5.8 In situ coal resource raw coal quality

The raw coal quality parameters shall be reported for each coal seam or coal subseam in each block for the in situ coal resources for the range of applicable coal properties on an uncontaminated basis. No saleable products shall be stated for in situ coal resources.

5.9 Run of mine coal reserve coal quality

The ROM coal reserve coal quality may be reported. In the case where the coal is sold as a raw coal product, the ROM coal quality shall also be reported as a saleable coal reserve quality.

5.10 Saleable coal reserve coal quality

The following particulars shall be reported:

a) the saleable coal reserve products, whether for run of mine coal or beneficiated coal products;

b) the size range of the individual products;

c) the practical product yield stated for each product, on an air-dried basis;

d) the coal quality parameters for each mineable coal seam in each block;

e) the saleable coal reserves for the range of applicable coal properties on a wet contaminated basis in the case of ROM products, or on a product basis for beneficiated coal; and

f) the coal quality parameters for each product for each coal seam in each block separately.

5.11 Coal discards

5.11.1 Coal discards in dumps and stockpiles (excluding production buffer stockpiles) or both, shall be included as a coal resource if the calorific value exceeds 12 MJ/kg, even if there is no present reasonable and realistic prospect for exploitation. The resource tonnage shall be quoted on an in situ basis and the coal quality shall be reported on an air-dried moisture basis.

5.11.2 Discards and reject coal that will be produced as part of future production from planned mining and coal-processing operations shall be reported as a coal resource if the calorific value exceeds 12 MJ/kg, even if there is no present reasonable and realistic prospect for economic utilization. This tonnage shall be reported in the ”as arising discards” product line. The resource tonnage shall be quoted on an in situ basis and the coal quality shall be reported on an air-dried moisture basis.

5.11.3 Coal discards in dumps and stockpiles shall only be included as a coal reserve if economic exploitation is justified and shall be quoted on a mineable in situ reserve, ROM and saleable basis. The coal quality of the coal discards defined as a coal reserve shall be stated for both the ROM coal and for the saleable product.

5.12 Obligations by information provider

5.12.1 Any coal company, coal mine or information provider who supplies information for the purpose of the National Coal Inventory shall submit all information under cover of a letter certifying the validity of the information, duly signed by a competent person (see 3.3 and the *SAMREC Code*, 4.3) and duly authorized thereto by the controlling company.

5.12.2 Once this certified or validated information is received from a coal company, coal mine or information provider by the National Coal Inventory, some information may have to be queried or clarified. If changed or amended information is then re-submitted, the coal company, coal mine or information provider shall re-submit the data under cover of a duly signed letter of validation.

6 Coal resource and coal reserve calculation and reporting

6.1 Introduction

This clause reviews industry's recommended best practice for the calculation and reporting of coal resources and coal reserves for both Securities Exchange and National Coal Inventory reporting.

Coal resources (see 3.25) are estimated from specific geological evidence and knowledge and are subdivided on the basis of the geological confidence in the estimate of the in situ coal into high, moderate and low confidence categories.

Coal reserves (see 3.31) are those coal resources with a moderate to high level of confidence that have been constrained by technical and economic modifying factors. In deposits that will be mined by underground methods, the extracted tonnage is usually a function of the depth below surface, surface constraints and the selected mining method. Where deposits will be mined by opencast methods, the technical limitations, such as geotechnical aspects, spoiled pile stability or mining equipment limitations are often less significant than the economic factors. The opencast depth limit is specific to a particular deposit type and is usually a function of the mining method and geotechnical constraints. The mineable limit of deposits that can be mined by opencast methods, will often be at the depth at which underground mining becomes more economical.

6.2 Coal resource estimation confidence

6.2.1 The classification of coal resources into reconnaissance, inferred, indicated and measured categories is a function of increasing geological confidence in the estimate based on the density of points of observation, the physical continuity of the coal seams, the distribution and the reliability of the coal sampling data, the coal quality continuity, the reliability of the geological model and the evaluation method. Factors that contribute to the uncertainty in coal resource estimation include the key constraints used to construct the geological model, the seam thickness variation within the geological model and the coal quality distribution within the geological model.

6.2.2 The categories of coal resources are based on the level of confidence in the estimate of both the tonnage and the coal quality. Reconnaissance coal resources and inferred coal resources are at a low level of confidence, indicated coal resources are at a moderate level of confidence, while measured coal resources are at a high level of confidence.

6.3 Coal resource reporting categories

6.3.1 Introduction to reporting categories

6.3.1.1 Coal resources are subdivided into reconnaissance, inferred, indicated, measured, pre-feasibility and feasibility categories and are reported on a gross in situ (see 3.26), in situ (see 3.27) and mineable in situ reporting basis (see 3.29) (see table 2).

6.3.1.2 In the case of gross in situ and in situ coal resources it is permissible to subdivide the full coal seam into defined subseams and quote them separately, such that the sum of the individual subseam coal resources equals the full seam coal resource. The coal resource can be subdivided into different thickness and depth categories.

6.3.1.3 The in situ coal resource category is a subset of the gross in situ coal resource category and is calculated by applying the appropriate geological loss factors. The mineable in situ coal resource category is a subset of the in situ coal resource category in that it may refer to a different coal seam thickness (theoretical mineable seam thickness versus full seam thickness and might refer to a smaller block area). The basis used for the reporting of a coal resource shall be stated (for example, gross in situ, in situ, mineable in situ).

Table 2 — Qualifications for coal resource reporting categories

1	2
Coal resource category	**Qualification** [a]
Gross in situ coal resource	Full seam thickness
In situ coal resource	Full seam thickness, geological loss factors
Mineable in situ coal resource	Theoretical mineable seam thickness, geological loss factors, depth cut-off, strip ratio cut-off for opencastable blocks
[a] All coal resources shall comply with the minimum seam thickness cut-off and the minimum coal quality, which define a coal seam or composite coal seam and any other coal quality cut-off criteria.	

6.3.1.4 The basis of coal resource statements in terms of borehole spacing, seam structure, coal seam thickness cut-offs, physical coal seam continuity, relevant coal quality cut-offs, coal quality continuity, coal quality variability, computer-modelling techniques and estimation confidence shall be stated.

6.3.2 Coal occurrence

A coal occurrence (see 3.10) shall not be included in a coal resource estimate. Tonnage figures for a coal occurrence shall not be quoted for reporting purposes.

6.3.3 Reconnaissance coal resource

6.3.3.1 A reconnaissance coal resource (see 3.25.1) is quantified by a minimum of one cored borehole with coal quality data per 400 ha (approximately 2 km spacing) for multiple seam deposit types, while for thick interbedded seam deposit types a reconnaissance coal resource is quantified by a minimum of one cored borehole with coal quality data per 1 600 ha (approximately 4 km spacing) (see figure 6).

6.3.3.2 Although the minimum borehole density allows for a reasonable estimate of the coal deposit with a low level of confidence in most situations, this does not necessarily hold true for sedimentologically and structurally complex areas. The competent person shall make the

judgement as to whether the physical continuity can be assumed, and state the basis of the decision. The available coal quality data shall include coal quality of economic interest. The tonnage of a reconnaissance coal resource with uncertain or unknown coal quality shall not be reported, since it represents a coal occurrence.

6.3.3.3 Tonnage and coal quality figures for reconnaissance coal resources are not quoted for Securities Exchange reporting purposes.

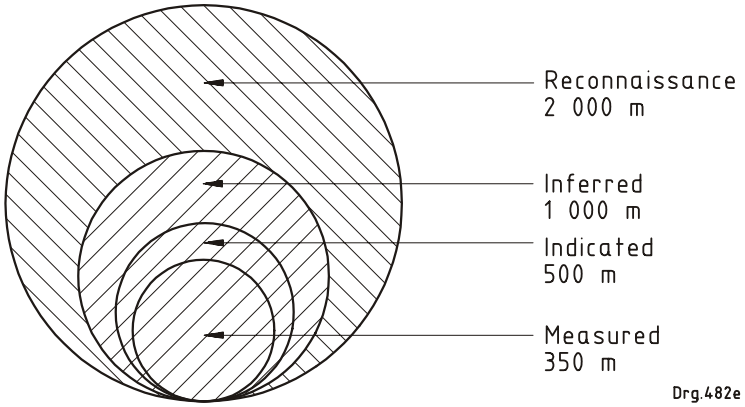


Figure 6(a) — Multiple seam deposit type coal resources
(< 50 % ash)

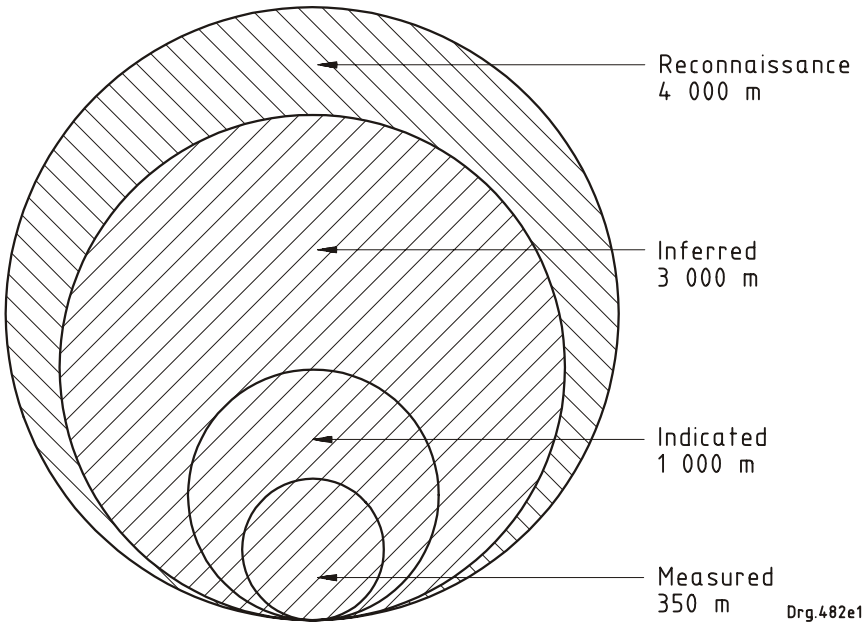


Figure 6(b) — Thick interbedded seam deposit type coal resources
(< 65 % ash)

Figure 6 — Coal resource: minimum borehole spacing — Schematic diagram to illustrate the minimum borehole spacing for each coal resource classification category for the various coal deposit types (the minimum distance between boreholes shown in metres)

6.3.3.4 Reconnaissance coal resources are reported on an in situ tonnage basis for National Coal Inventory purposes, where the coal quality of the full coal seam is of economic interest and can be subdivided on incremental thickness and incremental depth bases.

6.3.4 Inferred coal resource

6.3.4.1 An inferred coal resource (see 3.25.2) is quantified by a minimum of one cored borehole with coal quality data per 100 ha (approximately 1 km spacing) for multiple seam deposit types, while for thick interbedded seam deposit types an inferred coal resource is quantified by a minimum of one cored borehole with coal quality data per 1 000 ha (approximately 3 km spacing) (see figure 6).

6.3.4.2 Although the minimum borehole density allows for a reasonable estimate of the coal deposit with a low level of confidence in most situations, this does not necessarily hold true for sedimentologically and structurally complex areas. The competent person shall make the judgement as to whether the physical continuity can be assumed, and state the basis of the decision.

6.3.4.3 Inferred coal resources shall comply with the criteria for reasonable and realistic prospects of economic extraction.

6.3.4.4 Tonnage and coal quality figures for inferred coal resources are not quoted for Securities Exchange reporting purposes.

6.3.4.5 Inferred coal resources are reported on an in situ tonnage basis for National Coal Inventory purposes, where the coal quality of the full coal seam is of economic interest and can be subdivided on an incremental thickness and incremental depth bases.

6.3.5 Indicated coal resource

6.3.5.1 An indicated coal resource (see 3.25.3) is quantified by a minimum of four cored boreholes with coal quality data per 100 ha (approximately 500 m spacing) for multiple seam deposit types, while for thick interbedded seam deposit types an indicated coal resource is quantified by a minimum of one cored borehole with coal quality data per 100 ha (approximately 1 km spacing) (see figure 6).

6.3.5.2 Although the minimum borehole density allows for a reasonable estimate of the coal resource with a moderate level of confidence in most situations, this will not necessarily hold true for sedimentologically and structurally complex areas and areas with significant variability in the coal quality. The competent person shall make the judgement as to whether the physical continuity is confirmed and whether coal quality continuity may be assumed, and state the basis of the decision.

6.3.5.3 Indicated coal resources shall comply with the criteria for reasonable and realistic prospects of economic extraction.

6.3.5.4 Tonnage and coal quality figures for indicated coal resources are quoted on an in situ tonnage basis for both Securities Exchange and National Coal Inventory reporting purposes, and can be subdivided on incremental thickness and incremental depth bases.

6.3.6 Measured coal resource

6.3.6.1 A measured coal resource (see 3.25.4) is quantified by a minimum of eight cored boreholes with coal quality data per 100 ha (approximately 350 m spacing) for all deposit types (see figure 6).

6.3.6.2 Although the minimum borehole density allows for a reasonable estimate of the coal resource with a high level of confidence in most situations, this does not necessarily hold true for sedimentologically and structurally complex areas and areas with significant variability in the coal quality. The competent person shall make the judgement as to whether the physical continuity and whether coal quality continuity is confirmed, and state the basis of the decision.

6.3.6.3 Measured coal resources shall comply with the criteria for reasonable and realistic prospects of economic extraction.

6.3.6.4 Tonnage and coal quality figures for measured coal resources are quoted on an in situ tonnage basis for both Securities Exchange and National Coal Inventory reporting purposes, and can be subdivided on incremental thickness and incremental depth bases.

6.3.7 Pre-feasibility coal resource

That part of an indicated coal resource and in some cases measured coal resource that has been shown, after a pre-feasibility study has been carried out, to be marginally economical (see 3.25.5). This coal resource category is only to be reported for National Coal Inventory purposes.

6.3.8 Feasibility coal resource

That part of a measured coal resource that has been shown, after a feasibility study has been carried out, to be not economically mineable (see 3.25.6). This coal resource category is only to be reported for National Coal Inventory purposes.

6.4 Coal reserve reporting categories

6.4.1 Introduction

6.4.1.1 Coal reserves (see 3.31) are calculated from mineable in situ coal resources only after selecting a mining method for which an economic mine plan had been defined. For reporting purposes, coal reserves may be categorized into mineable in situ coal reserves, ROM coal reserves and saleable coal reserves. Figure 7 illustrates the sequential calculation of coal resources and coal reserves from gross in situ tonnes to saleable tonnes showing the application of the key resource and reserve discount factors and cut-off criteria. For calculation purposes the extractable coal reserve category can be reported as an intermediate step between the mineable in situ coal reserve and ROM coal reserve categories (see table 3).

6.4.1.2 The mining method shall be stated and the coal reserves shall be subdivided into separate underground and opencast categories. The coal reserves may be subdivided into different thickness categories and depth categories and in the case of opencast mines the coal reserve boundary can be defined by a strip ratio cut-off.

Table 3 — Qualifications for coal reserve reporting categories

1	2
Coal reserve category	**Qualification (incremental)**
Mineable in situ coal reserve (theoretical mining height) (not reported)	Theoretical mining height, mine layout losses, depth cut-off, strip ratio cut-off in opencast mines
Mineable in situ coal reserve (practical mining height)	Practical mining height, dilution, minimum and maximum mining height cut-offs
Extractable coal reserve (not reported)	Mining layout extraction factors
Run of mine coal reserve	Contamination, mining recovery efficiency factor, ROM moisture correction factor
Saleable coal reserve	Practical product yield, saleable product moisture correction factor

6.4.1.3 Each subsequent reporting category is a subset of the previous category and is calculated by applying the appropriate additional adjustment or discount factors.

6.4.1.4 The basis of coal reserve statements in terms of borehole spacing, seam structure, coal seam thickness cut-offs, physical coal seam continuity, relevant coal quality cut-offs, coal quality continuity, coal quality variability, computer-modelling techniques and estimation confidence shall be stated. In addition, the key geotechnical, mining, coal processing, economic, marketing, environmental, legal and governmental modification factors shall be stated.

6.4.1.5 As a guide, the accuracy and confidence of opencast and underground coal reserve estimates increase with each evaluation phase. For pre-feasibility studies ± 15 % to 25 % confidence is considered acceptable, for detailed feasibility studies ± 10 % to 15 % is considered acceptable, while during the operational phase the actual production tonnage and coal quality are generally within ± 5 % of the predicted coal reserves. Owing to the nature of the coal quality requirements, the confidence in the coal quality estimates are often required to be significantly higher than the confidence in the tonnage estimates and coal quality estimates may be required to be within ± 1 % to 3 % of the average actual target coal quality.

6.4.2 Probable coal reserve

A probable coal reserve (see 3.31.1) is the economically mineable material derived from a measured or indicated coal resource, or both. A probable coal reserve shall be demonstrated to be economically mineable by at least a pre-feasibility study.

6.4.3 Proven coal reserve

A proven coal reserve (see 3.31.2) is the economically mineable material derived from a measured coal resource. A proven coal reserve shall be demonstrated to be economically mineable by a feasibility study or by actual mining activity.

6.5 Calculation of coal resources and coal reserves

6.5.1 General

A systematic approach to the calculation of coal resources and coal reserves is necessary in order to have consistency in reporting tonnages and coal qualities for coal resources and coal reserves for both Securities Exchange and National Coal Inventory reporting, and for comparison between companies.

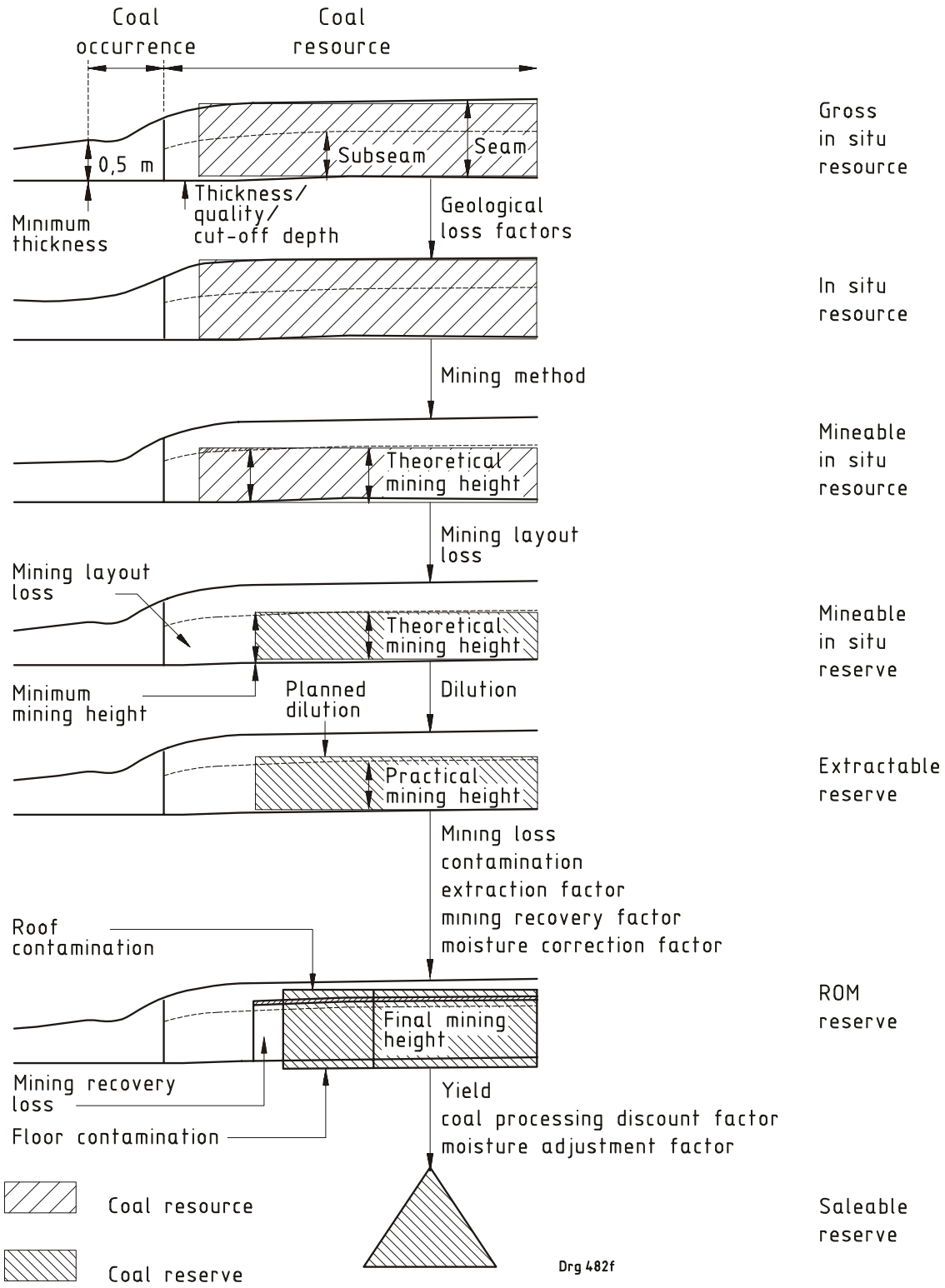


Figure 7 —Diagram that illustrates the sequential calculation of coal resources and coal reserves from gross in situ tonnes (as modelled) to saleable tonnes by the application of key cut-off criteria and discount factors associated with modifying factors

The methodology described in 6.5.2 to 6.5.7 represents the recommended best practice for the incremental calculation of coal resources and coal reserves. If the methodology adopted in the calculations undertaken by the competent person does not conform to the proposed best practice, the variances in the methodology applied shall be documented.

NOTE A list of all the variables used in the calculations is given in annex F.

6.5.2 Calculation of coal resources

6.5.2.1 Coal resource block definition

The presence of any physical, geographical and statutory constraints that will define the practical limits of the coal resource shall be defined, including but not limited to mineral right boundaries, statutory mining limits along river courses and statutory barrier pillars between adjacent properties, amongst others.

The blocks shall be coordinated with respect to a recognized survey projection (either latitude and longitude, or coordinates on the LO Cape Datum or the WGS84 Hartebeesthoek Datum survey system) and plotted on a map showing the requisite amount of detail.

6.5.2.2 Coal resource cut-off parameters

6.5.2.2.1 Physical cut-offs

A statement shall be made describing the minimum thickness cut-off used to define the extent of the full coal seam, including the sub-outcrop limit or the limit of weathering, or both. In the case of mineable in situ resources, the minimum and maximum theoretical mining height cut-offs shall be stated.

Any major geological features that limit or subdivide the coal resource, such as major faults, dolerite intrusions, devolatilized or burnt areas, should be positioned on a map and, should they pose an impediment to future exploitation, shall be discussed in detail. Large areas of burnt coal and devolatilized coal shall not be included in coal resource estimates.

The coal resources should be reported on selected depth increments, particularly with respect to the boundary between potential opencast mineable areas and potential underground mineable areas. The cut-off depth or strip ratio cut-off in respect of opencast mineable areas shall be stated. The minimum depth to mining roof in respect of underground mineable areas shall be reported. If the coal thickness shows significant variability, the coal resources should also be reported on selected thickness increments.

The thickness cut-off criteria for gross in situ coal resources and in situ coal resources can be described by the following inequality:

$$th_{\text{in situ, uc}} > th_{\text{cut-off, in situ, uc}}$$

where

$th_{\text{in situ, uc}}$ is the in situ uncontaminated thickness, in metres (m).

$th_{\text{cut-off, in situ, uc}}$ is the in situ uncontaminated thickness cut-off value, in metres (m);

The additional thickness cut-off criteria for mineable in situ coal resources can be described by either of the following inequalities:

$th_{\text{maximum mh cut-off}} > th_{\text{mineable in situ, uc}} > th_{\text{minimum mh cut-off}}$,

or

$th_{\text{maximum mh cut-off}} > th_{\text{mh theor}} > th_{\text{minimum mh cut-off}}$

where

$th_{\text{maximum mh cut-off}}$ is the maximum mining height cut-off, in metres (m).

$th_{\text{mineable in situ, uc}}$ is the in situ mineable uncontaminated thickness, in metres (m);

$th_{\text{minimum mh cut-off}}$ is the minimum mining height cut-off, in metres (m);

$th_{\text{mh theor}}$ is the vertical theoretical mining height within the resource block, in metres.

The depth cut-off criteria for gross in situ coal resources and in situ coal resources can be described by the following inequality:

$\text{depth} \leq \text{depth}_{\text{cut-off}}$

and the strip ratio cut-off criteria for gross in situ coal resources and in situ coal resources can be described by the following inequality:

$sr_{\text{inc}} \leq sr_{\text{cut-off}}$

or

$th_{\text{overburden}} / (th_{\text{coal}} \times rd_{\text{coal}}) \leq sr_{\text{cut-off}}$

where

$\text{depth}_{\text{cut-off}}$ is the maximum net overburden depth cut-off to the top of the lowermost mineable coal seam, in metres (m);

sr_{inc} is the incremental strip ratio of overburden volume to coal tonnes (in situ, run of mine, or sales) in the mineable coal seam(s), in bank cubic metres ((bcm)/ton);

$sr_{\text{cut-off}}$ is the incremental strip ratio cut-off of the net overburden volume to net coal thickness (in situ, run of mine, or sales) in the mineable coal seam(s) (bank cubic metres (bcm)/ton);

$th_{\text{overburden}}$ is the net overburden thickness above the lowermost mineable coal seam, in metres (m);

th_{coal} is the net thickness of the mineable coal seam(s) (after the relevant discount factors have been applied), in metres (m);

rd_{coal} is the density of the mineable coal seam(s), in grams per cubic centimetres (g/cm^3).

The average strip ratio shall be stated for all coal resource blocks that can potentially be mined by opencast method.

6.5.2.2.2 Coal quality cut-offs

The coal quality cut-off parameters, if different from the standard definition of coal (see 3.5) and from the definition of composite coal seam (see 3.7), shall be defined.

The coal quality cut-off for coal resources can be described by the following inequalities:

$Q_{\text{cut-off, coal, uc}}$ < 50 % or < 65 % ash (dry basis), depending on the coal deposit type

and

$Q_{\text{in situ}}$ < or > $Q_{\text{cut-off, raw, uc}}$, depending on the particular raw coal quality variable(s)

or

$Q_{\text{wash, in situ}}$ < or > $Q_{\text{cut-off, wash, uc}}$

depending on the particular coal quality washability variable, the typically theoretical yield or the practical yield.

where

$Q_{\text{cut-off, coal, uc}}$ is the uncontaminated raw coal quality used in the standard definition of a coal seam or a composite coal seam, depending on the coal deposit type, in percentage;

$Q_{\text{in situ}}$ is the in situ coal quality, uncontaminated, in percentage;

$Q_{\text{cut-off, raw, uc}}$ is the raw coal quality cut-off value, uncontaminated but including dilution, in percentage;

$Q_{\text{wash, in situ}}$ is the coal washability quality, uncontaminated, but including dilution, in percentage;

$Q_{\text{cut-off, wash uc}}$ is the coal washability quality, uncontaminated cut-off value, in percentage.

6.5.2.3 Coal volume

6.5.2.3.1 General

The coal volume shall be calculated by using the horizontal area and the apparent seam thickness (see 3.18.1), or the inclined area and the true seam thickness (see 3.18.2). In flat lying or shallowly dipping coal deposits (say less than a 5° average dip), the true seam thickness may be assumed to be equal to the apparent thickness, and thus the horizontal area is equal to the inclined area.

6.5.2.3.2 Coal volume (from apparent thickness)

The coal volume V is the product of the apparent thickness and the horizontal area:

$$V = th_{\text{app}} \times A_{\text{horz}} \quad (1)$$

or

$$V = th_{\text{true}} / \text{COS}_{(\text{seam dip angle})} \times A_{\text{horz}} \quad (2)$$

where

V is the gross in situ coal volume (as modelled, assuming no previously mined areas), in cubic metres (m^3);

th_{app} is the apparent seam thickness (in the vertical plane), in metres (m);

A_{horz} is the horizontal area of the resource block, in metres squared (m^2);

th_{true} is the true seam thickness (at right angles to the dip of the seam), in metres (m);

$COS_{(seam\ dip\ angle)}$ is the cosine of the average seam dip angle;

$_{seam\ dip\ angle}$ is the average dip angle of the coal seam.

6.5.2.3.3 Coal volume (from true thickness)

The coal volume V is the product of the true thickness and the inclined area (where the average dip exceeds a 5° average dip):

$$V = th_{true} \times A_{incl} \quad (3)$$

or

$$V = th_{app} \times COS_{(seam\ dip\ angle)} \times A_{incl} \quad (4)$$

where

V is the gross in situ coal volume (as modelled, assuming no previously mined areas), in cubic metres (m^3);

th_{true} is the true seam thickness (at right angles to the dip of the seam), in metres (m);

A_{incl} is the inclined area of the resource block, in metres squared (m^2);

th_{app} is the apparent seam thickness (in the vertical plane), in metres (m);

$COS_{(seam\ dip\ angle)}$ is the cosine of the average seam dip angle.

6.5.2.4 Density of the coal seam

6.5.2.4.1 General

The density (see 3.20) of individual borehole coal samples shall be weighted on a thickness basis to obtain the average density of the coal seam (or parting) intersected in a borehole.

The averaged density values for each coal seam (or parting) intersection shall be weighted on a volumetric basis to obtain the average density of the coal seam (or parting) being modelled.

6.5.2.4.2 Air-dried density

Although the density should be correctly quoted on an in situ bed moisture basis, it is common practice to use the air-dried density on South African coal that has a relatively low in situ bed moisture content. The relationship between air-dried moisture content and in situ bed moisture content should be established before this assumption is made.

6.5.2.4.3 In situ bed moisture density

The density should be correctly quoted on an in situ bed moisture basis. The as analysed laboratory determined density shall be adjusted to the equivalent in situ bed moisture content using the Sanders and Preston methodology shown by the equation below:

$$rd_{\text{in situ}} = \frac{(rd_{\text{true density}} \times (100 - M_{\text{true density}}))}{(100 + rd_{\text{true density}} \times (M_{\text{in situ}} - M_{\text{true density}}) - M_{\text{in situ}})} \quad (5)$$

where

$rd_{\text{in situ}}$ is the in situ bed moisture density, in grams per cubic centimetres (g/cm^3);

$rd_{\text{true density}}$ is the true density of the coal as determined in the laboratory, in grams per cubic centimetres (g/cm^3);

$M_{\text{true density}}$ is the coal moisture content at which the true density is determined, in percentage (%);

$M_{\text{in situ}}$ is the in situ coal total moisture content as sampled (Mas) (or the in situ bed moisture (Mbm)), in percentage (%).

In the case where the air-dried moisture is used for the reporting of the in situ resources instead of the in situ bed moisture, the correct moisture content is the air-dried moisture (Madb), then:

$$rd_{\text{adb}} = \frac{(rd_{\text{true density}} \times (100 - M_{\text{true density}}))}{100 + rd_{\text{true density}} \times (M_{\text{adb}} - M_{\text{true density}}) - M_{\text{adb}})} \quad (5a)$$

where

rd_{adb} is the density on the air-dried moisture basis, in grams per cubic centimetres (g/cm^3);

$rd_{\text{true density}}$ is the true density of the coal as determined in the laboratory, in grams per cubic centimetres (g/cm^3);

$M_{\text{true density}}$ is the coal moisture content at which the true density is determined, in percentage (%);

M_{adb} is the coal air-dried moisture (Madb), in percentage (%).

In the case where the air-dried moisture is used for the reporting of the in situ resources instead of the in situ bed moisture and the density measurements are based on the particle density, then:

$$rd_{\text{adb}} = \frac{(rd_{\text{particle density}} \times (100 - M_{\text{particle density}}))}{(100 + rd_{\text{particle density}} \times (M_{\text{adb}} - M_{\text{particle density}}) - M_{\text{adb}})} \quad (5b)$$

or in the special case where the particle density equals the reporting air-dried moisture basis:

$$rd_{adb} = rd_{particle\ density} \quad (5c)$$

where

rd_{adb} is the density for reporting purposes on an air-dried moisture basis, in grams per cubic centimetres (g/cm^3);

$rd_{particle\ density}$ is the apparent relative density of the coal particle as determined in the laboratory, in grams per cubic centimetres (g/cm^3);

$M_{particle\ density}$ is the average coal moisture content at which the apparent relative density was determined, in percentage (%);

M_{adb} is the coal air-dried moisture, in percentage (%).

6.5.2.5 Raw coal quality

Determine the average raw coal quality of the coal seam or parting intersected in a borehole, using the raw coal quality parameters of individual samples weighted by the product of the thickness and density of each sample. Although the raw coal quality parameters should be correctly quoted on an in situ bed moisture basis, it is common practice to quote the raw coal quality on an air-dried basis for South African coal with relatively low in situ bed moisture content.

The averaged raw coal quality parameters for each sampled seam intersection shall be weighted on a tonnage basis (calculated from the product of the volume and the density) to obtain the average raw coal quality parameters for the coal seam or parting being modelled. In the case where the raw coal quality is determined on an air-dried basis, the density weighing factors shall also be on an air-dried basis, while if the raw coal quality is determined on an in situ bed moisture basis, the density shall also be on an in situ bed moisture basis.

6.5.2.6 Gross in situ coal resource tonnage

The gross in situ coal resource tonnage (*GTIS*) is the calculated product of the coal volume and the density. The gross in situ tonnage shall be quoted on an air-dried basis if the density is quoted on an air-dried basis or shall be quoted on an in situ bed moisture basis if the density is quoted on an in situ bed moisture basis. The density shall be at the same moisture content at which the full seam is reported. The moisture content of the full seam shall be reported. The *GTIS* can be calculated as follows:

$$GTIS = V \times rd \quad (6)$$

where

GTIS is the gross in situ coal resource tonnage (as modelled, assuming no previously mined areas), (t);

V is the gross in situ coal volume (as modelled, assuming no previously mined areas), in cubic metres (m^3); (see equation (1, 2 or 3);

rd is the density (in situ or air-dried basis), in grams per cubic centimetres (g/cm^3).

The coal thickness cut-off and coal quality cut-off parameters shall be applied before calculating the gross in situ tonnage from equation 6, such that the following conditions, applying to the relevant cut-offs, are complied with:

$th_{\text{gross in situ, uc}} > th_{\text{cut-off, gross in situ, uc}}$

and

$Q_{\text{gross in situ, uc}} < Q_{\text{cut-off, coal, uc}}$ < 50 % or < 65 % ash (dry basis), depending on the coal deposit type

and

$Q_{\text{raw, uc}}$ < or > $Q_{\text{cut-off, raw, uc}}$, depending on the particular raw coal quality variable(s)

or

$Q_{\text{wash, uc}}$ < or > $Q_{\text{cut-off, wash, uc}}$, depending on the particular coal quality washability variable, typically theoretical or practical yield

where

$th_{gross\ \text{in situ, uc}}$ is the in situ uncontaminated thickness, in metres (m);

$th_{\text{cut-off, gross in situ, uc}}$ is the minimum gross in situ uncontaminated thickness cut-off value, in metres (m);

$Q_{\text{gross in situ, uc}}$ is the gross in situ coal quality, uncontaminated (typically expressed in percentage (%));

$Q_{\text{cut-off, coal, uc}}$ is the uncontaminated raw coal quality constituent (i.e. ash %) used in the standard definition of coal or composite coal seam, depending on the coal deposit type, in percentage (%);

$Q_{\text{raw, uc}}$ is the raw coal quality, uncontaminated but including dilution (typically expressed in percentage (%));

$Q_{\text{cut-off, raw, uc}}$ is the raw coal quality, uncontaminated cut-off value (typically expressed in percentage (%));

$Q_{\text{wash, uc}}$ is the coal washability quality, uncontaminated but including dilution (typically expressed in percentage (%));

$Q_{\text{cut-off, wash, uc}}$ is the coal washability quality, uncontaminated cut-off value (typically expressed in percentage (%)).

6.5.2.7 Gross in situ coal resource quality

The coal quality shall be reported either on an in situ bed moisture basis or on an air-dried basis for the relevant coal quality properties. The gross in situ coal resource coal quality values may be quoted on either a full seam basis or on a subseam basis, provided the coal qualities are quoted for all the subseams.

The coal quality reporting units depend on the particular coal quality constituent being evaluated, although in a majority of cases it is on a percentage (%) basis. A list of coal quality constituents and the relevant reporting units are presented in tables G.1 and G.2.

6.5.2.8 Previously mined areas

6.5.2.8.1 General

Where the coal seams have been previously mined by underground mining methods and it is anticipated that these pre-mined areas will be re-mined, the coal resource tonnage estimates shall be adjusted for the volume or tonnage of coal previously mined. In order to estimate the volume of coal remaining, an estimate of both the vertical thickness and the area of the seam that was mined and the resultant proportion of the resource contained in the remaining pillars shall be made.

The gross in situ coal resource tonnage (see 3.26) shall be discounted by the tonnage of coal that was previously extracted from old mine workings to obtain the gross in situ resource tonnage remaining after previous mining. An estimate of the tonnage extracted from old mine workings is calculated using either the volume extracted, percentage (with an assumed known density), or the actual tonnage extracted, percentage (if the historical production statistics are known).

6.5.2.8.2 Volume extracted from previously mined areas

The volume extracted from previously mined areas can be calculated as follows:

$$V_{\text{prev mined}} = A_{\text{horz prev mined}} \times th_{\text{mh prev mined}} \quad (7)$$

where

$V_{\text{prev mined}}$ is the volume of coal extracted from previously mined areas (in the area(s) that are going to be re-mined), in cubic metres (m^3).

$A_{\text{horz prev mined}}$ is the net area extracted from previously mined area(s) (not total area), in metres squared (m^2);

$th_{\text{mh prev mined}}$ is the average thickness of coal mined in the previously mined area(s), in metres (m);

6.5.2.8.3 Tonnage extracted from previously mined areas

The tonnage extracted from previously mined areas can be calculated as follows:

$$T_{\text{prev mined}} = A_{\text{horz prev mined}} \times th_{\text{mh prev mined}} \times rd_{\text{prev mined}} \quad (8)$$

or

$$T_{\text{prev mined}} = V_{\text{prev mined}} \times rd_{\text{prev mined}} \quad (9)$$

where

$T_{\text{prev mined}}$ is the tonnage of coal extracted from previously mined areas (in the areas that are going to be re-mined), (t);

$A_{\text{horz prev mined}}$ is the net area extracted from previously mined area(s) (not total area), in metres squared (m^2);

$th_{\text{mh prev mined}}$ is the average thickness of coal mined in the previously mined area(s), in metres (m);

$rd_{\text{prev mined}}$ is the density of the previously mined coal (in situ or air-dried) (not the bulk density), in grams per cubic centimetres (g/cm^3).

$V_{\text{prev mined}}$ is the volume of coal extracted from previously mined areas (in areas that are going to be re-mined), in cubic metres (m^3);

The moisture content of the previously mined coal shall be reported (in situ or air-dried basis). The density (in situ or air-dried) of the previously mined coal shall be reported at the same moisture content and on the same basis as the previously mined coal moisture content.

6.5.2.8.4 Tonnage percentage extracted from previously mined areas

The tonnage percentage extracted from previously mined areas can be calculated as follows:

$$T_{\text{extr\%}} = A_{\text{horz prev mined}} \times th_{\text{mh prev mined}} \times rd_{\text{prev mined}} / GTIS \quad (10)$$

or

$$T_{\text{extr\%}} = T_{\text{prev mined}} / GTIS \times 100 \quad (11)$$

where

$T_{\text{extr\%}}$ is the tonnage percentage extracted from previously mined areas, in percentage (%);

$A_{\text{horz prev mined}}$ is the net area extracted from previously mined area(s) (not total area), in metres squared (m^2);

$th_{\text{mh prev mined}}$ is the average thickness of coal mined in the previously mined area(s), in metres (m);

$rd_{\text{prev mined}}$ is the density of the previously mined coal, in grams per cubic centimetres (g/cm^3);

$GTIS$ is the gross in situ coal resource tonnage (as modelled, assuming no previously mined areas), (t);

$T_{\text{prev mined}}$ is the tonnage of coal extracted from previously mined areas (in the area(s) that are going to be re-mined), (t).

6.5.2.8.5 Gross in situ resource tonnage that remained after previous mining

The gross in situ coal resource tonnage that remained after accounting for previously mined areas within the coal resource block can be calculated as follows:

$$GTIS_{\text{remain}} = GTIS - T_{\text{prev mined}} \quad (12)$$

or

$$GTIS_{\text{remain}} = GTIS \times (1 - T_{\text{extr\%}}/100) \quad (13)$$

where

$GTIS_{remain}$ is the remaining gross in situ coal resource tonnage (as modelled) after accounting for old mine workings, (t);

$GTIS$ is the gross in situ coal resource tonnage (as modelled, assuming no previously mined areas), (t);

$T_{prev\ mined}$ is the tonnage of coal extracted from previously mined areas (in the area(s) that are going to be re-mined), (t);

$T_{extr\%}$ is the tonnage percentage extracted from previously mined areas, in percentage (%).

6.5.2.8.6 Gross in situ coal quality that remained after previous mining

6.5.2.8.6.1 Coal quality

Cognizance should also be taken of the coal quality of the remaining coal if the mined-out section mining height in the previously mined areas was not mined to the proposed new mining height. The coal seam should be split in the geological model to accommodate the mined-out section as a separate subseam(s) to enable an estimate of the coal quality in the remaining pillar coal and the coal quality of the remaining roof coal to be made separately or, if this is not possible, the assumptions used shall be qualified.

6.5.2.8.6.2 Moisture content, density and other coal quality variables

The moisture content, density and other coal quality variables in the tonnage that remained after the previous mining shall be calculated as the difference between the relevant variable of gross tonnes in situ (as modelled, assuming no previously mined areas) and that of the tonnes extracted from the previously mined areas. This calculation can be based on the actual qualities mined (if the historical records exist) or by modelling the section mined and estimating the moisture content, density and other coal quality variables from the borehole data. The moisture content, density and other coal quality variables can be calculated as follows:

$$M_{remain} = (M_{in\ situ} \times GTIS - M_{prev\ mined} \times T_{prev\ mined}) / (GTIS - T_{prev\ mined}) \quad (14)$$

$$rd_{remain} = (GTIS - T_{prev\ mined}) / (V - V_{prev\ mined}) \quad (15)$$

$$Q_{remain} = (Q_{in\ situ} \times GTIS - Q_{prev\ mined} \times T_{prev\ mined}) / (GTIS - T_{prev\ mined}) \quad (16)$$

where

M_{remain} is the moisture content (in situ or air-dried) of the remaining coal, in percentage (%);

$M_{in\ situ}$ is the moisture content (in situ or air-dried) of the in situ coal, in percentage (%);

$GTIS$ is the gross in situ coal resource tonnage (as modelled, assuming no previously mined areas), (t);

$M_{prev\ mined}$ is the moisture content (in situ or air-dried) of the previously mined coal, in percentage (%);

$T_{\text{prev mined}}$ is the tonnage of coal mined from previously mined areas (in the area(s) that are going to be re-mined), (t);

rd_{remain} is the density of the remaining coal, in grams per cubic centimetres (g/cm^3);

rd is the density (in situ or air-dried basis), in grams per cubic centimetres (g/cm^3);

V is the gross in situ coal volume (as modelled, assuming no previously mined areas), in cubic metres (m^3);

$V_{\text{prev mined}}$ is the volume of coal extracted from previously mined areas (in area(s) that are going to be re-mined), in cubic metres (m^3) (derived from equation 9);

Q_{remain} is the coal quality variable (in situ or air-dried) of the remaining coal, in percentage (%);

$Q_{\text{in situ}}$ is the coal quality variable (in situ or air-dried) of the in situ coal, in percentage (%);

$Q_{\text{prev mined}}$ is the coal quality variable (in situ or air-dried) of the previously mined coal, in percentage (%).

6.5.2.8.7 Gross in situ coal resource tonnage (theoretical mining height)

The gross in situ coal resource tonnage at the theoretical mining height is the calculated product of the area, theoretical mining height and the density, minus the tonnage extracted from previously mined areas, using equations 17,18 and 19. The gross in situ tonnage shall be quoted on an air-dried basis if the density is quoted on an air-dried basis or shall be quoted on an in situ basis if the density is quoted on an in situ bed basis.

The physical cut-off and coal quality cut-off parameters shall be applied before the gross in situ tonnage is calculated (see 6.5.2.2.).

$$GTIS_{\text{mh theor}} = A_{\text{horz}} \times th_{\text{mh theor}} \times rd_{\text{mh theor}} \quad (17)$$

or

$$GTIS_{\text{mh theor remain}} = A_{\text{horz}} \times th_{\text{mh theor}} \times rd_{\text{mh theor}} - T_{\text{prev mined}} \quad (18)$$

in the case where there are previously mined areas

or

$$GTIS_{\text{mh theor remain}} = GTIS_{\text{mh theor}} - T_{\text{prev mined}} \quad (19)$$

in the case where there are previously mined areas

where

$GTIS_{\text{mh theor}}$ is the gross in situ coal resource tonnage at the theoretical mining height within the resource block or the mine plan, (t).

A_{horz} is the horizontal area of the resource block, in metres squared (m^2);

$th_{\text{mh theor}}$ is the vertical theoretical mining height within the resource block, in metres (m);

$rd_{\text{mh theor}}$ is the theoretical mining height density, in grams per cubic centimetres (g/cm^3);

$GTIS_{\text{mh theor remain}}$ is the remaining gross in situ coal resource tonnage at the theoretical mining height within the resource block or the mine plan after accounting for old mine workings, (t);

$T_{\text{prev mined}}$ is the tonnage of coal extracted from previously mined areas (in areas that are going to be re-mined), (t).

6.5.3 In situ coal resources

6.5.3.1 In situ coal resource tonnage (for reporting purposes)

The in situ coal resource tonnage is calculated from the gross in situ tonnage by applying the physical geological loss factor and model estimation error geological loss factor using equations 20, 21 or 22 below. The in situ coal resource tonnage shall be quoted on an in situ basis or on an air-dried basis.

The moisture content of the in situ coal shall be reported (in situ or air-dried basis). The density (in situ or air-dried basis) of the in situ coal shall be reported at the same moisture content and on the same basis as the in situ coal moisture content.

The relevant physical cut-offs and coal quality cut-off parameters shall be applied before the in situ tonnage (see 6.5.2.2.) is calculated.

$$TTIS_{\text{resource}} = GTIS \times (1 - GL_p/100) \times (1 - GL_m/100) \quad (20)$$

or

$$TTIS_{\text{resource}} = (GTIS - T_{\text{prev mined}}) \times (1 - GL_p/100) \times (1 - GL_m/100) \quad (21)$$

in the case where there are previously mined *areas*,

or

$$TTIS_{\text{resource}} = GTIS_{\text{remain}} \times (1 - GL_p/100) \times (1 - GL_m/100) \quad (22)$$

in the case where there are previously mined areas,

where

$TTIS_{\text{resource}}$ is the total in situ coal resource tonnage (t);

$GTIS$ is the gross in situ coal resource tonnage (as modelled, assuming no previously mined areas), (t);

GL_p is the physical geological loss percentage (%);

GL_m is the geological model estimation error percentage (%)

$T_{\text{prev mined}}$ is the tonnage of coal mined from previously mined areas (in the area(s) that are going to be re-mined), (t);

$GTIS_{\text{remain}}$ is the remaining gross in situ coal resource tonnage (as modelled) after accounting for previously mined areas, (t);

6.5.3.2 In situ coal resource coal quality

The in situ raw coal quality shall be quoted either on an in situ basis or on an air-dried basis for the relevant coal quality properties. The in situ coal resource coal quality values may be quoted on either a full seam basis or on a subseam basis, provided coal qualities are quoted for all the subseams.

The theoretical product yield and associated product qualities may be quoted for the coal seams or subseams, if applicable.

6.5.4 Mineable in situ coal resources

6.5.4.1 Mineable in situ coal resources (for reporting purposes)

Mineable in situ coal resources are based on the selected theoretical mining height (see 3.28) within the coal resource block and can be calculated from equations 23, 24 or 25, which are derived by the application of the geological loss factors to the gross tonnes in situ at the theoretical mining height (see 6.5.2.8.7). The moisture content of the mineable in situ coal shall be reported on an in situ basis or on an air-dried basis. The density on an in situ or on an air-dried basis, of the mineable in situ coal shall be reported at the same moisture content and on the same basis as the mineable in situ coal moisture content.

The mining method, the minimum mineable thickness cut-off and maximum mineable thickness cut-off shall be quoted for the selected mining method (see 6.5.2.2).

$$MTIS_{\text{resource mh theor}} = A_{\text{horz}} \times th_{\text{mh theor}} \times rd_{\text{mh theor}} \times (1 - GL_p/100) \times (1 - GL_m/100) \quad (23)$$

or

$$MTIS_{\text{resource mh theor}} = (A_{\text{horz}} \times th_{\text{mh theor}} \times rd_{\text{mh theor}} - T_{\text{prev mined}}) \times (1 - GL_p/100) \times (1 - GL_m/100)$$

in the case where there are previously mined areas (24)

or

$$MTIS_{\text{resource mh theor}} = GTIS_{\text{mh theor remain}} \times (1 - GL_p/100) \times (1 - GL_m/100) \quad (25)$$

in the case where there are previously mined areas

where

$MTIS_{\text{resource mh theor}}$ is the mineable in situ coal reserve tonnage at the theoretical mining height within the resource block, (t);

$_{\text{mh theor}}$ is the theoretical mining height within the resource block, in metres (m);

A_{horz}	is the horizontal area of the resource block, in metres squared (m^2);
$th_{mh\ theor}$	is the vertical theoretical mining height within the resource block, in metres (m);
$rd_{mh\ theor}$	is the theoretical mining height density, in grams per cubic centimetres (g/cm^3);
GL_p	is the physical geological loss percentage (%);
GL_m	is the geological model estimation error percentage (%);
$T_{prev\ mined}$	is the tonnage of coal mined from previously mined areas (in area(s) that are going to be re-mined), (t);
$GTIS_{mh\ theor\ remain}$	is the remaining gross in situ coal resource tonnage at the theoretical mining height within the resource block or mine plan, after accounting for old mine workings, (t).

The tonnage shall be quoted on an in situ bed moisture basis or on an air-dried basis and the coal qualities shall be quoted on an in situ bed moisture or on an air-dried basis. The basis of reporting the tonnage and coal quality shall be reported.

6.5.4.2 Mineable In situ coal resource coal quality

The mineable in situ raw coal quality shall be quoted on either an in situ or an air-dried basis for the relevant coal quality properties. The mineable in situ coal resource coal quality values shall be quoted on the theoretical mining height, which may be on either a full seam basis or on a select seam basis.

The theoretical product yield and associated product qualities may be quoted for the theoretical mining height, if applicable.

6.5.5 Calculation of coal reserves

6.5.5.1 Introduction – Gross in situ and mineable in situ coal reserves

The calculation of coal reserves shall be undertaken on a sequential basis starting from the gross in situ coal resources through to the mineable in situ coal resources (to ensure consistency in the selected mining horizon from a thickness, density and coal quality perspective) that will be converted to a coal reserve by the application of the relevant discount factors and modifying factors.

The gross in situ coal resource tonnage at the theoretical mining height is the calculated product of the area, the theoretical mining height and the density, minus the tonnage extracted from previously mined areas, using equations 17, 18 or 19 (see 6.5.2.8.7).

The physical cut-offs and coal quality cut-off parameters shall be applied before the gross in situ tonnage is calculated (see 6.5.2.2).

The mineable in situ coal resources are based on the selected theoretical mining height within the coal resource block and can be calculated using the equations 23, 24 or 25 as presented in 6.5.4.1.

The mining method, the minimum mineable thickness cut-off and maximum mineable thickness cut-off shall be quoted for the selected mining method.

6.5.5.2 Mining layout loss

The mining layout loss factor accounts for the expected loss of coal reserves due to actual mining activities not reaching the defined boundary of the mineable in situ coal resource block. The mining layout loss factor includes boundary pillar and other fringe or limit losses on the extremity of the planned mining operations, between the coal resource block boundary and the mining layout, but does not include internal barrier pillars and support pillars.

The mining layout loss factor is a measure of the efficiency of the practical aerial extraction of coal reserves within a defined coal resource block and can be calculated using the following equation:

$$MLL = (1 - (A_{layout} / A_{horz})) \times 100 \quad (26)$$

or

$$MLL = (1 - (MTIS_{mh\ theor\ layout} / MTIS_{resource\ mh\ theor})) \times 100 \quad (27)$$

where

MLL is the mining layout loss within the coal resource block, in percentage (%);

A_{layout} is the horizontal mineable area, in metres squared (m^2);

A_{horz} is the horizontal area of the coal resource block, in metres squared (m^2);

$MTIS_{mh\ theor\ layout}$ is the mineable in situ resource tonnage at the theoretical mining height in the defined mining layout (not including internal barrier pillars and support pillars), (t);

$MTIS_{resource\ mh\ theor}$ is the mineable in situ coal resource tonnage at the theoretical mining height within the resource block, (t).

6.5.5.3 Mineable in situ coal reserves (theoretical mining height) (for reporting purposes)

The mineable in situ coal reserves are based on the selected theoretical mining height (see 3.33) within the area defined by the mine plan.

The mineable in situ coal reserves are the discounted theoretical mineable in situ coal reserves within a practical mining layout, and can be calculated after applying the theoretical mining layout loss percentage, as indicated in equations 28, 29 and 30. The mining layout loss factors represent the expected losses that are caused by not reaching the extremities of the planned, or theoretical, layout.

$$MTIS_{reserve\ mh\ theor} = MTIS_{resource\ mh\ theor} \times (1 - MLL/100) \quad (28)$$

or

$$MTIS_{reserve\ mh\ theor} = A_{horz} \times th_{mh\ theor\ mp} \times rd_{mh\ theor} \times (1 - GL_p/100) \times (1 - GL_m/100) \times (1 - MLL/100) \quad (29)$$

or

$$MTIS_{\text{reserve mh theor}} = (A_{\text{horz}} \times th_{\text{mh theor mp}} \times rd_{\text{mh pract}} - T_{\text{prev mined}}) \times (1 - GL_p/100) \times (1 - GL_m/100) \times (1 - MLL/100) \quad (30)$$

in the case where there are previously mined areas,

where

$MTIS_{\text{reserve mh theor}}$ is the mineable in situ coal reserve tonnage at the theoretical mining height within the mine plan, (t);

$MTIS_{\text{resource mh theor}}$ is the mineable in situ coal resource tonnage at the theoretical mining height within the resource block, (t);

MLL is the mining layout loss within the resource block, in percentage (%);

A_{horz} is the horizontal area of the coal resource block, in metres squared (m^2);

$th_{\text{mh theor mp}}$ is the vertical theoretical mining height within the mine plan, in metres (m);

$rd_{\text{mh theor}}$ is the theoretical mining height density, in grams per cubic centimetres (g/cm^3);

GL_p is the physical geological loss percentage (%);

GL_m is the geological model estimation error percentage (%);

$T_{\text{prev mined}}$ is the tonnage of coal mined from previously mined areas (in area(s) that are going to be re-mined), (t).

The mining method, the minimum mineable thickness cut-off and the maximum mineable thickness cut-off shall be quoted for the selected mining method. The tonnage shall be quoted on an in situ bed moisture or on an air-dried basis and the coal qualities shall be quoted on an in situ bed moisture basis or on an air-dried moisture basis.

6.5.5.4 Dilution material tonnage and percentage

The impact of the dilution material (see 3.34) shall be added in the calculations, preferably on an additional thickness basis or on a percentage basis. The density and quality of the dilution material (due to non-coal or coal) should preferably be measured, but may be assumed if necessary. Although the impact of the dilution material may be included in the geological model to provide a modelled practical mining horizon, it is important that the impact of dilution is quantified.

Dilution does not include non-correlateable thin non-coal bands or lenses within the coal seam that are part of the theoretical mining height. These thin bands or lenses should be included in the tonnage and coal quality in the case of mineable in situ coal reserves at the theoretical mining height.

The density of the mineable coal at the practical mining height shall be calculated by weighting the coal density and the density of the dilution material on a volumetric basis. The coal quality of the mineable coal at the practical mining height shall be calculated by weighting the coal quality and the quality of the dilution material on a tonnage basis.

The dilution tonnage can be calculated as follows:

$$th_{\text{dilution}} = th_{\text{dilution roof}} + th_{\text{dilution floor}} \quad (31)$$

$$rd_{\text{dilution}} = (rd_{\text{dilution roof}} \times th_{\text{dilution roof}} + rd_{\text{dilution floor}} \times th_{\text{dilution floor}}) / (th_{\text{dilution roof}} + th_{\text{dilution floor}}) \quad (32)$$

$$T_{\text{dilution}} = th_{\text{dilution}} \times rd_{\text{dilution}} \times A_{\text{horz}} \times (1 - MLL/100) \quad (33)$$

or

$$T_{\text{dilution}} = th_{\text{dilution}} \times rd_{\text{dilution}} \times A_{\text{layout}} \quad (34)$$

(using $A_{\text{layout}} = A_{\text{horz}} \times (1 - MLL/100)$ derived from equation 26)

where

th_{dilution} is the total dilution material thickness from above the roof or from below the floor of the theoretical coal seam, or both, in metres (m);

$th_{\text{dilution roof}}$ is the dilution material thickness from above the roof of the theoretical coal seam, in metres (m);

$th_{\text{dilution floor}}$ is the dilution material thickness from below the floor of the theoretical coal seam, in metres (m);

rd_{dilution} is the dilution material average density from above the roof or from below the floor of the theoretical coal seam, or both, in grams per cubic centimetres (g/cm^3);

$rd_{\text{dilution roof}}$ is the dilution material density from above the roof of the theoretical coal seam, in grams per cubic centimetres (g/cm^3);

$rd_{\text{dilution floor}}$ is the dilution material density from below the floor of the theoretical coal seam, in grams per cubic centimetres (g/cm^3);

T_{dilution} is the dilution material tonnage (t);

A_{horz} is the horizontal area of the resource block, in metres squared (m^2);

MLL is the mining layout loss within the resource block, in percentage (%);

A_{layout} is the horizontal mineable area, in metres squared (m^2).

The dilution material can be calculated as follows:

$$d = (MTIS_{\text{mh pract}} - MTIS_{\text{mh theor}}) / (MTIS_{\text{mh pract}}) \times 100 \quad (35)$$

where

d is the dilution mass percentage (on an air-dried basis) (%);

$MTIS_{\text{mh pract}}$ is the practical mineable in situ coal resource at the practical mining height including the dilution material, in tonnes (t);

$MTIS_{\text{mh theor}}$ is the mineable in situ coal resource at the theoretical mining height, in tonnes (t).

6.5.5.5 Mineable in situ coal reserves (practical mining height)

The mineable in situ coal reserves (practical mining height) (see 3.36) are based on the selected practical mining height (see 3.35) (or the theoretical mining height (see 3.28) with planned dilution material (see 3.34)) within the area defined by the mine plan.

The practical mining height is the height of the full seam or the optimal selected part of the seam, which is expected to be mined, including any planned dilution material added due to practical mining considerations for safety reasons, or for minimum mining height or optimum mining height requirements. The practical mining height does not include any external contamination material.

The mineable in situ coal reserves are the discounted practical mineable in situ coal reserves within a practical mining layout, calculated after applying the theoretical mining layout loss percentage. The mining layout loss factor (see 3.32) represents the expected losses that are caused by not reaching the extremities of the planned, or theoretical, mining layout.

The density of the coal in the practical mining height shall be calculated by weighting the coal density and the density of the dilution material on a volumetric basis. The coal quality of the coal in the practical mining height shall be calculated by weighting the coal quality and the quality of the dilution material on a tonnage basis.

The tonnage of the mineable in situ coal reserves at the practical mining horizon (including planned dilution) can be calculated as follows:

$$th_{\text{mh pract}} = th_{\text{mh theor mp}} + th_{\text{dilution}} \quad (36)$$

$$rd_{\text{mh pract}} = (rd_{\text{mh theor}} \times th_{\text{mh theor mp}} + rd_{\text{dilution}} \times th_{\text{dilution}}) / th_{\text{mh pract}} \quad (37)$$

$$MTIS_{\text{reserve mh pract}} = A_{\text{horz}} \times th_{\text{mh pract}} \times rd_{\text{mh pract}} \times (1 - GL_p/100) \times (1 - GL_m/100) \times (1 - MLL/100) \quad (38)$$

or

$$MTIS_{\text{reserve mh pract}} = (A_{\text{horz}} \times th_{\text{mh pract}} \times rd_{\text{mh pract}} - T_{\text{prev mined}}) \times (1 - GL_p/100) \times (1 - GL_m/100) \times (1 - MLL/100) \quad (39)$$

in the case where there are previously mined areas.

The coal quality of the mineable in situ coal reserves at the practical mining horizon (including planned dilution) can be calculated as follows:

$$Q_{\text{mh pract}} = (Q_{\text{mh theor}} \times rd_{\text{mh theor}} \times th_{\text{mh theor mp}} + Q_{\text{dilution}} \times rd_{\text{dilution}} \times th_{\text{dilution}}) / (th_{\text{mh pract}} \times rd_{\text{mh pract}}) \quad (40)$$

or

$$Q_{\text{mh pract}} = (Q_{\text{mh theor}} \times MTIS_{\text{resource mh theor}} + Q_{\text{dilution}} \times T_{\text{dilution}}) / (MTIS_{\text{resource mh theor}} + T_{\text{dilution}}) \quad (41)$$

where

$th_{\text{mh pract}}$	is the vertical practical mining height within the mine plan (uncontaminated but including planned dilution), in metres (m);
$th_{\text{mh theor mp}}$	is the vertical theoretical mining height within the mine plan, in metres (m);
th_{dilution}	is the total dilution thickness from above the roof or from below the floor, of the theoretical coal seam, in metres (m);
$rd_{\text{mh pract}}$	is the practical mining height density, in grams per cubic centimetres (g/cm^3);
$rd_{\text{mh theor}}$	is the theoretical mining height density, in grams per cubic centimetres (g/cm^3);
rd_{dilution}	is the dilution average density from above the roof or from below the floor of the theoretical coal seam, in grams per cubic centimetres (g/cm^3);
$MTIS_{\text{reserve mh pract}}$	is the mineable in situ coal reserve at the practical mining height including dilution within the mine plan, in tonnes (t);
A_{horz}	is the horizontal area of the resource block, in metres squared (m^2);
GL_p	is the physical geological loss, expressed in percentage (%);
GL_m	is the geological model estimation error, in percentage (%);
MLL	is the mining layout loss within the resource block, in percentage (%);
$T_{\text{prev mined}}$	is the tonnage of coal mined from previously mined areas (in areas that are going to be re-mined), (t);
$Q_{\text{mh pract}}$	is the coal quality for the practical mining height within the mine plan (uncontaminated but including planned dilution), typically a percentage (%);
$Q_{\text{mh theor}}$	is the coal quality of the coal within the theoretical mining height within the mine plan, typically a percentage (%);
Q_{dilution}	is the coal quality of the material from above the roof or from below the floor of the theoretical coal seam, or both, typically a percentage (%);
$MTIS_{\text{resource mh theor}}$	is the mineable in situ coal resource at the theoretical mining height within the resource block, in tonnes (t);
T_{dilution}	is the dilution tonnage (t).

6.5.5.6 Extractable coal reserves

The extractable coal reserves (see 3.38) are the discounted practical mineable in situ coal reserves within a practical mining layout, calculated after applying the theoretical mining layout extraction factor (as a percentage) (see 3.37). The mining layout extraction percentage represents the expected theoretical mining extraction percentage, depending on the mining method.

The extractable coal reserves include dilution material, but exclude any contamination material (as calculated in equation 42). The tonnage and coal quality shall be quoted on an in situ bed moisture or on an air-dried moisture basis.

The extractable coal reserves and the associated area can be calculated as follows:

$$ETIS_{\text{reserve mh pract}} = (MTIS_{\text{reserve mh pract}} \times (MLE/100)) \quad (42)$$

and the associated area can be calculated as

$$A_{\text{extractable}} = A_{\text{horz}} \times (1 - MLL/100) \times MLE/100 \quad (43)$$

or

$A_{\text{extractable}} = A_{\text{layout}} \times MLE/100$, after substituting equation 26 into equation 43,

where

$ETIS_{\text{reserve mh pract}}$ is the extractable coal reserve tonnage (t);

$MTIS_{\text{reserve mh pract}}$ is the mineable in situ coal reserve tonnage at the practical mining height including dilution within the mine plan, (t);

MLE is the theoretical mining layout extraction, in percentage (%);

$A_{\text{extractable}}$ is the horizontal extractable area, in metres squared (m^2);

A_{horz} is the horizontal area of the resource block, in metres squared (m^2);

MLL is the mining layout loss within the resource block, in percentage (%);

A_{layout} is the horizontal mineable area, in metres squared (m^2).

6.5.6 ROM coal reserves

6.5.6.1 Contamination material

The contamination material or contaminant (see 3.40) shall be added in by calculation, preferably on a thickness basis, but may be applied on a percentage basis. The density and quality of the contamination due to non-coal material or coal, or both, should preferably be determined, but may be assumed, if necessary.

The density of the mineable coal at the practical mining height shall be calculated by weighting the coal density and the contaminant density on a volumetric basis. The coal quality of the mineable coal at the practical mining height shall be calculated by weighting the coal quality and the contaminant material quality on a tonnage basis.

The contaminant tonnage can be calculated as follows:

$$th_{\text{contamination}} = th_{\text{contaminant roof}} + th_{\text{contaminant floor}} \quad (44)$$

$$rd_{\text{contamination}} = \frac{(rd_{\text{contaminant roof}} \times th_{\text{contaminant roof}} + rd_{\text{contaminant floor}} \times th_{\text{contaminant floor}})}{(th_{\text{contaminant roof}} + th_{\text{contaminant floor}})} \quad (45)$$

$$T_{\text{contamination}} = th_{\text{contamination}} \times rd_{\text{contamination}} \times A_{\text{horz}} \times (1 - MLL/100) \times MLE/100 \quad (46)$$

or

$T_{\text{contamination}}$ = $th_{\text{contamination}} \times rd_{\text{contamination}} \times A_{\text{extractable}}$, after substituting equation 43 into equation 46,

where

$th_{\text{contamination}}$ is the contaminant thickness from the roof and floor, in metres (m);

$th_{\text{contaminant roof}}$ is the contaminant thickness from above the roof of the practical mining height, in metres (m);

$th_{\text{contaminant floor}}$ is the contaminant thickness from below the floor of the practical mining height, in metres (m);

$rd_{\text{contamination}}$ is the contaminant average density from the roof and floor, in grams per cubic centimetres (g/cm^3);

$rd_{\text{contaminant roof}}$ is the contaminant density from above the roof of the practical mining height, in grams per cubic centimetres (g/cm^3);

$rd_{\text{contaminant floor}}$ is the contaminant density from below the floor of the practical mining height, in grams per cubic centimetres (g/cm^3);

$T_{\text{contamination}}$ is the contaminant tonnage (t);

A_{horz} is the horizontal area of the resource block, in metres squared (m^2);

MLL is the mining layout loss within the resource block, in percentage (%);

MLE is the theoretical mining layout extraction, in percentage (%).

$A_{\text{extractable}}$ is the horizontal extractable area, in metres squared (m^2).

The contaminant percentage can be calculated as follows:

$$c = (T_{\text{contamination}} / (ETIS_{\text{reserve mh pract}} + T_{\text{contamination}})) \times 100 \quad (47)$$

where

c is the contamination on an air-dried basis, in percentage (%);

$T_{\text{contamination}}$ is the contaminant tonnage (t);

$ETIS_{\text{reserve mh pract}}$ is the extractable coal reserve tonnage (t).

6.5.6.2 ROM coal reserves (air-dried basis or in situ basis)

The run of mine coal reserves (air-dried) are the extractable coal reserves with contamination material added due to expected mining conditions, which are reported on an in situ bed moisture or on an air-dried moisture basis, after applying the mining recovery efficiency factor, which is the expected recovery of broken contaminated material within the planned mining layout.

The density of the contaminated ROM tonnage shall be calculated by weighting the coal density and the average contaminant density on a volumetric basis (or average thickness basis in the case where the areas are identical).

The practical mining horizon height can be calculated as in equation 48, while the density of the practical mining horizon can be calculated as in equation 49 or equation 49a, as follows:

$$th_{\text{mh pract c}} = th_{\text{mh pract}} + th_{\text{contamination}} \quad (48)$$

$$rd_{\text{mh pract c}} = \frac{(rd_{\text{mh pract}} \times th_{\text{mh pract}} \times A_{\text{extractable}} + rd_{\text{contamination}} \times th_{\text{contamination}} \times A_{\text{extractable}})}{(th_{\text{mh pract c}} \times A_{\text{extractable}})} \quad (49)$$

which can be simplified to

$$rd_{\text{mh pract c}} = (rd_{\text{mh pract}} \times th_{\text{mh pract}} + rd_{\text{contamination}} \times th_{\text{contamination}}) / th_{\text{mh pract c}} \quad (49a)$$

assuming that the areas are the same.

The ROM coal reserve tonnage can be calculated as follows:

$$ROM_{c} = (ETIS_{\text{reserve mh pract}} + T_{\text{contamination}}) \times MR \quad (50)$$

or

$$\text{ROM}_{c} = (ETIS_{\text{reserve mh pract}} / (1 - c/100)) \times MR \quad (51)$$

where

$th_{\text{mh pract c}}$ is the vertical practical contaminated mining height within the mine plan, in metres (m);

$th_{\text{mh pract}}$ is the vertical practical mining height within the mine plan (uncontaminated but including planned dilution), in metres (m);

$th_{\text{contamination}}$ is the contamination thickness from the roof and floor, in metres (m);

$rd_{\text{mh pract c}}$ is the practical contaminated mining height density, in grams per cubic centimetres (g/cm^3);

$rd_{\text{mh pract}}$ is the practical mining height density, in grams per cubic centimetres (g/cm^3);

$A_{\text{extractable}}$ is the horizontal extractable area, in metres squared (m^2);

$rd_{\text{contamination}}$ is the contamination average density from the roof and floor, in grams per cubic centimetres (g/cm^3);

ROM_{c} is the ROM coal reserve on a contaminated air-dried moisture basis or on a contaminated in situ bed moisture basis, in tonnes (t);

$ETIS_{\text{reserve mh pract}}$ is the extractable coal reserve tonnage (t);

$T_{\text{contamination}}$ is the contaminant tonnage (t);

MR is the mining recovery efficiency, in percentage (%);

c is the contamination on an air-dried basis, in percentage (%).

or

from a first principle basis where the results of the intermediate calculations are not required, then using the results obtained from equations (8), (31), (32), (44) and (45), the contaminated run of mine coal reserve tonnage can be calculated as follows:

$$ROM_{\text{c}} = \left\{ \begin{array}{l} \left(\dfrac{(th_{\text{mh theor mp}} + th_{\text{dilution}}) \times (rd_{\text{mh theor}} \times th_{\text{mh theor mp}} + rd_{\text{dilution}} \times th_{\text{dilution}})}{(th_{\text{mh theor mp}} + th_{\text{dilution}}) \times A_{\text{horz}} - T_{\text{prev mined}}} \right) \times \dfrac{(1 - GL_{\text{p}})}{100} \times \dfrac{(1 - GL_{\text{m}})}{100} \times \\ \dfrac{(1 - MLL)}{100} \times \dfrac{MLE}{100} + \left(th_{\text{contamination}} \times rd_{\text{contamination}} \times A_{\text{horz}} \times \dfrac{(1 - MLL)}{100} \times \dfrac{MLE}{100} \right) \end{array} \right\} \times MR \quad (52)$$

where

ROM_{c} is the ROM coal reserve tonnage on a contaminated air-dried moisture basis or on a contaminated in situ bed moisture basis (t);

$th_{\text{mh theor mp}}$ is the vertical theoretical mining height within the mine plan, in metres (m);

th_{dilution} is the total dilution thickness from above the roof, or from below the floor of the theoretical coal seam, or both, in metres (m) (derived from equation 36);

$rd_{\text{mh theor}}$ is the theoretical mining height density, in grams per cubic centimetres (g/cm^3);

rd_{dilution} is the dilution average density from above the roof, or from below the floor of the theoretical coal seam, or both, in grams per cubic centimetres (g/cm^3) (derived from equation 42);

GL_{p} is the physical geological loss, in percentage (%);

GL_{m} is the geological model estimation error, in percentage (%);

A_{horz} is the horizontal area of the resource block, in metres squared (m^2);

$T_{\text{prev mined}}$ is the tonnage of coal mined from previously mined areas (in the area(s) that are going to be re-mined), (t);

MLL is the mining layout loss within the resource block, in percentage (%);

MLE is the theoretical mining layout extraction, in percentage (%);

MR is the mining recovery efficiency, in percentage (%);

$th_{\text{contamination}}$ is the contamination thickness from the roof and floor, in metres (m)(derived from equation 48);

$rd_{\text{contamination}}$ is the contamination average density from the roof and floor, in grams per cubic centimetres (g/cm^3) (derived from equation 49).

6.5.6.3 ROM moisture content

The ROM moisture content is calculated (see equations 53 and 54) by weighting the moisture of the coal, the moisture content of the dilution and the moisture of the contaminant by the respective tonnes. The calculation may be applied equally to the air-dried moisture content of the relevant constituents or to the in situ bed moisture content of the relevant constituents to derive the air-dried ROM moisture content or the ROM in situ bed moisture content respectively.

The ROM moisture content can be calculated as follows using the relevant moisture contents:

$$M_{\text{ROM, c}} = \frac{((ETIS_{\text{reserve mh pract}} \times M_{\text{coal}}) + (T_{\text{contamination}} \times M_{\text{contaminant}}))}{(ETIS_{\text{reserve mh pract}} + T_{\text{contamination}})} \quad (53)$$

or

$$M_{\text{ROM, c}} = ((MTIS_{\text{resource mh theor}} \times (1 - MLL) \times M_{\text{coal}} + T_{\text{dilution}} \times M_{\text{dilution}}) \times (MLE/100) + (T_{\text{contamination}} \times M_{\text{contaminant}})) / ((MTIS_{\text{resource mh theor}} \times (1 - MLL) + T_{\text{dilution}}) \times (MLE/100) + T_{\text{contamination}}) \quad (54)$$

where

$M_{\text{ROM, c}}$ is the contaminated ROM moisture on an air-dried basis (Madb) or on an in situ bed moisture basis (Mbm), in percentage (%);

$ETIS_{\text{reserve mh pract}}$ is the extractable coal reserve tonnage, (t);

M_{coal} is the coal moisture content on an air-dried basis (Madb) or on an in situ bed moisture basis (Mbm), in percentage (%);

$T_{\text{contamination}}$ is the contaminant tonnage (t);

$M_{\text{contaminant}}$ is the contaminant moisture content on an air-dried basis (Madb) or on an in situ bed moisture basis (Mbm), in percentage (%);

$MTIS_{\text{resource mh theor}}$ is the mineable in situ coal resource at the theoretical mining height within the coal resource block, in tonnes (t);

MLL is the mining layout loss within the resource block, in percentage (%);

T_{dilution} is the dilution tonnage (t);

$M_{dilution}$ is the dilution moisture content on an air-dried basis (Madb) or on an in situ bed moisture basis (Mbm), in percentage (%);

MLE is the theoretical mining layout extraction, in percentage (%).

6.5.6.4 ROM moisture correction factor

The ROM moisture correction factor is the correction factor obtained by calculation (see equations 55 or 56) to account for the change in the coal reserve tonnage from the ROM coal reserves (at the actual mining height with included dilution and contamination) on an air-dried moisture basis or in situ moisture basis to a ROM as delivered basis as a result of moisture addition during mining operations. Similarly the calculation may be applied to the in situ bed moisture content.

The ROM moisture correction factor can be calculated as follows:

$$MCF_{ROM} = (100 - M) / (100 - (M + M_{sm})) \quad (55)$$

with $M_{sm} = (M_t - M)$ (see 3.16.11)

or

$$MCF_{ROM} = (100 - M) / (100 - M_t) \quad (56)$$

where

MCF_{ROM} is the ROM moisture correction factor to convert air-dried tonnage or the tonnage at in situ moisture to the tonnage on an as-delivered basis;

M is the coal moisture content on an air-dried basis (Madb) or on an in situ bed moisture basis (Mbm), in percentage (%);

M_{sm} is the coal surface moisture, in percentage (%);

M_t is the total coal moisture (Mas), in percentage (%).

6.5.6.5 ROM coal reserve tonnage (as delivered)

The ROM coal reserves (as delivered) are the ROM coal reserves with moisture added or lost due to expected mining and transportation conditions which can be calculated from equations 57, 58 and 59. The additional surface moisture or free moisture shall be added to the air-dried ROM tonnes or to the ROM tonnes on an in situ bed moisture content.

The ROM coal reserves tonnage (as delivered) can be calculated as follows:

$$ROM_{as\ del} = ROM_c \times MCF_{ROM} \quad (57)$$

or

$$ROM_{as\ del} = ROM_c \times (100 - M) / (100 - M_t) \quad (58)$$

or

$$ROM_{as\ del} = ROM_c \times (100 - M) / (100 - (M + M_{sm})) \quad (59)$$

with $M_{sm} = M_t - M$ (see 3.16.11)

where

$ROM_{\text{as del}}$ is the ROM coal reserve on an as-delivered basis, in tonnes (t);

ROM_{c} is the ROM coal reserve on a contaminated air-dried moisture basis or on a contaminated in situ bed moisture basis, in tonnes (t);

$MCF_{\mathbf{ROM}}$ is the ROM moisture correction factor to convert air-dried tonnage or the tonnage at in situ moisture to the tonnage on an as-delivered basis;

M is the coal moisture content on an air-dried basis (Madb) or on an in situ bed moisture basis (Mbm), in percentage (%);

M_t is the total coal moisture (Mas), in percentage (%);

M_{sm} is the coal surface moisture, in percentage (%).

6.5.6.6 Raw ROM coal quality

The raw ROM coal quality should be quoted on an air-dried contaminated basis, or on a contaminated in situ moisture basis, or on an as-delivered basis (wet contaminated basis) or on a dry contaminated basis. The tonnages used to weight the coal quality shall be on the same basis as the coal quality basis. The basis of ROM coal quality reporting shall be stated. The quality of the contaminated coal shall be calculated (see equations 60 and 61) by weighting the coal quality (including dilution) and the average roof and floor contaminant quality on a tonnage basis, or on the contaminant percentage, as shown below.

The contaminated raw ROM coal quality shall be calculated as follows:

$$Q_{\text{raw, c}} = (Q_{\text{raw, uc}} \times ETIS_{\text{reserve mh pract}} + Q_{\text{contaminant}} \times T_{\text{contamination}})/(ETIS_{\text{reserve mh pract}} + T_{\text{contamination}}) \quad (60)$$

or

$$Q_{\text{raw, c}} = Q_{\text{raw, uc}} \times (1 - c/100) + Q_{\text{contaminant}} \times c/100 \quad (61)$$

where

$Q_{\text{raw, c}}$ is the raw coal quality, contaminated, typically in %;

$Q_{\text{raw, uc}}$ is the raw coal quality, uncontaminated but including dilution, typically in %;

c is the contamination on an air-dried basis, in percentage (%);

$ETIS_{\text{reserve mh pract}}$ is the extractable coal reserve tonnage (t);

$Q_{\text{contaminant}}$ is the average quality of the roof and floor contaminant, typically in percentage (%);

$T_{\text{contamination}}$ is the contaminant tonnage (t).

6.5.7 Saleable coal reserves

6.5.7.1 Raw saleable (ROM) product

In the case where the raw coal is delivered directly to the customer as a raw saleable product, the ROM coal reserve (as delivered) is also the saleable coal reserve.

6.5.7.2 Theoretical product yield

The theoretical product yield may be reported on an uncontaminated basis (see 3.44) or on a contaminated basis (see 3.45).

The theoretical product yield on a contaminated basis can be calculated as follows:

$$Y_{\text{theor, c, adb}} = Y_{\text{theor adb}} \times (1 - c/100) + Y_{\text{contaminant}} \times c/100 \quad (62)$$

where

$Y_{\text{theor, c, adb}}$ is the theoretical product yield of contaminated coal on an air-dried moisture basis, in percentage (%);

$Y_{\text{theor adb}}$ is the yield of the theoretical borehole coal product on an uncontaminated air-dried moisture basis, in percentage (%);

c is the contamination on an air-dried basis, in percentage (%);

$Y_{\text{contaminant}}$ is the yield of the contaminant in the product on an air-dried moisture basis, in percentage (%).

6.5.7.3 Practical product yield

The practical product yield can be calculated by applying the coal processing discount factors to the contaminated theoretical borehole yield, as follows:

$$Y_{\text{prac, adb}} = Y_{\text{theor, c, adb}} \times CPDF \quad (63)$$

or

$$Y_{\text{prac, adb}} = (\text{sales}_{\text{adb}} / ROM_{\text{adb, c}}) \times 100 \quad (64)$$

where

$Y_{\text{prac, adb}}$ is the practical product yield on a contaminated air-dried moisture basis, in percentage (%);

$Y_{\text{theor, c, adb}}$ is the theoretical product yield of contaminated coal on an air-dried moisture basis, in percentage (%);

$CPDF$ is the net coal processing discount factors;

$sales_{\text{adb}}$ is the saleable coal reserve on an air-dried moisture basis, in tonnes (t);

$ROM_{\text{adb, c}}$ is the ROM coal reserve tonnage on a contaminated air-dried moisture basis, (t).

It is recommended that the practical product yield shall be quoted on the basis of an air-dried saleable product tonnage to an air-dried ROM tonnage in order to remove the effect of tonnages at differing moisture contents on the yield. It should be remembered that the saleable air-dried moisture is in all cases different to the contaminated ROM air-dried moisture.

The basis of reporting the yield shall be stated.

6.5.7.4 Saleable moisture correction factor ($MCF_{saleable}$)

The saleable moisture correction factor is the correction factor obtained by calculation (see equation 65) applied to the respective saleable product tonnages to account for the change in moisture content from the saleable coal reserve tonnage at either air-dried moisture content or at in situ moisture content to the saleable coal reserve tonnage at product moisture as a result of coal processing operations (including moisture addition for dust suppression purposes) using the following equation:

$$MCF_{saleable} = (100 - M_{saleable}) / (100 - M_{pm}) \quad (65)$$

where

$MCF_{saleable}$ is the saleable moisture correction factor to convert the sales tonnage on an air-dried basis or on an in situ bed moisture basis to the product tonnage on a product moisture basis;

$M_{saleable}$ is the saleable coal moisture content on an air-dried basis (Madb) or on an in situ bed moisture basis (Mbm), in percentage (%);

M_{pm} is the product moisture on an as-sampled basis (Mas), in percentage (%).

6.5.7.5 Beneficiated saleable coal reserves

The saleable coal reserves are the ROM coal reserves (on an air-dried moisture basis or on an in situ bed moisture basis) discounted by the practical product yield and the relevant moisture correction factors, and can be calculated as follows:

$$sales_{adb} = ROM_{adb,c} \times Y_{prac,adb} \quad (66)$$

with

$$ROM_{adb,c} = ROM_{c} \times (100 - M_{ROM,adb,c}) / (100 - M_{ROM\,bm,c}) \quad (67)$$

in the case of the ROM moisture being on an in situ moisture basis,

or

$$sales_{pm} = sales_{adb} \times (100 - M_{sales,adb}) / (100 - M_{pm}) \quad (68)$$

or by combining equations 66 and 68:

$$sales_{pm} = ROM_{adb,c} \times Y_{prac,adb} \times (100 - M_{sales,adb}) / (100 - M_{pm})$$

or

$$sales_{pm} = sales_{adb} \times MCF_{saleable} \quad (69)$$

where

$sales_{adb}$ is the saleable coal reserve tonnage on an air-dried basis (t);

$ROM_{adb, c}$ is the ROM coal reserve on a contaminated air-dried moisture basis, in tonnes (t);

$Y_{prac, adb}$ is the practical product yield on a contaminated air-dried moisture basis, in percentage (%);

ROM_{c} is the ROM coal reserve on a contaminated air-dried moisture basis or on a contaminated in situ bed moisture basis, in tonnes (t);

$M_{ROM, adb, c}$ is the contaminated ROM moisture on an air-dried basis (Madb), in percentage (%);

$M_{ROM, bm, c}$ is the contaminated ROM moisture on an in situ bed moisture basis (Mbm), in percentage (%);

$sales_{pm}$ is the saleable coal reserve at product moisture, in tonnes (t);

$M_{sales, adb}$ is the saleable coal moisture content on an air-dried moisture basis (Madb), in percentage (%);

M_{pm} is the product moisture on an as-sold basis (Mas), in percentage (%);

$MCF_{saleable}$ is the saleable moisture correction factor to convert the sales tonnage on an air-dried basis or on an in situ bed moisture basis to the product tonnage on a product moisture basis.

6.5.7.6 Saleable product moisture content

The saleable product moisture content is based on the weighted average product moisture content of the various saleable products, calculated from the total moisture content of each individual product sold and the tonnage of each individual product on an air-dried moisture basis (see equation 70).

The saleable product moisture for reserve reporting basis shall be reported either on an as-sold basis or on an as-received basis, and can be calculated as follows:

$$Q_{sales, pm} = (M_{pm1} \times T_1 + M_{pm2} \times T_2 + \ldots. + M_{pmN} \times T_N) / (T_1 + T_2 + \ldots. + T_N) \quad (70)$$

where

$Q_{sales, pm}$ is the average saleable product moisture as sold, in percentage (%);

$M_{pm1\ldots.N}$ are the individual product moisture content values on a total moisture basis (Mt) for each of the individual products sold, on an as-sold basis, in percentage (%);

$T_{1\ldots N}$ are the incremental tonnages of the individual products sold on an air-dried basis, (t);

6.5.7.7 Saleable coal quality

The saleable coal quality should preferably be quoted on a product moisture basis, or alternatively, on an air-dried basis, or on an in situ basis, or on a dry basis (see equations 71 and 72). The basis of saleable coal quality reporting shall be stated.

The saleable product quality for reserve reporting basis shall be reported either on an as-sold basis or on an as-received basis, depending on the moisture reporting basis.

The saleable coal quality can be calculated as follows:

$$Q_{\text{sales, pm}} = Q_{\text{sales, adb}} \times (100 - M_{\text{adb}}) / (100 - M_{\text{pm}}) \quad (71)$$

or

$$Q_{\text{sales, pm}} = Q_{\text{sales, in situ}} \times (100 - M_{\text{bm}}) / (100 - M_{\text{pm}}) \quad (72)$$

where

$Q_{\text{sales, pm}}$ is the average saleable product moisture as sold, in percentage (%);

$Q_{\text{sales, adb}}$ is the saleable coal quality on an air-dried basis, typically in percentage (%);

M_{adb} is the coal moisture content on an air-dried basis (Madb), in percentage (%);

M_{pm} is the product moisture on an as-sold basis (Mas), in percentage (%);

$Q_{\text{sales, in situ}}$ is the saleable coal quality on an in situ basis, typically in percentage (%);

M_{bm} is the coal moisture content on an in situ basis (Mbm), in percentage (%).

7 Evaluation methods and procedures

7.1 Introduction

The overall objective of an evaluation exercise is to effectively define the coal resources and coal reserves within a coal deposit. In order to determine the appropriate strategy, the type of deposit and the phase of economic evaluation, whether a geological study, a conceptual economic study, a pre-feasibility study, a feasibility study or an operational phase, shall be established.

A summary of the methods and procedures for the evaluation of coal resources and coal reserves is outlined below. The results of each phase will often determine any special needs for successive phases of evaluation.

General guidelines are outlined below with reference to each particular component of the geological evaluation, i.e.:

a) preliminary surveys;

b) geological drilling;

c) coal sampling;

d) computer processing and deposit modelling;

e) coal processing;

f) geotechnical evaluation;

g) geohydrology;

h) environmental aspects; and

i) legislation.

7.2 Preliminary surveys

7.2.1 Collation of available information

Before any exploratory work is done, a review of all available information on the proposed exploration area is essential in order to

a) establish the geological setting of the area,

b) establish surface and mineral ownership and title,

c) identify any previous geological exploration work, or mining activities, or both,

d) collate all available coal quality information,

e) delineate topocadastral features (details of ownership, boundaries and values of properties peculiar to the specific region), including survey control data,

f) evaluate the regional infrastructure and development, and

g) evaluate the potential environmental impacts.

Included in this information survey is the preparation of base maps, which should be generated at a scale appropriate to the level of detail sought.

7.2.2 Remote sensing surveys

The use of satellite remote sensing images and aerial photography will assist with the interpretation of cadastral, geological, structural and environmental aspects.

Airborne geophysical surveys may be applicable during the pre-feasibility, feasibility and operational phases. Airborne magnetic surveys and electromagnetic surveys might be necessary for the delineation of faults, igneous intrusions and the depth of weathering. Ground geophysical follow-up work might be required to determine the expected geophysical responses before the survey, or to evaluate any anomalies detected after the survey, or both.

7.2.3 Regional mapping

The information survey will assist in defining the level of detail required in field mapping. In some areas regional mapping may be beneficial during the reconnaissance phase and would provide the framework for the successive evaluation phases. Field mapping may include the tracing of marker beds, the measuring of stratigraphic sections and the locating of major faults, igneous intrusions and any other geological features that affect seam continuity.

7.2.4 Land survey

Land surveys make use of topocadastral maps and survey diagrams to establish property boundaries, cultural features and topographic control.

Land surveying may be required to locate specific property boundaries, lease boundaries and borehole sites.

It is important to set up the project survey data, accurately positioned with respect to the national survey reference grid early in the program, within the lease or project area, to reduce any possible survey discrepancies later. The projection and data being used shall be defined. It is important to ensure that all the source data is properly referenced to the appropriate survey system.

It is essential that all borehole sites be accurately coordinated with respect to the project survey data and national survey reference grid.

7.3 Geological drilling

7.3.1 Small diameter borehole core drilling

Small diameter borehole core drilling enables the evaluation of both the physical continuity of the coal seam(s) and the quality continuity of the coal. The borehole core data shall be used for structural evaluation, coal seam correlation, coal quality analyses and geotechnical evaluation. For adequate sample volume, the borehole core diameter shall be not less than 60 mm in diameter in the case of coal samples submitted for washability analysis. A minimum borehole core diameter of 49 mm is acceptable for coal samples for washability and raw proximate analyses.

For reliable coal resource evaluation the core recovery shall be in excess of 95 % within the coal seam and all core recovery information shall be properly documented.

The spacing of small diameter borehole core holes for geological studies depends on the coal deposit type, whether thick interbedded seam or multiple seam deposit types. The spacing between boreholes shall be decreased appropriately where significant coal quality changes occur in structurally complex areas and along the coal seam suboutcrop.

7.3.2 Open hole drilling

Open hole drilling may be employed in conjunction with small diameter borehole core drilling during the pre-feasibility to operational phases in order to reduce the borehole spacing to an acceptable spacing for the evaluation of the physical continuity of the coal seam(s). All open holes shall be geophysically logged to enable the accurate recognition of coal seam intersections. The definition of the limits of oxidation or the depth of weathering, or both, may be undertaken by making reference to chip samples from open hole drilling.

7.3.3 Borehole down-hole geophysics

Where required, down-hole geophysical logging shall be undertaken to allow for stratigraphic correlation and core recovery calculations. The borehole geophysical surveys will allow the definition of the top and bottom of the coal seams and some indication of lithological correlation.

Down-hole geophysical surveys shall include, at least, density and gamma and calliper electric logs. Comparison of the responses of geophysically logged cored holes with the detailed core description will enable better evaluation and calibration of the geophysical data.

An intersection of the full coal seam in an open hole that has been geophysically logged (with at least density electric log and calliper log) may be used as a physical point of observation. Calibration of the geophysical responses against the observed geology within cored boreholes is recommended before open holes are used for observation, to ensure that the interpretation of the geophysical responses is compatible with the geology observed in the borehole core.

In addition, the geophysical logging in open hole boreholes may be used for qualitative comparison of coal quality and rock strength parameters with adjacent cored boreholes. In the case where the geophysical responses have been calibrated against laboratory derived coal quality analyses for that specific area, and where the reproducibility of a particular geophysically derived parameter (for example ash content or density derived from the density electric log) is within acceptable tolerances, based on laboratory derived analysis from cored holes, then that geophysically derived coal quality parameter may be used to improve the coal quality continuity.

In addition, geophysical logging may be used for the qualitative comparison of rock strength parameters with those of adjacent cored boreholes. Some borehole geophysical responses, particularly density, gamma, neutron-neutron and sonic electric logs may be correlated to the physical laboratory testing of borehole core samples. These geophysical tools respond to rock density, fracture spacing, rock strength and porosity. Specialized geophysical electric logs, such as dip-meter logs and acoustic scanner logs may be used to define the structural orientation of the bedding and the identification of structural features.

7.3.4 Large diameter borehole core drilling

Large diameter borehole core drilling provides sufficient sample material for bulk samples for product testing and for detailed product washability assessment and is desirable for assisting with the coal chain engineering and for coal processing plant design. The nominal diameter of the borehole core defined as large diameter drilling would typically be in excess of 100 mm. Large diameter drilling may be undertaken at the pre-feasibility phase, but is normally undertaken during the feasibility phase once the proposed coal products have been defined.

7.3.5 Directional and angled borehole drilling

The drilling of angled and directional small diameter boreholes from the surface may be undertaken to confirm either the absence or the presence of structural discontinuities or igneous dykes. Due to the cost of this drilling technique these drilling programmes are typically only undertaken during the feasibility, pre-production and operational phases of geological evaluation.

In underground mining areas with a high density of igneous dykes and sills, horizontal holes should be drilled from the underground workings, to evaluate the presence of igneous intrusive bodies ahead of the mining face, as part of the ongoing operational phase geological drilling programme.

7.4 Coal sampling

7.4.1 Small diameter borehole core samples

Borehole core samples collected during the borehole core drilling programme(s) will provide most of the coal quality data in the evaluation programme. During the geological study and pre-feasibility drilling phases, detailed sampling should be carried out to delineate the coal quality distribution in a vertical sense. Such detailed sampling will facilitate seam correlation, coal quality zonation, lateral coal quality continuity and the determination of potential mineable horizons and associated intervening partings. The emphasis on detailed sampling in future core drilling campaigns should then shift to the evaluation of potential seam sections or mineable horizons, as lateral physical continuity and coal quality continuity is established. During the feasibility, pre-production and

operational phases, borehole core samples shall be taken to adequately reflect the vertical coal quality variation within the seam.

The minimum borehole core sample width shall be such that the resulting sample mass will satisfy, as far as possible, the analytical requirements, depending on the type of analysis to be undertaken. A borehole core length of 0,30 m from a 60 mm diameter borehole core is recommended as being the minimum for a representative sample.

For reliable coal resource evaluation the sample recovery shall be in excess of 95 % in each of the samples in the coal seam. In the case of friable coal seams (for example heat affected high vitrinite coals) preferential loss of certain sample material may occur. If a preferential loss of sample material results in a relationship between core recovery and coal quality, there will be a bias in the coal quality results and theoretical product yield results.

7.4.2 Sample preparation, storage and analysis

Coal samples shall be treated with due care throughout the exploration and laboratory analytical stages, including the drilling, transport, sample preparation, analysis and storage of final residues, such that the sample coal quality parameters analysed do not change significantly from the material originally sampled.

The sample preparation and analysis shall be undertaken according to international or national coal standards (see bibliography). The selected sample preparation and analysis methods shall be quoted. A typical flow diagram to show the sequential crushing, division and analysis of core samples for washability or for raw coal analysis (or both) is shown in figure 8.

In cases where the required methods of analysis are not covered by national or international standards, the adopted working procedure shall be stated and should be made available, if so required.

7.4.3 Coal quality

Different analytical requirements might be necessary for each phase of the coal resource assessment, depending on the target product quality specifications.

During the geological study and pre-feasibility drilling phases, the appropriate analyses should be carried out to delineate the general coal characteristics and likely product range. Typically analyses would include proximate analysis, calorific value and sulphur content. The analyses may also include washability float and sink tests and other special analyses, depending on the target product. The individual subseam samples may be combined into composite samples that represent the required mineable horizon(s), with or without added contamination.

NOTE For the purposes of this standard, “sulphur” is deemed to be equivalent to “sulfur” (the International Union for Pure and Applied Chemistry preferred spelling).

At the feasibility, pre-production and operational phases, the emphasis on detailed analysis may shift to the evaluation of potential seam sections or mineable horizons, as lateral physical continuity and coal quality continuity are established.

Composited float and sink washability tests on samples (see figure 8) over the proposed seam sections and mining horizon(s) may be used to simulate likely product(s) and indicate the potential marketability of the coal.

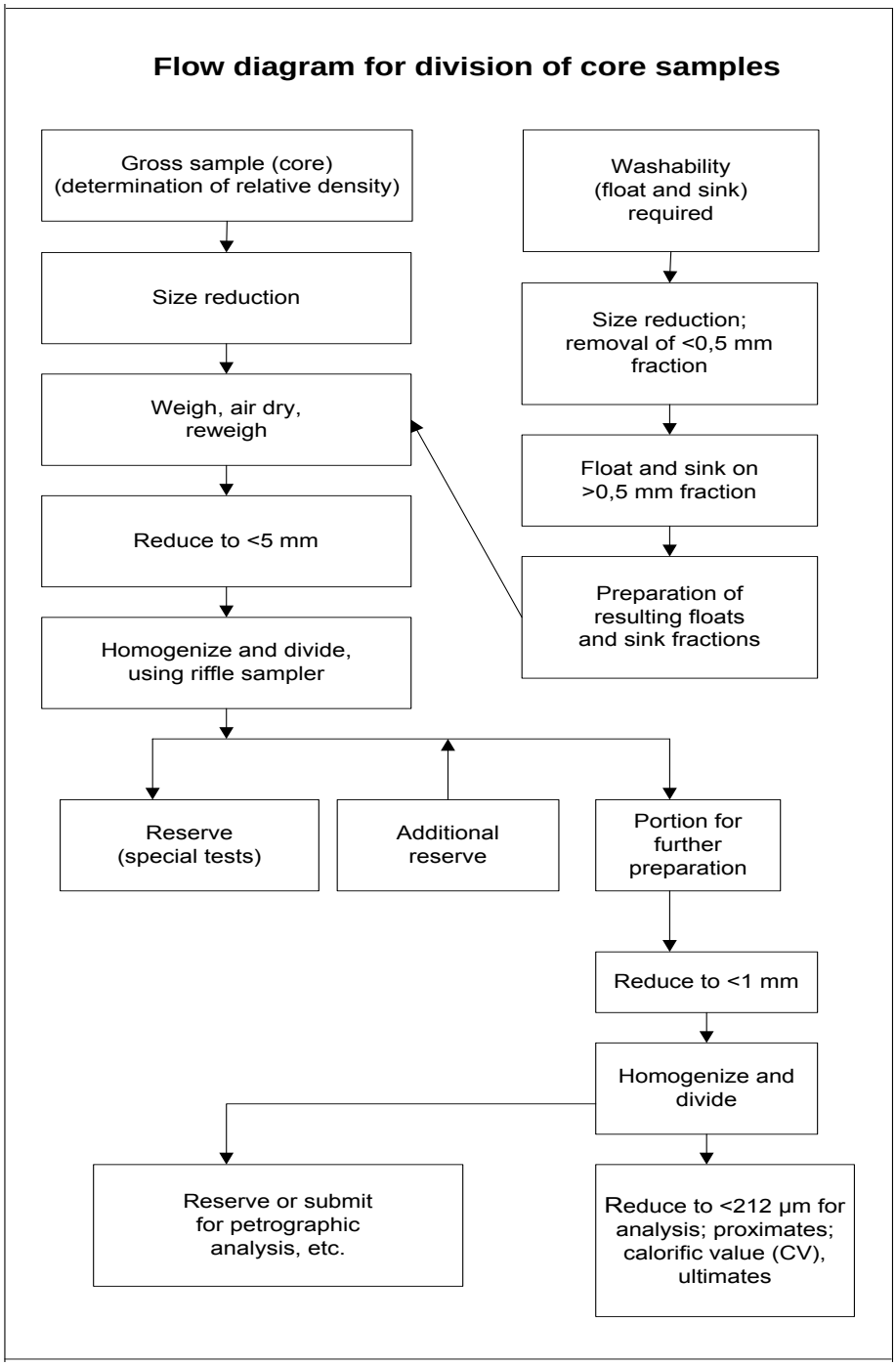


Figure 8 — Flow diagram to show the sequential crushing, sample division and analysis of core samples for washability or raw coal analysis (or both)

During the feasibility or pre-production phases, large diameter (>100 mm) drilling will provide sufficient sample mass for size analysis, coal processing plant design and hence more accurate determination of product yield and product qualities. At the feasibility or pre-production phases the expected product quality specification should be derived from the available coal quality data. Where necessary, bulk samples may be obtained through test pits, or shafts.

Tables G.1 and G.2 in annex G list some recommended tests and analyses that may be used to define the quality of various coal seams and coal products.

7.4.4 Density

Sufficient care shall be taken to ensure that the appropriate density is determined for the particular deposit, since inaccurate density determinations can have a significant impact on the tonnage estimates.

The apparent density or true density of a coal seam shall be determined on coal samples from borehole cores (or channel samples) using recognized standard laboratory methods or commonly used procedures, which shall be quoted. The moisture basis on which the density determination is based and the moisture basis on which the final density value is reported (in situ or air-dried basis), shall be stated.

Although the density should be correctly quoted on an in situ bed moisture basis, it is common practice to use the air-dried density of South African coal that have low in situ bed moisture contents. The in situ bed moisture should be determined to establish whether this relationship is in fact true.

If the true density is determined in the laboratory, the as analysed laboratory-determined true density shall be adjusted to the equivalent in situ bed moisture content (or air-dried moisture content) using the Sanders and Preston methodology. If the apparent density is measured, the moisture content can be assumed to be on an air-dried basis.

In some cases, where there are sufficient analytical results to obtain an acceptable relationship, it may be possible to calculate the density of the coal from the laboratory-determined ash content.

The in situ density may also be derived from calibrated geophysical density electric logs (with associated calliper logs), where these geophysical logs have been calibrated against laboratory analytical results.

7.5 Computer processing and coal deposit modelling

Computer processing of geological exploration data is critical for all projects, particularly for large deposits with numerous points of observation. The computer modelling of the coal deposit enables a thorough spatial evaluation of the coal resource by utilizing the individual points of observation data. Initial data input would include lithological, sampling, analytical, geotechnical and geophysical data. The importance of a reliable and detailed geological model for estimating the coal resources cannot be over emphasized.

All input data (such as collar coordinates, lithology, sampling data and coal quality analyses, amongst others) should be properly validated before the data is being manipulated. Such input enables the creation of plans and sections for validation and correlation purposes and the development of both a physical computer model based on the coal seam geometry and a coal quality computer model based on sampling analytical data. The spatial evaluation also enables facies analysis of associated sediments and statistical summaries of coal quality parameters and hence the development of an optimum product specification.

Proprietary software modelling techniques usually involve the generation of regularly spaced grids or surfaces of values based on the original points of observation data. The key aspect to a reliable computer model is an understanding of the interpolators used. For flat-lying deposits with limited thickness and topographic variability, the impact of different interpolators is minimal, while in the case of steeply dipping or structurally complex deposits the impact may be significant. In reporting the results, all computing parameters shall be carefully specified, such as the compositing method for sample data and analytical data, gridding technique, interpolator parameters and model cell size. The techniques employed shall be appropriate for the deposit being evaluated and a statement shall be made regarding the accuracy of the results, by comparing interpreted data with observed data.

7.6 Coal processing

The potential saleable products can be simulated based on a raw coal analysis or a washability analysis. In the case of a wash plant design, large diameter holes may be required to evaluate the washability characteristics of larger coal particles which is not possible when small diameter borehole core is used. Large diameter borehole core drilling provides sufficient sample material for bulk samples for product testing and for detailed product washability assessment, and is desirable for assisting with the coal chain engineering and for coal processing plant design. In addition, large diameter core samples may be required to provide sufficiently representative samples for combustion tests and other specialized tests for new potential coal products.

7.7 Geotechnical aspects

Geotechnical studies involve rock strength and degradation characteristics. In potential opencast mining operations geotechnical studies relate to high wall and spoil pile stability, and the assessment of blasting and ripping characteristics. In potential underground mining operations the geotechnical studies would relate to the evaluation of pillar strength, roof stability and coal cutability.

During the borehole core drilling programmes, rock properties such as fracture type, fracture spacing, rock quality designation (RQD) and hardness should be systematically recorded. Point load tests may be incorporated into the field logging of the core.

Representative borehole core samples that cover the full range of rock types and coal seams should be subjected to compressive and tensile strength tests and their elastic properties determined. In the case of potential underground mines, the borehole core testing should be concentrated within 5 m of the immediate roof and floor, while in the case of potential opencast mines, the borehole core testing should be conducted on representative samples of all lithological units which comprise the full overburden stratigraphic section.

7.8 Geohydrology

A specific integrated geohydrological evaluation programme should be undertaken during the pre-feasibility and feasibility phases to evaluate the impact of the potential mining operations on the ground water regime and vice versa. This work should include the drilling of water-monitoring wells, packer testing over specified sections, insertion and monitoring of piezometers and ground water quality determinations.

Ground water studies are essential since the results influence the following operational aspects:

a) high wall and spoil pile stability in opencast operations;

b) roof and floor conditions in underground operations;

c) blasting requirements;

d) mine equipment operational and trafficability impacts;

e) coal processing plant requirements;

f) mine water balance;

g) environmental treatment and containment; and

h) cost of mining.

7.9 Environmental aspects

The likely environmental impacts of any potential mining operations on the existing environment should be identified at the conceptual phase and evaluated in progressive levels of detail through to the operational phase. Such impacts involve predominately sensitive ecosystems, surface water, ground water, dust, noise, infrastructure requirements and social impacts and may necessitate the sterilization of coal resources.

All potential impacts on the environment specifically based on the geology shall be progressively assessed from the conceptual phase through to the operational phase, including closure. In the pre-feasibility and feasibility phases it is important to assess the acid-base generating potential of the coal (in situ, product and discard, as required) and rock (roof, floor and overburden, as required) using borehole core samples obtained during the various drilling phases. The following aspects should be evaluated from an acid-base accounting perspective in order to assess the short-term and long-term impacts on the ground-water and surface-water chemistry:

a) waste rock spoils and coal seams in opencast operations;

b) coal seams, roof and floor material in the underground operations; and

c) discards associated with any coal-processing operations.

7.10 Legislation

Consideration should be given to any legal constraints and regulations in defining the mineable limit of the coal resources or coal reserves. The evaluation shall take into consideration all relevant national regulations and statutory requirements.

8 Economic assessment

8.1 General

Economic assessment of coal resources and coal reserves is a key requirement for coal resource and coal reserve classification, which depends on the level of the associated economic study. The definition of a coal resource requires that an assessment shall have been done which shows that there are reasonable and realistic prospects of economic extraction, while the definition of a coal reserve requires that an assessment shall have been done which demonstrates that extraction is reasonably justifiable. A marginally economic coal resource is a reserve that is not economic at the time of assessment, but may become economic in the future as a result of changes in technological, economic, environmental and other relevant factors or conditions.

In order to adequately assess the economic potential of a coal resource and the associated coal reserve, a number of phases of technical and economic assessment are typically undertaken (see figure 4), which result in a progressive increase in the level of confidence required for the technical or the economic assessment (or both) of the project.

The increasing level of detail in the economic evaluation and therefore increasing level of reliability in the resource and reserve estimates is related to various phases of assessment which, in order of increasing detail, are

a) phase L1 : the geological study (see 3.4.1),

   L1A: the geological target generation study (see 3.4.1.1),
   L1B: the detailed geological study (see 3.4.1.2);

b) phase L2 : the conceptual economic study (see 3.4.2);

c) phase L3 : the pre-feasibility study (see 3.4.3);

d) phase L4 : the feasibility study (see 3.4.4); and

e) phase L5 : the mining or operational report (see 3.4.5).

To determine the appropriate exploration strategy, the type of deposit and the phase of economic evaluation shall first be established (see figure 4). The results of each phase of geological assessment will often determine any special needs for successive phases of the evaluation.

The prescribed level of reliability and detail required by each phase of economic assessment will determine the scope of the economic evaluation study. The ultimate objective of each phase of economic assessment is the comparison of the mining and coal processing costs against the anticipated product value. Some detail is given on the associated geological exploration programme which is required at each phase to ensure that the correct level of confidence in the coal resource is achieved, as this is the foundation for the proper classification of the coal resources and the associated coal reserves.

Diagrammatic representations of the coal resource and coal reserve subcategories regarding a geological and an economic study are illustrated in figure 9.

The discussion in 8.2 to 8.6 is focussed on the level of study required and does not necessarily give any comprehensive details on the requirements for each of the economic assessment studies.

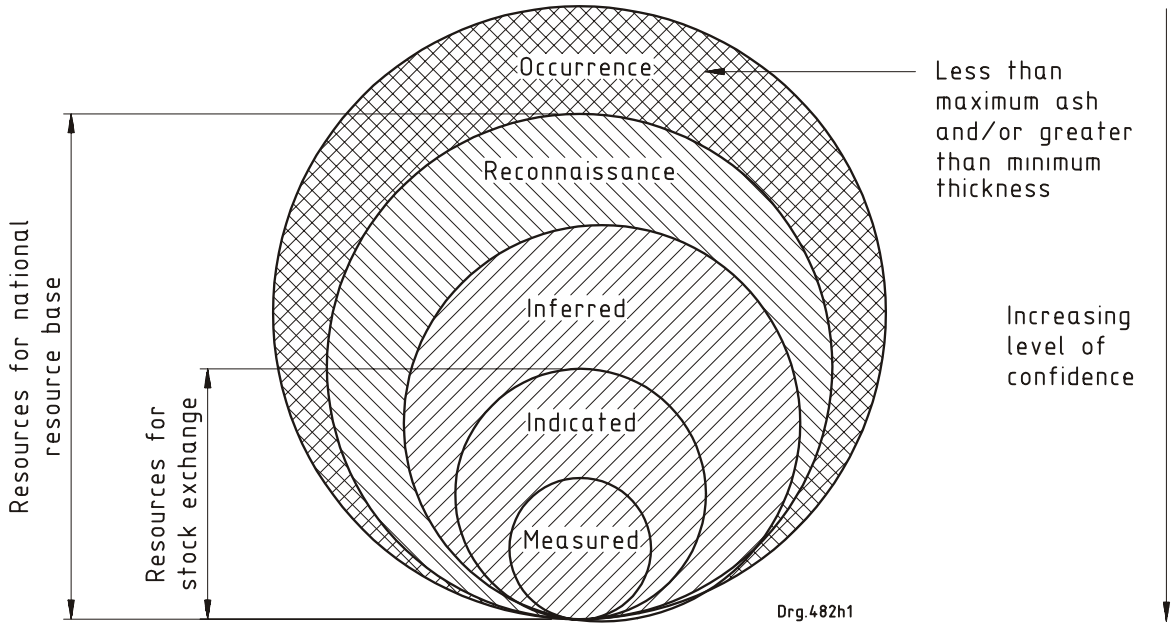
8.2 Phase L1: Geological study

8.2.1 Phase L1A: Target generation study (G0)

A geological target generation study is an initial geological evaluation composed of a desktop study, including a literature review of all available data. Limited fieldwork, where applicable, is recommended for the evaluation of a coal occurrence. Limited geological drilling may be required to confirm the presence of a coal occurrence.

8.2.2 Phase L1B: Detailed geological study (G1)

The purpose of the geological study is to identify a coal deposit, investigate the physical continuity and coal quality continuity, determine the prospects of economic extraction and thereby identify an investment opportunity. A geological study represents the technical work undertaken to produce a physical and coal quality model at varying levels of confidence.



NOTE Note the difference in the reporting requirements for coal resources reported to the National Coal Inventory and to the stock exchange.

Figure 9(a) – Geological study

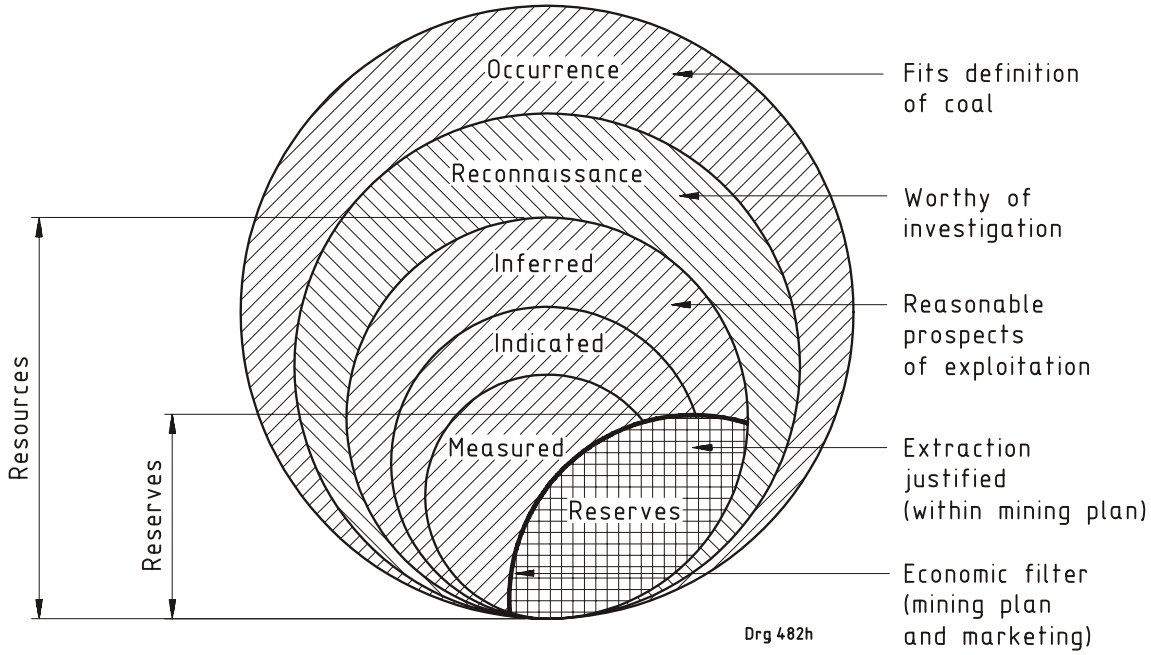


Figure 9(b) — Economic study

Figure 9 — A diagrammatic representation of the coal resource and coal reserve subcategories in relation to a geological and an economic study

In the geological study the borehole spacing shall be sufficient to gauge the continuity of the coal seam in terms of physical characteristics and coal quality characteristics. The lithological and structural parameters that affect geological continuity and mining shall be assessed. The impact of the coal quality variability, including yield variability and mineability, on the coal processing efficiency (where applicable) and expected product quality shall be assessed. Geotechnical and environmental constraints that affect the coal resource should also be identified.

Critical aspects of the geological study are the evaluation of the physical continuity and the coal quality continuity, which impact on the level of confidence of the coal resource estimate. The minimum objective of a geological study shall be a borehole spacing that at least defines the coal deposit as an inferred coal resource, but preferably as an indicated coal resource.

The physical continuity of the coal seam is the primary component in evaluating a coal deposit and will include cognizance of the seam thickness variability, seam splitting, the impact of faulting, the structural complexity and intrusions. The coal quality continuity of the coal seam is an important secondary component in the evaluation of a coal deposit. Although coal quality data may exist at several specific points of observation, the coal quality continuity of the deposit cannot always be assumed due to inadequate sampling data for the specific variability of the coal quality in the deposit.

From a geological study point of view certain factors need to be considered at the beginning of the economic evaluation to provide an assessment of the critical factors that will affect the mineability and marketability of the deposit. It is important to identify these factors as part of the geological study in order to be able to provide the criteria for mine design and coal processing design required in the economic assessment. In addition to the geological assessment, an initial assessment of geotechnical, geohydrological, mining, environmental, coal processing and marketing aspects can be made from the data collected as part of the geological drilling and core sampling programme.

The following criteria should be considered in the geological study (The list is extensive, but is not necessarily comprehensive.):

a) **Geological factors**

1) thickness and spatial distribution of coal seams,

2) characteristics of inter-seam and intra-seam partings, type, thickness, variability,

3) weathering characteristics and location of coal seam sub-outcrop(s),

4) dip and dip variability,

5) impact of basement geology on coal seam distribution,

6) overburden and interburden: type, geotechnical aspects, impact on blasting and mining,

7) roof: type, variability, geotechnical aspects, impact on dilution and contamination and safety,

8) floor: type, variability, geotechnical aspects, impact on dilution and contamination and safety,

9) faults: throw, frequency and orientation, and

10) intrusions: type, size, extent, age, frequency and orientation.

b) **Coal quality**

1) typical,

2) variability,

3) spatial distribution, and

4) coal quality cut-off.

c) **Geotechnical factors**

1) rock strength;

2) fracture frequency;

3) presence of weak zones, etc.

d) **Geohydrology factors**

1) presence of ground water;

2) water quality;

3) recognition of aquifers;

4) impact on geotechnical aspects; and

5) mineability.

e) **Mining factors**

1) mineable coal seam cut-off(s), both minimum and maximum,

2) control of selective mining,

3) grade control,

4) gas: type, presence, quantity, and

5) spontaneous combustion: potential for coal or overburden to self combust.

f) **Coal processing**

– yield: theoretical product yield, practical product yield discount factors, yield cut-off.

g) **Marketability**

1) product type,

2) product quality variability, and

3) combustion characteristics.

h) **Environmental factors**

– potential impacts to the surface environment and subsurface environment, including the impact on rivers, wetlands, ground water, natural habitat.

i) **Legal factors**

1) mineral rights, prospecting rights, mining rights, surface rights, and

2) governmental regulations and statutory requirements.

8.3 Phase L2: Conceptual economic study

The conceptual economic study (see 3.4.2) is typically a desktop preliminary economic assessment of a coal resource, which allows for a preliminary comparison of project alternatives. The result of this assessment can be either the rejection of the project, the shelving of a project or the continuation thereof. A conceptual economic study indicates whether there is a case for further investigation, such as further geological exploration, laboratory test work, market research or a more detailed engineering study, and will give a preliminary indication of the order of magnitude of the capital, operating costs and revenue. Accuracy of estimates within the conceptual economic study will usually not be better than plus or minus 30 %.

8.4 Phase L3: Pre-feasibility study

8.4.1 Economic evaluation

A pre-feasibility study (see 3.4.3) is a preliminary assessment of the economic viability of a deposit and forms the basis for justifying further investigations. It usually follows a successful geological exploration campaign and summarizes all geological, geotechnical, mining, coal processing, engineering, environmental, marketing, legal and economic information accumulated on the project. A pre-feasibility study is undertaken to determine the initial economic viability of a project. It is suitable for a detailed comparison of alternatives, meaningful economic evaluations, the definition of areas in need of further detailed investigation and deciding to proceed with detailed environmental studies or not. The confidence of estimations within the pre-feasibility study is usually within plus or minus 15 % to 25 %.

A pre-feasibility study should preferably be undertaken on either measured coal resources, indicated coal resources or both, but the life of mine plan may include some inferred coal resources on condition that the percentage of inferred resources in the mine plan is stated. Mine scheduling shall be developed for the life of mine, or 20 years, whichever is the minimum, in increments of five years. The market status evaluation is based on product type, geographic location and costs of standard mining methods and transport systems. Product prices will partly determine the minimum annual tonnage required, and the maximum transport distance for the project to be viable.

A pre-feasibility study should be carried out before a feasibility study to be able to determine the preliminary economic feasibility of the project and assist in defining the scope of the feasibility study or the shelving or the rejection of a project. The pre-feasibility study is often used for ranking the coal resource in the market place. If the project is marginal for any reason, further assessment may be postponed or the project could be rejected. The outcome of a pre-feasibility study will determine whether the coal resource may be reclassified as a probable coal reserve.

8.4.2 Pre-feasibility geological study (G2)

The pre-feasibility geological study requires the cored borehole spacing to be reduced to an acceptable level to define the coal deposit as an indicated coal resource or as a measured coal

resource. The physical points of observation and coal quality points of observation data shall have been evaluated using a three-dimensional computer model of the coal deposit. Indicative mining limits and coal quality trends should be delineated. The potential impact of sedimentological variations, structural disturbances and intrusive activity shall be evaluated. Geophysical investigations relevant to the particular deposit may be undertaken. Indicative geotechnical, geohydrological and environmental assessments shall be made.

Large diameter drilling, depending on the expected particle top size of the product, may be necessary to evaluate product quality, coal washability, product yields, preliminary coal processing plant concept design and preliminary coal utilization aspects.

8.5 Phase L4: Feasibility study

8.5.1 Economic evaluation

A feasibility study (see 3.4.4) represents a detailed assessment of the technical soundness and economic viability of a mining project. It represents a detailed economic evaluation that serves as a basis for the investment decision and allows for the preparation of a bankable document for project financing. The study constitutes an audit of all geological, geotechnical, mining, coal processing, engineering, environmental, marketing, legal and economic information accumulated on the project. The feasibility study provides a basis for evaluating the potential viability of the project and serves as a reference for board approval for a project to proceed.

A feasibility study is seldom undertaken unless there is a reasonable assurance that the proposal is feasible and is usually preceded by a pre-feasibility study. The confidence of estimations within the feasibility study is usually within plus or minus 10 % to 15 % (see 3.4.4).

The feasibility study shall only be undertaken on measured coal resources and indicated coal resources. The feasibility study shall not be undertaken on inferred coal resources. The measured coal resources in the mine plan shall at least cover the payback period or five years, whichever is the longer. Some inferred coal resources may be included in the mine plan on condition that the percentage of inferred resources in the mine plan is less than 20 % and that the actual percentage of inferred resources in the mine plan is stated.

Mine scheduling shall be developed for the life of mine, or 20 years, whichever is the minimum, and shall include details of the yearly increments of the first five-year development plan, with the remaining life of the mine in increments of five years.

The outcome of a feasibility study determines whether the coal resource may be reclassified as a proven or probable coal reserve.

The planning and design of coal handling facilities and required coal processing facilities are undertaken during the feasibility study.

A detailed coal quality assessment of a bulk sample is recommended for product evaluation and coal utilization test work. A trial mining operation or a pilot plant may be required, especially if the project is in a new area or a new product is being considered. Detailed environmental base line study and environmental impact assessment shall be undertaken during the feasibility study to ensure that mining authorization from the Department of Minerals and Energy can be obtained should the project be approved. Sufficient information needs to be available to undertake a risk analysis on all the technical and economic factors associated with the project in order to be able to assess the risks of the project.

8.5.2 Feasibility geological study (G3)

The feasibility geological study requires the cored borehole spacing to be reduced to an acceptable level to define the coal deposit as a proportion of a measured coal resource or an indicated coal resource. The proportion of measured coal resources should at least cover the five-year mining window or the payback period, whichever is the longer.

The physical point of observation data and coal quality point of observation data shall have been evaluated using a three-dimensional computer model of the coal deposit. Mineable limits and coal quality trends shall be delineated. The impact of sedimentological and depositional variations, structural disturbances and igneous activity shall be carefully evaluated. Geophysical investigations relevant to the particular deposit should be undertaken. Complete geotechnical, geohydrological and environmental assessments shall be made.

Large diameter drilling, depending on the top size of the product, may be necessary to confirm the product quality, coal washability, product yields, detailed coal processing plant design and coal utilization aspects.

8.6 Phase L5: Operational phase

8.6.1 Mining or operational report

A mining report (see 3.4.5) reflects the state of development and exploitation of a deposit during its economic life, including current mining plans. The mining report presents the status of the deposit, providing detailed and accurate up-to-date statements on the remaining coal reserves and coal resources. The mining report takes into account any reconciliation exercises that have been undertaken and compares what has been mined with the original coal reserve predictions. The remaining coal reserves and coal resources are based on the updated reserve discount factors or modifying factors, or both.

The mine plan requires detailed scheduling for the current year and further details on an annual basis for the five-year development plan (or life of mine). The remaining life of mine outside the five-year window shall be evaluated at a maximum of five-year increments over the life of mine.

8.6.2 Pre-production geological investigation (G4)

The pre-production geological investigation shall focus on improving the level of geological confidence in the early stage of the project. Typically additional close-spaced drilling will be undertaken in the immediate mining area (in year one to two) as defined by the grade control borehole drilling requirements for short-term quality control. This borehole spacing depends on the local variability of the geological, physical and coal quality data in the coal reserve. At least the first five years' production, or up to the end of the payback period (whichever is the minimum), should be at the proven coal reserve level (see 3.31.2). Pre-production geological investigations call for the detailed delineation of the coal seam sub-outcrop and the limitation of weathering or oxidation. The definition of the drilling requirements in the one to two-year budget window and the two to five-year medium-term mining window shall be defined. The additional boreholes shall be drilled to bring the borehole drilling density to the required density within the specified time windows, i.e. "grade control" in a one to two-year window, "medium term" in years two to three, and "measured" to at least year five or the payback period, whichever is the longer.

8.6.3 Production or operational geological investigation (G5)

It is recommended that the operational phase of geological investigation continues to delineate the coal reserve by drilling geological boreholes on an ongoing basis to provide a cover of adequate

borehole spacing to define proven coal reserves for a minimum of five years ahead of the planned mining operations.

More detailed geological drilling is required in the immediate vicinity of the mining operations for grade control purposes. This grade control drilling should typically cover a one to two-year mining window in opencast or underground operations. The computerized geological model shall be progressively updated, on at least an annual basis, with the addition of the geological data that is collected as part of the ongoing operational geological drilling programme.

Monitoring of the physical and the coal quality parameters of the coal reserve remains ongoing, with the periodic reconciliation (at least annually) of the predicted coal reserves against the actual coal mined.

The drilling requirements in the one to two-year budget window and the two to five-year medium-term mining window shall be defined, such that the “grade control” drilling is undertaken for the one to two-year window, “medium-term” drilling is undertaken for the window that covers years two to three, with the drilling in the five-year window at such a level to define the coal resources at least at measured status.

Annex A
(normative)

National Coal Inventory data capture forms

NOTE For the purposes of this standard, “sulphur” is deemed to be equivalent to “sulfur” (the International Union for Pure and Applied Chemistry’s preferred spelling).

Form 1 – Resource and reserve table

Block name /ID	1	
Seam /subseam /dump name	2	
Coalfield	3	
Colliery /Prospect	4	
Owner	5	
Map reference	6	

A block is defined by a single enclosing polygon per seam

	RESERVES (million tonnes)						**RESOURCES** (million tonnes in situ after geological loss has been applied)											
	PAST EXPLOITATION *(Reserves only)*		**APPROVED MINING REPORT** *(Economic mine plan)*				**MINE PLAN** *At feasibility / pre-feasibility stage (Mine plan with economics uncertain)*				**GEOLOGICAL STUDY** (No mine plan)					
											Detailed exploration		General exploration		Prospecting exploration		Reconnaissance exploration	
	Mined out		**Proven coal reserve**		**Probable coal reserve**		**Feasibility coal resource**		**Pre-feasibility coal resource**		**Measured coal resource**		**Indicated coal resource**		**Inferred coal resource**		**Reconnaissance resource**	
Date as at	7		18		31		44		47		50		53		56		59	
(in million tonnes)																		
In situ resource basis (TTIS)			19		32		45		48		51		54		57		60	
Mineable in situ **resource** basis (MTIS)			20		33		46		49		52		55		58		61	
Mineable in situ **reserve** basis (MTIS)	8		21		34													
Run of Mine reserve basis (ROM)	9		22		35													
Saleable reserve basis																		
Steam coal (export)	10		23		36													
Low ash coal	11		24		37													
Metallurgical coal	12		25		38													
Power generation coal	13		26		39													
Gasification coal	14		27		40													
Coal (general domestic)	15		28		41													
Other	16		29		42													
Existing stacked discards *	17																	
Future discards **			30		43													

* *As arising for Life of Mine*
** *As for remaining planned Life of Mine*

STERILIZED AREAS AND COAL LOSSES (million tonnes in situ)		
Date as at	62	
Due to		
Surface structures	63	
Orderly urban development	64	
Informal urban development	65	
Other (elaborate)		
	66	
	67	
	68	
	69	
	70	
	71	
	72	

MINING METHOD (million tonnes ROM)					
Opencast	73		75		77	
Underground	74		76		78	

COMPETENT PERSON(S)			
Name		SACNASP No.	
79		82	
80		83	
81		84	

GEOLOGICAL LOSS FACTORS (%)		
Reconnaissance resource	85	
Inferred coal resource	86	
Indicated coal resource	87	
Measured coal resource	88	
Pre-feasibility coal resource	89	
Feasibility coal resource	90	
Probable coal reserve	91	
Proven coal reserve	92	

Form 2 – Block locality

Block name /ID	1	
Seam /subseam /dump name	2	
Coalfield	3	
Colliery /Prospect	4	
Owner	5	
Map reference	6	

Copy from form 1

Attach 1:50 000 scale map that shows block boundaries, relevant seam extent as well as physical, economic and cultural features

OPTIONS

		Mark with X
Electronic copy	7	
or		
Coordinates for corners of the Block boundary	8	

PROJECTION

LO system	9		NOTE Cape or Hartebeeshoek Datum (Gauss conform)
WGS 84 system	10		

Preferred system if coordinates are used			or	*Alternative system*				or	*Alternative system*	
					Deg	Min	Sec e.g. 9,99			Decimal degrees
Central meridian	11									
LOY	12			Long					Long	
LOX	13			Lat					Lat	
LOY	14			Long					Long	
LOX	15			Lat					Lat	
LOY	16			Long					Long	
LOX	17			Lat					Lat	
LOY	18			Long					Long	
LOX	19			Lat					Lat	
LOY	20			Long					Long	
LOX	21			Lat					Lat	
LOY	22			Long					Long	
LOX	23			Lat					Lat	
LOY	24			Long					Long	
LOX	25			Lat					Lat	
LOY	26			Long					Long	
LOX	27			Lat					Lat	
LOY	28			Long					Long	
LOX	29			Lat					Lat	
LOY	30			Long					Long	
LOX	31			Lat					Lat	
LOY	32			Long					Long	
LOX	33			Lat					Lat	
LOY	34			Long					Long	
LOX	35			Lat					Lat	

Continuation pages for coordinates up to field 1000

Form 3 – Physical characteristics

Block name/ ID	1	
Seam/ subseam/ dump name	2	
Coalfield	3	
Colliery /Prospect	4	
Owner	5	
Map reference	6	

Copy from form 1

Reserve	7	
Resource	8	

Mark with X; a separate form has to be completed for resource and reserve

MINING METHOD

Opencast	9	
Underground	10	

Mark with X; a separate form has to be completed for the area of each mining method

SEAM CHARACTERISTICS

FULL SEAM THICKNESS (m)			MINING HORIZON THICKNESS (m)		
Cut-off (usually 0,5 m)	11		Cut-off	22	
Maximum thickness	12		Maximum thickness	23	
Minimum thickness	13		Minimum thickness	24	
Average thickness	14		Average thickness	25	
Coal quality cut-off(s)			Coal quality cut-off(s)		
Ash (%)	15		Ash (%)	26	
CV (MJ/kg)	16		CV (MJ/kg)	27	
Moisture (%)	17		Moisture (%)	28	
Volatiles (%)	18		Volatiles (%)	29	
Sulphur (%)	19		Sulphur (%)	30	
Swell number	20		Swell number	31	
Roga index	21		Roga index	32	

ROOF DEPTH BELOW SURFACE (m)			PRACTICAL MINING THICKNESS with dilution (m)		
Maximum	33		Maximum	36	
Minimum	34		Minimum	37	
Average	35		Average	38	

COAL – NOT RECOVERABLE (m)

In roof	39	
In floor	40	

INTERBURDEN PARTING THICKNESS BETWEEN SUCCESSIVE COAL SEAMS (m)

Above: from seam name	41		to seam name	42	
Maximum	43				
Minimum	44				
Average	45				
Below: from seam name	46		to seam name	47	
Maximum	48				
Minimum	49				
Average	50				
Minimum interburden part cut-off	51				

For enclosed lithology include one or more typical stratigraphic columns with their respective coordinates.

Form 4 – Coal resource quality table

Block name /ID	1	
Seam /subseam /dump name	2	
Coalfield	3	
Colliery /Prospect	4	
Owner	5	
Map reference	6	

Copy from form 1

BASIS FOR ANALYSIS		Air-dried	Dry	
CV – uncorrected for sulphur	7			MJ/kg
CV – corrected for sulphur	8			MJ/kg
Relative density of coal	9			

PROXIMATE ANALYSIS (in %)		Air-dried	Dry	As determined
Moisture in analysis sample	10			
Bed moisture/ equilibrium moisture	11			
Ash content #	12			
Volatile matter content	13			
Fixed carbon content*	14			

 # If ash content is higher than 50 %, material may only be considered as coal if exploitation has been proven to be economic

***Fixed carbon = 100 - (H_2O + ash + volatiles)**

ULTIMATE ANALYSIS (in %)		Air-dried	Dry	Dry ash-free
Carbon	15			
Hydrogen	16			
Oxygen **	17			
Nitrogen	20			
Total sulphur	21			

Mark with X where applicable

By calculation 18 | **By analysis** 19

**** O = 100 - (moisture in analysis sample + ash + C + H + N + S)**

MISCELLANEOUS CHEMICAL ANALYSES (in %)		Air-dried	Dry
Sulphate sulphur	22		
Pyritic sulphur	23		
Organic sulphur***	24		
Carbonate (CO_3)	25		
Chlorine	26		
Phosphorus	27		

***** Organic sulphur = total sulphur - sulphate sulphur - pyritic sulphur**

ASH FUSION TEMPERATURE (°C)		Reducing		Oxidizing
Deformation temperature	28		32	
Softening temperature	29		33	
Hemisphere temperature	30		34	
Flow temperature	31		35	

COKING PROPERTIES		
Swelling number	36	
Roga index	37	
Gieseler maximum plasticity	38	
Audibert-Amu max. expansion	39	

SUNDRY ANALYSES		
Grindability (Hardgrove index)	40	
Abrasion (Yancey, Geer & Price index)	41	

Mark with X where applicable

PETROGRAPHY

$\overline{R}_r$ **(random)(%)**	42		**If measured optically**	48		**If not, leave open; to be determined by database**
Vitrinite content (%)	43		**If measured optically**	49		**If not, leave open; to be determined by database**
Liptinite content (%) (Exinite)	44					
Inertinite content (%)	45					
Total reactives (%)	46					
Mineral matter (A%)	47					

To be filled in electronically by the contractor using data above

Ash (db)	50		$Ash_{(db)} = \{100 / [100-H_2O_{(ad)}]\} \times ash_{(ad)}$
GCV (daf)	51		$GCV_{(daf)} = \{100 / [100-H_2O_{(ad)} - ash_{(ad)}]\} \times GCV_{(ad)}$
Net CV (ad)	52		$Net\ CV_{(ad)} = GCV_{(ad)} - 0{,}206 \times H_{(ad)} - 0{,}023 \times H_2O_{(ad)}$
Net CV (daf)	53		$Net\ CV_{(daf)} = \{100 / [100 - H_2O_{(ad)} - Ash_{(ad)}]\} \times NCV_{(ad)}$
Volatiles(daf)	54		$VM_{(daf)} = \{100 - H_2O_{(ad)} - Ash_{(ad)}\} \times VM_{(ad)}$
Carbon(daf)	55		$C_{(daf)} = \{100 / [100 - H_2O_{(ad)} - Ash_{(ad)}]\} \times C_{(ad)}$
Hydrogen(daf)	56		$H_{(daf)} = \{100 / [100 - H_2O)_{(ad)} - Ash_{(ad)}]\} \times H_{(ad)}$
Oxygen(daf)	57		$O_{(daf)} = \{100 / [100 - H_2O_{(ad)} - Ash_{(ad)}]\} \times O_{(ad)}$
Nitrogen(daf)	58		$N_{(daf)} = \{100 / [100 - H_2O_{(ad)} - Ash_{(ad)}]\} \times N_{(ad)}$
Bed moisture/equilibrium moisture$_{(af)}$	59		$BM_{(af)} = [100 / (100 - ((100 - BM_{(as\ det)}) / (100-H_2O_{(ad)}) \times ash_{(ad)})] \times BM_{(as\ det)}$

CALCULATED PETROGRAPHICAL PARAMETERS

Inferred vitrinite reflectance ($\overline{R}_r$ %)	60	
Inferred vitrinite (%)	61	

Form 5 – Coal reserve quality table

Block name /ID	1	
Seam /subseam /dump name	2	
Coalfield	3	
Colliery /Prospect	4	
Owner	5	
Map reference	6	

Copy from form 1

Product No.	7	

PRODUCT NAME		Million tonnes
Mineable in situ coal (air-dried)	8	
ROM (contaminated)	9	
Saleable coal		
Steam coal	10	
Low ash coal	11	
Metallurgical coal	12	
Power station coal	13	
Gasification coal	14	
Domestic heating coal	15	
Other	16	
Practical yield (air-dried) %	17	

SIZE RANGE (mm)		Bituminous	Anthracite
Cobbles	18		
Large nuts	19		
Small nuts	20		
Peas I	21		
Peas II	22		
Smalls I	23		
Smalls II	24		
Smalls III	25		
Duff	26		
Other	27		

BASIS FOR ANALYSIS		Air-dried	Dry	
CV – uncorrected for sulphur	28			MJ/kg
CV – corrected for sulphur	29			MJ/kg
Relative density of coal	30			

PROXIMATE ANALYSIS (in %)		Air-dried	Dry
Moisture in analysis sample	31		
Bed moisture/ equilibrium moisture	32		
Ash content #	33		
Volatile matter content	34		
Fixed carbon content*	35		

If ash content is higher than 50 %, material may only be considered as coal if exploitation has been proven to be economic

* Fixed Carbon = 100 – (H_2O + ash + volatiles)

ULTIMATE ANALYSIS (in %)		Air-dried	Dry	Dry ash-free
Carbon	36			
Hydrogen	37			
Oxygen **	38			
Nitrogen	39			
Total sulphur	40			

Mark with X where applicable

By calculation ** 41 | by analysis 42

**O = 100 - (moisture in analysis sample + ash + C + H + N + S)

MISCELLANEOUS CHEMICAL ANALYSIS (in %)		Air-dried	Dry
Sulphate sulphur	43		
Pyritic sulphur	44		
Organic sulphur ***	45		
Carbonate (CO_3)	46		
Chlorine	47		
Phosphorus	48		

***Org sulphur = total sulphur - sulphate sulphur - pyritic sulphur

ASH FUSION TEMPERATURE (°C)		Oxidizing	Reducing
Deformation temperature	49		
Softening temperature	50		
Hemisphere temperature	51		
Flow temperature	52		

Form 5 *(continued)*

COKING PROPERTIES

Swelling number	53	
Roga index	54	
Gieseler maximum plasticity	55	
Audibert-Amu max. expansion	56	

SUNDRY ANALYSIS

Grindability (Hardgrove index)	57	
Abrasion (Yancey, Geer & Price index)	58	

PETROGRAPHY

$\overline{R}_r$ (random) %	59	
Vitrinite content %	60	
Liptinite content % (Exinite)	61	
Inertinite content %	62	
Total reactives %	63	
Mineral matter %	64	

Mark with X where applicable

If measured optically	65		If not, leave open; to be determined by database
If measured optically	66		If not, leave open; to be determined by database

For each product, fill in a separate form 5.

Form 6 – Coal classification

To be filled in by contractor from data collected from the forms.

Block name /ID	1	
Seam /subseam /dump name	2	
Coalfield	3	
Colliery /Prospect	4	
Owner	5	
Map reference	6	

Copy from form 1

COAL RANK
From: form 4

Classification method	75 %>BM (af) >35%	$\bar{R}_r$ < 0,40 % BM (af) ≤ 35%	Random reflectance ($\bar{R}_r$) % *If reflectance is unavailable, calculate $\bar{R}_r$ by using one or more of the calculations shown in form 4*							
			0,40 to 0,49	0,5 to 0,6	0,6 to 1,0	1,0 to 1,4	1,4 to 2,0	2,0 to 3,0	3,0 to 4,0	4,0 to 6,0
Rank	**Low-rank coal**			**Medium-rank coal (bituminous)**				**High-rank coal (anthracitic)**		
	LRC	LRB	LRA	MRD	MRC	MRB	MRA	AC	AB	AA
Mark selection	7	8	9	10	11	12	13	14	15	16

*: BM (af) denotes bed moisture, on an ash-free basis.

Final rank classification

Determined	Inferred		
	Method A	Method B	Method C
17	18	19	20

Ash mass (%) (dry basis)					
Below 10	10 to less than 20	20 to less than 30	30 to less than 50	50 to less than 70*	Plus 70*
21	22	23	24	25	26

Mark selection

*To be filled in only in the case when the company involved has shown that exploitation is economically feasible.

Annex B
(informative)

Alphabetical list of definitions

List of definitions (for ease of reference)

air-dried moisture	3.16.1
apparent relative density	3.20.2
apparent rank	3.14.1
apparent seam thickness	3.18.1
average strip ratio	3.56.1
bed moisture	3.16.2
bulk density	3.20.3
burnt coal	3.8
coal	3.5
coal deposit	3.11
coal deposit type	3.12
coal in remnants and coal in pillars	3.51
coal occurrence	3.10
coal quality	3.13
coal quality cut-off value	3.15.2
coal quality point of observation	3.17.2
coal reserve	3.31
coal resource	3.25
coal seam	3.6
coal seam thickness cut-off value	3.15.1
competent person	3.3
composite coal seam	3.7
conceptual economic study	3.4.2
contamination material	3.40
cut-off value	3.15
density	3.20
detailed geological study	3.4.1.2
devolatilized coal	3.9
dilution material	3.34
discards and reject coal	3.52
dry basis	3.16.14
dump	3.54
economic studies	3.4
equilibrium moisture	3.16.3
extractable coal reserve	3.38
extrapolation distance	3.19

feasibility coal resource 3.25.6
feasibility study 3.4.4
floor of the coal seam 3.6.3

free moisture 3.16.4
full coal seam 3.6.1

geological loss factor 3.21
geological model estimation error 3.21.2
geological study 3.4.1

geological target generation study 3.4.1.1
gross in situ coal resource 3.26

in situ coal resource 3.27
in situ moisture 3.16.2
incremental strip ratio 3.56.2

incremental strip ratio cut-off value 3.15.3
indicated coal resource 3.25.3
inferred coal resource 3.25.2

inferred rank 3.14.2
inherent moisture 3.16.5

marginally economic coal resource 3.23
measured coal resource 3.25.4
mineable in situ coal resource 3.29

mineable in situ coal reserve (practical mining height) 3.36
mineable in situ coal reserve (theoretical mining height) 3.33
mining layout extraction factor 3.37

mining layout loss factor 3.32
mining recovery efficiency factor 3.39
mining report 3.4.5

modifying factor 3.30
moisture 3.16
moisture as-determined 3.16.9

moisture as-received 3.16.8
moisture-free basis 3.16.14
moisture-holding capacity 3.16.6

moisture in analysis sample 3.16.7
moisture reporting basis for tonnage, density and coal quality 3.16.15
multiple seam deposit type 3.12.1

National Coal Inventory 3.2
national survey reference grid 3.55

physical geological loss 3.21.1
physical point of observation 3.17.1
point of observation 3.17

practical mining height 3.35
practical product yield 3.46
pre-feasibility coal resource 3.25.5

pre-feasibility study 3.4.3
probable coal reserve 3.31.1
proven coal reserve 3.31.2
public report 3.1

rank 3.14
reasonable and realistic prospect of economic extraction 3.22
reconnaissance coal resource 3.25.1

reject coal 3.51
relative density 3.20.1
residual moisture 3.16.10

roof of the coal seam 3.6.2
run of mine (as delivered) coal reserve 3.42
run of mine moisture content correction factor 3.41
run of mine coal reserve reporting basis 3.43

saleable coal reserve 3.48
saleable coal reserve reporting basis (reserve beneficiated) 3.50
saleable coal reserve reporting basis (reserve not beneficiated) 3.49

saleable moisture correction factor 3.47
seam thickness 3.18
sterilized coal resource 3.24

stockpile 3.53
strip ratio 3.56
surface moisture 3.16.11

theoretical mining height 3.28
theoretical product yield (uncontaminated basis) 3.44
theoretical product yield (contaminated basis) 3.45

thick interbedded seam deposit type 3.12.2
total moisture 3.16.12
true seam thickness 3.18.2

vitrinite maximum reflectance 3.57.1
vitrinite minimum reflectance 3.57.2
vitrinite random reflectance 3.57.3
vitrinite reflectace 3.57

water of constitution 3.16.13

Annex C
(informative)

Rank determination

C.1 Background

Information to date indicates that South African coal resources are predominantly bituminous (medium-rank coal) followed by some anthracitic (high-rank coal) and negligible lignites (low-rank coal). In terms of rank parameters, it is recommended that the guidelines of the ISO draft on classification of coals (ISO/DIS 11760) are followed. Mean vitrinite random reflectance is the predominant rank parameter in the draft ISO standard. Mean vitrinite random reflectance ($\overline{R}_r$) (see 3.57.3) is used to delineate the medium-rank and high-rank boundaries and the higher category of the low-rank coals. Bed moisture (ash-free basis) is the prime rank parameter for the two lowermost rank subdivisions of the low-rank coals.

C.2 Rank parameters

C.2.1 Rank – Primary categories

Three primary rank categories, low-rank, medium-rank and high-rank, are defined in table C.1.

Table C.1 — Definitions of primary rank coal categories, low-rank, medium-rank and high-rank

1	2
Coal rank	**Rank parameter**
Low-rank [a] (Lignite/brown coal and sub-bituminous coals)	Bed moisture $\leq$ 75 % and $\overline{R}_r$ < 0,5 %
Medium-rank [a] (Bituminous coals)	0,5 % $\leq \overline{R}_r$ <2,0 %
High-rank [b] (Anthracites)	2,0 % $\leq \overline{R}_r$ < 6,0 % (or $\overline{R}_{v\,max}$ < 8,0 %) [c]

[a] The boundary between low-rank and medium-rank coals is set at $\overline{R}_r$ = 0,5 % since coals with $\overline{R}_r$ between 0,5 % and 0,6 % (the latter being the threshold value set for medium-rank coals in the *International classification of in-seam coals*) are texturally similar to coals with $\overline{R}_r$ exceeding 0,6 %. The degree of gelification is high and shrinkage cracks are not observed when fresh coal is exposed to the atmosphere.

[b] $\overline{R}_{v\,max}$ = 8,0 % (see 3.57.1) is just beyond the rank where $\overline{R}_{v\,max}$ ~2,5 % falls rapidly from its maximum of $\overline{R}_{v\,max}$ ~3,5 % at $\overline{R}_{v\,max}$ = 6 % and marks the transition to increasing graphitization (see *Organic petrology*).
(Contact altered coals with $\overline{R}_{v\,max}$ as high as 10,5 % are classified as anthracite in China.)

[c] $\overline{R}_{v\,max}$ is preferred at this rank since $\overline{R}_r$ is difficult to measure reliably.

C.2.2 Rank – Subcategories

To provide a greater classification resolution, the three primary rank categories are subdivided into subcategories, defined in tables C.2, C.3 and C.4.

Table C.2 — Low-rank coals

1	2
Coal rank	**Rank parameter**
Low-rank C [a, b] (Lignite C)	$\overline{R}_r$ < 0,4 % and bed moisture > 35 % and < 75 %, ash-free basis
Low-rank B [a, b] (Lignite B)	$\overline{R}_r$ < 0,4 % and bed moisture ≤ 35 %, ash-free basis
Low-rank A (Sub-bituminous coal)	0,4 % ≤ $\overline{R}_r$ < 0,5 %

[a] $\overline{R}_r$ shall be measured on ulminite B, or, preferably, eu-ulminite, or telovitrinite, if present.

[b] A 35 % bed moisture corresponds approximately to the bed moisture content used in Germany to distinguish between coals designated “soft brown” and “hard brown”. Soft brown coals, at the microscopic level, have large pore volume with open cell lumens (textinite) with little evidence of gelification. Hard brown coals have low pore volume, mainly filled cell lumens and significant gelification.

Table C.3 — Medium-rank coals (bituminous coals)

1	2
Coal rank	**Rank parameter**
Medium-rank D [a] (Bituminous D)	0,5 % ≤ $\overline{R}_r$ < 0,6 %
Medium-rank C [b] (Bituminous C)	0,6 % ≤ $\overline{R}_r$ < 1,0 %
Medium-rank B [c] (Bituminous B)	1,0 % ≤ $\overline{R}_r$ < 1,4 %
Medium-rank A [d] (Bituminous A)	1,4 % ≤ $\overline{R}_r$ < 2,0 %

[a] A reflectance of 0,6 % approximates to the onset, as the rank increases, of the formation of coke from the vitrinite under standard heating conditions (3 ºC per min).

[b] A reflectance of 1,0 % approximates to the transition, under standard heating conditions (3 ºC per min), as the rank increases, of the texture of the coke formed from the vitrinite, from fine to medium mosaic; also coincides approximately with the coalification stage where maximum oil generation occurs.

[c] A reflectance of 1,4 % approximates to the transition, as the rank increases, of the texture of the coke formed from the vitrinite, under standard heating conditions (3 ºC per min), from medium mosaic to fibrous; also coincides approximately with the coalification stage where oil generation ceases.

[d] A reflectance of 2,0 % approximates to the end, as the rank increases, of the softening and swelling properties of the vitrinite, under standard heating conditions (3 ºC per min).

Table C.4 — High-rank coals (anthracites)

1	2
Coal rank	**Rank parameter**
High-rank C [a] (Anthracite C)	2,0 % $\leq \overline{R}_r$ < 3,0 %
High-rank B [b] (Anthracite B)	3,0 % $\leq \overline{R}_r$ < 4,0 %
High-rank A (Anthracite A)	4,0 % $\leq \overline{R}_r$ < 6,0 % (or $\overline{R}_{v\,max}$ < 8,0)

[a] $\overline{R}_r$ = 3,0 % approximates to the rank where the volatile matter yield (see ISO 562) has decreased to a level that results in a significant decrease in the ease of ignition and where a strong increase in the bi-reflectance begins to occur (see the *International handbook on coal petrology, Vitrinite classification, ICCP system 1994,* and *Organic petrology*).

[b] $\overline{R}_r$ = 4,0 % approximates to the rank where the development of bi-reflectance begins to accelerate owing to the onset of a decrease $\overline{R}_{v\,min}$ as $\overline{R}_{v\,max}$ continues to increase.

C.3 Procedure to establish the rank of coal

C.3.1 If $\overline{R}_r$ % data is available, and if $\overline{R}_r$ < 0,4 %, then bed moisture (ash-free) is the parameter. Follow the boundary limit rules as described in C.2 for bed moisture. Bed moisture is determined in accordance with AS 2434.1.

C.3.2 If $\overline{R}_r$ % data is available, and if $\overline{R}_r \geq$ 0,4 %, determine the rank of the coal using the information in C.2 and obeying the boundary limits.

C.3.3 If $\overline{R}_r$ % is not available, then $\overline{R}_r$ % can be determined by one of the following methods:

a) use C and H (daf) values and the equation from *Chemical and physical characteristics of South African coal and a suggested classification system* (method A); or

b) if C and H (daf) values are not available, use volatiles (daf) to estimate C and H (daf) values and then calculate the inferred $\overline{R}_r$ % as described in method A (method B); or

c) use a current suite of equations obtained from the correlation of volatiles (daf) and measured $\overline{R}_r$ % of two sets of data from *Bulletins 113 and 114*, to calculate $\overline{R}_r$ % from the volatile content (daf) (method C).

C.4 Formulae to calculate inferred rank

C.4.1 Method A

If $\overline{R}_r$ % data is not available, but C and H data (part of the ultimate analysis) have been determined on a dry, ash-free basis, $\overline{R}_r$ can be estimated using the following equations:

$$\overline{R}_{v\,max} = 0{,}9177287 - 0{,}26656 \times C + 3{,}6055708 \times H + 0{,}0037036 \times C^2 - 0{,}0587235 \times C \times H + 0{,}1145169 \times H^2$$

then, $\overline{R}_r = \overline{R}_{v\,max} / 1{,}066$

where

$\overline{R}_{v\,max}$ is the inferred vitrinite maximum reflectance, in percentage (%);

$\overline{R}_r$ is the inferred mean vitrinite random reflectance, in percentage (%);

C(daf) is the carbon determined on a dry, ash-free basis, in percentage (%);

H(daf) is the hydrogen determined on a dry, ash-free basis, in percentage (%).

C.4.2 Method B

If neither $\overline{R}_r$ %, C and H data is available, C and H can be estimated, using the following equations based on a gross calorific value and volatile matter (both determined on a dry, ash-free basis) and then the results in the equations of method A above can be applied:

$$C\ (\text{daf}) = 0{,}59 \times (2{,}39 \times GCV - 0{,}37 \times V) + 43{,}4$$

$$H\ (\text{daf}) = 0{,}069 \times (2{,}39 \times GCV + V) - 2{,}86$$

where

C (daf) is the carbon determined on a dry, ash-free basis, in percentage (%);

GCV is the gross calorific value, determined on a dry, ash-free basis, in megajoules per kilogram (MJ/kg);

H (daf) is the hydrogen determined on a dry, ash-free basis, in percentage (%);

V the percentage volatiles, determined on a dry, ash-free basis, (%).

After C and H have been calculated as indicated above, proceed as in method A.

C.4.3 Method C

Notwithstanding the fact that volatile matter determined on a dry, ash-free basis (daf) is not a reliable rank parameter for inertinite-rich coal, the following method is presented as a last resort to calculate $\overline{R}_r$ %. The correlations between volatile matter (daf) and $\overline{R}_r$ % were obtained by plotting analytical data reported in *Bulletins 113 and 114*. The best method to calculate $\overline{R}_r$ % in three ranges of volatiles, i.e. >16,5 % (say, bituminous, or medium-rank), 12,5 % to 16,5 % (so-called lean coal) and < 12,5 % for so-called anthracite.

This method therefore relies on the following three relationships:

a) for coals with volatiles (daf) > 16,5 %, $\overline{R}_r\ \% = -0{,}0085 \times V + 0{,}9738$;

b) for coals with volatiles (daf) > 12,5 % and < 16,5 %, $\overline{R}_r\ \% = 0{,}0323 \times V + 0{,}4034$;

c) for coals with volatiles (daf) < 12,5 %, $\overline{R}_r\ \% = -0{,}0013 \times V^3 + 0{,}0571 \times V^2 - 0{,}91 \times V + 7{,}1561$;

where

V is the percentage volatiles on a dry, ash-free basis (%).

Annex D
(informative)

Moisture and moisture reporting bases

D.1 Definitions and standard moisture terminology for coal, according to various national and international standards

Table D.1 — Standard moisture terminology for coal

1	2	3	4	5	6
Moisture	**ASTM D121**	**ISO 1213-2**	**AS 2418.3 and AS 2418.4**	**BS 3323**	**UNE 32101**
Bed moisture (3.16.2)	–	–	Mbm	–	–
Equilibrium moisture (3.16.3)	Meqm	–	Meqm	–	–
Free moisture (3.16.4)	(Mas-Meqm)	(Mas-Madet)	(Mas-Madet)	(Mas-Madet)	(Mas-Madet)
Inherent moisture [a] (3.16.5)	Meqm	–	–	–	–
Moisture-holding capacity (3.16.6)	–	Meqm	Meqm	Meqm	Meqm
Moisture in analysis sample (3.16.7)	MASadet	MASadet	MASadet	MASadet	MASadet
Moisture as received (3.16.8)	Mas	Mas	Mas	Mas	Mas
Moisture as determined (3.16.9)	Madet	Madet	Madet	Madet	Madet
Residual moisture (3.16.10)	Madet	–	–	–	–
Surface moisture (3.16.11)	(Mas-Meqm)	–	(Mas-Madet)	(Mas-Meqm)	(Mas-Madet)
Total moisture (3.16.12)	Mar(as)	Mas	Mas	Mas	Mas
Water of constitution (3.16.13)	–	Woc	Woc	Woc	Woc

NOTE The moisture terminology used in this table is as follows:

Mbm is the bed moisture or the natural moisture content of the coal in situ in the seam.
Meqm is the moisture after attaining equilibrium at a temperature of 30 ºC and a humidity of 97 %.
Mas is the moisture determined on the as-sampled coal. If sampled at the coalface and free of visible moisture, the total moisture is equivalent to the bed moisture.
Mar is the moisture determined on the as-received coal, as determined in accordance with ASTM D3302.
Mar(as) is the total moisture content (as sampled basis). If the sample has been maintained in a sealed state so that there has been no gain or loss, the as-received basis (arb) is equivalent to the as-sampled basis (as).
Madet is the moisture content in equilibrium with prevailing laboratory conditions of temperature and humidity (as-determined basis).
MASadet is the moisture content in equilibrium (as-determined basis) with prevailing laboratory conditions of temperature and humidity, provided that the analysed sample has been ground to pass a test sieve of 250 μm (ASTM standard) or 200 μm to 212 μm (AS, BS and ISO standards).
Woc is the water of constitution that is chemically bound to the mineral matter and that remains after the determination of the total moisture.

[a] Moisture that exists as an integral part of the coal seam in its natural state. In the ASTM system it is considered equivalent to bed moisture.

D.2 Definition of standard moisture conversion factors

Table D.2 — Standard coal reporting bases conversion factors

1	2	3	4
Given	**Desired**		
	As received (ar)	**Air-dried (ad)**	**Dry basis (db)**
Multiply **As received (ar)** by:	–	(100 – Mad)/ (100 – Mt)	100/(100 – Mt)
Air-dried (ad) by:	(100 – Mt)/(100 – Mad)	–	100/(100 – Mad)
Dry basis (db) by:	(100 – Mt)/100	(100 – Mad)/100	–
Dry ash-free basis (daf) by**:**	(100 – (Mt + Aar)/ 100	(100 – (Mad + Aad)) / 100	(100 – Adb)/100

NOTE 1 The abbreviations in this table are the following:

a) ar is the as-received moisture content, i.e. includes total moisture (Mt);

b) ad is the air-dried moisture content; which includes MASadet or Mrm moisture;

c) db is the dry basis, which excludes all moisture by calculation; and

d) daf is the dry ash-free basis, which excludes all moisture and ash by calculation.

NOTE 2 The proximate analysis of any coal, i.e. the moisture contents %, ash (A) content %, volatile matter (VM) %, fixed carbon (FC) %, and sulphur (S) % and calorific value (CV) can be expressed on any of the above bases.

Annex E
(informative)

Typical format of a coal resource and coal reserve report

1 Executive summary

2 Introduction

2.1 Purpose
2.2 Project description
2.3 Project location
2.4 Project ownership
2.5 Property ownership
2.6 Previous legal title, exploration and mining history

NOTE

The following statements should be prepared:

a) a statement on the ownership participation aspects of the project and whether the coal resources are quoted on a total basis, or on a participation basis;

b) a statement that describes the legal status of the coal rights and surface rights;

c) a statement as to whether a mining lease or permit has been obtained or else, comment on the progress made in obtaining the mining lease or permit. If the mining lease is over a fixed time period, the length of the lease should be stated, and mention should be made of any possible extensions; and

d) a statement that describes the physical, geographical and statutory constraints defining the limits of the coal reserve area.

3 Project data

3.1 Location of project data
3.2 Geological data
3.3 Sampling data
  3.3.1 Sampling method
  3.3.2 Sample preparation
  3.3.3 Coal quality analysis
3.4 Density

4 Geological resource interpretation

4.1 Geological data validation
4.2 Geological cut-off parameters
4.3 Geological model
4.4 Geological discount factors
4.5 Geological confidence and categories
4.6 Coal resource estimates

5 Coal resource statement

6 Competent person’s statement on coal resources

7 Mining

7.1 Geotechnical factors
7.2 Mining method, extraction percentage and production rate
7.3 Dilution and contamination
7.4 Mining recovery factors
7.5 Infrastructure
7.6 Life of mine plan
7.7 ROM coal resource estimate

8 Coal processing and marketing

8.1 Coal processing method
8.2 Coal processing recovery factors
8.3 Product specifications, including product moisture content
8.4 Market assessment
8.5 Discards and reject coal
8.6 Saleable coal resource estimate

9 Additional qualifying factors

9.1 Legal factors
9.2 Environmental compliance and reclamation
9.3 Social factors
9.4 Governmental factors

10 Economic evaluation

10.1 Economic valuation methodology
10.2 Economic factors
10.3 Economic evaluation

11 Other considerations

12 Reserve statement

13 Competent person’s statement on coal reserves

Annex F
(informative)

Summary of variables used in coal resource and coal reserve calculations

Table F.1 – List of variables used in the calculation of coal resources and coal reserves

Variable	Description	Units
A_{horz}	horizontal area of the coal resource block	m^2
A_{layout}	horizontal mineable area	m^2
$A_{extractable}$	horizontal extractable area	m^2
$A_{horz\ mineable}$	horizontal mineable area	m^2
$A_{horz\ prev\ mined}$	net area extracted from previously mined area	m^2
A_{incl}	inclined area of the resource block	m^2
c	contamination percentage determined on an air-dried basis	%
$COS_{(seam\ dip\ angle)}$	cosine of the average seam dip angle	
$CPDF$	coal processing discount factors	%
d	dilution mass percentage (air-dried basis)	%
$depth$	depth to the top of the mineable coal seam	m
$depth_{cut\text{-}off}$	maximum net overburden depth cut-off to the top of the lowermost mineable coal seam	m
$ETIS_{reserve\ mh\ prac}$	extractable coal reserve tonnage	tonne
GL_m	geological model estimation error percentage	%
GL_p	physical geological loss percentage	%
$GTIS$	gross in situ coal resource tonnage (as modelled)	tonne
$GTIS_{mh\ theor}$	gross in situ coal resource tonnage at the theoretical mining height within the resource block / mine plan	tonne
$GTIS_{mh\ theor\ remain}$	remaining gross in situ coal resource tonnage at the theoretical mining height within the resource block / mine plan after accounting for previously mined areas	tonne
$GTIS_{remain}$	remaining gross in situ coal resource tonnage (as modelled) after accounting for old mine workings	tonne
M	coal moisture content on an air-dried basis (Madb) or on an in situ bed moisture basis (Mbm)	%
M_{adb}	coal moisture content on an air-dried basis (Madb)	%
M_{coal}	coal moisture content on an air-dried basis (Madb) or on an in situ bed moisture basis (Mbm)	%
$M_{coal,\ adb}$	coal moisture content on an air-dried basis (Madb)	%
$M_{contaminant}$	contaminant moisture content on an air-dried basis (Madb) or on an in situ bed moisture basis (Mbm)	%
$M_{contaminant,\ adb}$	contaminant moisture content on an air-dried basis (Madb)	%
$M_{dilution}$	dilution moisture content on an air-dried basis (Madb) or on an in situ bed moisture basis (Mbm)	%
$M_{dilution,\ adb}$	dilution moisture content on an air-dried basis (Madb)	%
$M_{in\ situ}$	in situ coal total moisture content as sampled (Mas) (or the in situ bed moisture (Mbm)) percentage	%

Variable	Description	Units
$M_{\text{particle density}}$	is the average coal moisture content at which the apparent relative density was determined	%
M_{pm}	product moisture on an as-sold basis (Mas)	%
$M_{\text{prev mined}}$	moisture content (in situ or air-dried) of the previously mined coal	%
M_{remain}	is the moisture content (in situ or air-dried) of the remaining coal	%
$M_{\text{ROM, adb, c}}$	contaminated ROM moisture on an air-dried moisture basis (Madb)	%
$M_{\text{ROM, bm, c}}$	contaminated ROM moisture on an in situ bed moisture basis (Mbm)	%
$M_{\text{ROM, c}}$	contaminated ROM moisture on an air-dried basis (Madb) or on an in situ bed moisture basis (Mbm)	%
M_{sm}	surface moisture (Msm)	%
M_{saleable}	is the saleable coal moisture content on an air-dried basis (Madb) or on an in situ bed moisture basis (Mbm)	%
$M_{\text{sales, adb}}$	saleable coal moisture content on an air-dried moisture basis (Madb)	%
M_{t}	total coal moisture (Mas)	%
$M_{\text{true density}}$	coal moisture content at which the true density is determined	%
MCF_{ROM}	ROM moisture correction factor to convert air-dried tonnage or the tonnage at in situ moisture to the tonnage on an as-delivered basis	factor
$MCF_{saleable}$	saleable moisture correction factor	factor
MLE	theoretical mining layout extraction percentage	%
MLL	mining layout loss percentage within the resource block	%
MR	mining recovery efficiency percentage	%
$MTIS$	mineable in situ coal reserve tonnage	tonne
$MTIS_{\text{mh pract}}$	practical mineable in situ coal resource tonnage at the practical mining height including dilution	tonne
$MTIS_{\text{mh theor}}$	mineable in situ coal resource tonnage at the theoretical mining height	tonne
$MTIS_{\text{mh theor layout}}$	is the mineable in situ resource tonnage at the theoretical mining height in the defined mining layout (not including internal barrier pillars and support pillars)	tonne
$MTIS_{\text{reserve mh pract}}$	mineable in situ coal reserve tonnage at the practical mining height including dilution in the mine plan	tonne
$MTIS_{\text{reserve mh theor}}$	mineable in situ coal reserve tonnage at the theoretical mining height in the mine plan	tonne
$MTIS_{\text{resource mh theor}}$	mineable in situ coal resource tonnage at the theoretical mining height within the resource block	tonne
Q_{c}	coal quality (contaminated)	typically %
$Q_{\text{contaminant}}$	average quality of the roof and floor contaminant	typically %
$Q_{\text{cut-off, coal, uc}}$	uncontaminated raw coal quality constituent used in the standard definition of coal or a composite coal seam, depending on the coal deposit type	typically %
$Q_{\text{cut-off, raw, uc}}$	raw coal quality, uncontaminated cut-off value	typically %
$Q_{\text{cut-off, wash uc}}$	coal washability quality, uncontaminated cut-off value	typically %
Q_{dilution}	coal quality of the material from above the roof or from below the floor, or both, of the theoretical coal seam	typically %
$Q_{\text{gross in situ, uc}}$	the gross in situ coal quality, uncontaminated	typically %
$Q_{\text{in situ}}$	the in situ coal quality, uncontaminated	%

Variable	Description	Units
$Q_{mh\ pract}$	the coal quality for the practical mining height within the mine plan (uncontaminated but including planned dilution)	typically %
$Q_{mh\ theor}$	is the coal quality of the coal within the theoretical mining height within the mine plan	typically %
Q_{pm}	saleable coal quality at product moisture	typically %
$Q_{prev\ mined}$	coal quality variable (in situ or air-dried) of the previously mined coal	%
$Q_{raw,\ c}$	raw coal quality, contaminated	typically %
$Q_{raw,\ uc}$	raw coal quality, uncontaminated but including dilution	typically %
Q_{remain}	is the coal quality variable (in situ or air-dried) of the remaining coal	typically %
$Q_{sales,\ adb}$	saleable coal quality on an air-dried basis	typically %
$Q_{sales,\ in\ situ}$	saleable coal quality on an in situ basis	typically %
$Q_{sales,\ pm}$	average saleable product moisture as sold	%
Q_{uc}	coal quality (uncontaminated)	typically %
$Q_{wash,\ in\ situ}$	is the coal washability quality, uncontaminated but including dilution	
$Q_{wash,\ uc}$	is the coal washability quality, uncontaminated but including dilution	
$\overline{R}_{r}$	vitrinite random reflectance	
$\overline{R}_{v\ max}$	vitrinite maximum reflectance	
$\overline{R}_{v\ min}$	vitrinite minimum reflectance	
rd	density	g/cm^3
rd_{adb}	density on the air-dried moisture basis	g/cm^3
rd_{coal}	density of the mineable coal seam(s)	g/cm^3
$rd_{contaminant\ floor}$	contaminant density from below the floor of the practical mining height	g/cm^3
$rd_{contaminant\ roof}$	contaminant density from above the roof of the practical mining height	g/cm^3
$rd_{contamination}$	contamination average density from roof and floor	g/cm^3
$rd_{dilution}$	dilution average density from above the roof or from below the floor (or both) of the theoretical coal seam	g/cm^3
$rd_{dilution\ floor}$	dilution density from below the floor of the theoretical coal seam	g/cm^3
$rd_{dilution\ roof}$	dilution density from above the roof of the theoretical coal seam	g/cm^3
$rd_{in\ situ}$	in situ bed moisture density	g/cm^3
$rd_{mh\ pract}$	practical mining height density	g/cm^3
$rd_{mh\ pract\ c}$	practical contaminated mining height density	g/cm^3
$rd_{mh\ theor}$	theoretical mining height density	g/cm^3
$rd_{particle\ density}$	apparent relative density of the coal particle as determined in the laboratory	g/cm^3
$rd_{prev\ mined}$	density of the previously mined coal	g/cm^3
rd_{remain}	is the density of the remaining coal	g/cm^3
$rd_{true\ density}$	true density of the coal as determined in the laboratory	g/cm^3
$ROM_{adb,\ c}$	ROM coal reserve tonnage on a contaminated air-dried moisture basis	tonne
ROM_{c}	ROM coal reserve tonnage on a contaminated air-dried moisture basis or on a contaminated in situ bed moisture basis	tonne

Variable	Description	Units
$ROM_{\text{as del}}$	ROM coal reserve tonnage on an as-delivered basis	tonne
$sales_{\text{adb}}$	saleable coal reserve tonnage on an air-dried moisture basis	tonne
$sales_{\text{pm}}$	saleable coal reserve tonnage at product moisture	tonne
$sr_{\text{cut-off}}$	is the incremental strip ratio cut-off of the net overburden volume to net coal thickness (in situ, run of mine, or sales) in the mineable coal seam(s)	bcm/ton
sr_{inc}	is the incremental strip ratio of overburden volume to coal tonnes (in situ, run of mine, or sales) in the mineable coal seam(s)	bcm/ton
$T_{\text{contamination}}$	contaminant tonnage	tonne
T_{dilution}	dilution tonnage	tonne
$T_{\text{extr\%}}$	tonnage percentage extracted from old mine workings	%
T_{mined}	tonnage coal mined	tonne
$T_{\text{prev mined}}$	tonnage of coal previously mined from old mine workings	tonne
T	dry tonnages of the individual products sold	tonne
T_{sales}	dry saleable product tonnage	tonne
th_{app}	apparent seam thickness (in the vertical plane)	m
$th_{\text{contaminant floor}}$	contaminant thickness from below the floor of the practical mining height	m
$th_{\text{contaminant roof}}$	contaminant thickness from above the roof of the practical mining height	m
$th_{\text{contamination}}$	contamination thickness from the roof and floor	m
$th_{\text{cut-off, gross in situ, uc}}$	the minimum gross in situ uncontaminated thickness cut-off value	m
$th_{\text{cut-off, in situ, uc}}$	in situ uncontaminated thickness cut-off value	m
$th_{\text{dilution floor}}$	dilution thickness from below the floor of the theoretical coal seam	m
$th_{\text{dilution roof}}$	dilution thickness from above the roof of the theoretical coal seam	m
th_{dilution}	total dilution thickness from above the roof or from below the floor (or both) of the theoretical coal seam	m
$th_{\textit{gross in situ, uc}}$	in situ uncontaminated thickness	m
$th_{\text{in situ, uc}}$	in situ uncontaminated thickness	m
$th_{\text{maximum mh cut-off}}$	maximum mining height cut-off	m
$th_{\text{mh pract}}$	vertical practical mining height within the mine plan (uncontaminated but including planned dilution)	m
$th_{\text{mh pract c}}$	vertical practical contaminated mining height within the mine plan	m
$th_{\text{mh prev mined}}$	average thickness of coal mined in the previously mined areas	m
$th_{\text{mh theor}}$	vertical theoretical mining height within the resource block or mine plan	m
$th_{\text{mh theor mp}}$	vertical theoretical mining height within the mine plan	m
$th_{\text{mineable in situ, uc}}$	mineable in situ uncontaminated thickness	m
$th_{\text{minimum mh cut-off}}$	minimum mining height cut-off	m
$th_{\text{overburden}}$	is the net overburden thickness above the lowermost mineable coal seam	m
th_{coal}	is the net thickness of the mineable coal seam(s) (after the relevant discount factors have been applied)	m
th_{true}	true seam thickness (at right angles to the dip of the seam)	m
$TTIS_{\text{resource}}$	total in situ coal resource tonnage	tonne

Variable	Description	Units
V	gross in situ coal volume	m^3
$V_{prev\ mined}$	volume of coal extracted from previously mined old mine workings	m^3
$Y_{contaminant}$	yield of the contaminant in the product on an air-dried moisture basis	%
$Y_{prac,\ adb}$	practical product yield percentage on a contaminated air-dried moisture basis	%
$Y_{theor,\ adb}$	yield of the theoretical borehole coal product on an uncontaminated air-dried moisture basis	%
$Y_{theor,\ c,\ adb}$	theoretical product yield of contaminated coal on an air-dried moisture basis	%

Annex G
(informative)

Coal quality tests and standards

G.1 Some recommended tests and analyses for establishing coal rank and quality

Table G.1 — Some recommended tests and analyses for establishing coal rank and quality (for borehole core samples, channel samples and outcrop samples)

1	2	3
Recommended test or analysis	**Units**	**Classification parameter**
Apparent or true density	g/m^3	For conversion of volume to tonnes
Equilibrium moisture/ moisture-holding capacity	%	For bed moisture and calculation of calorific value to m, af[a] basis
Float and sink	%	For assessment of the theoretical separation of products from discards
Moisture content	%	Key reporting basis for tonnage and coal quality
Ash content	%	Grade (dry basis)
Volatiles content	%	Combustibility criteria of the saleable product
Total sulphur content	%	For combustibility criteria and potential pollution impact
Heat content/ Calorific value	MJ/kg (kcal/kg)	Energy content
Maceral composition	%	Petrographic composition
Vitrinite random reflectance		Rank
[a] Moisture, ash-free basis (see 3.16.15).		

G.2 Some recommended tests and analyses for establishing coal quality of product for specific fields of utilization

Table G.2 — Some recommended tests and analyses for establishing coal quality of product for specific fields of utilization

1	2	3	4	5	6	7	8	9	10
Test parameter	**Units**	**Combustion stoker**	**Combustion / pulverized fuel (PF)**	**Pulverized fuel injection (PCI)**	**Metallurgical coke**	**Char making**	**Fluidized bed combustion (FBC)**	**Gasification**	**Smelting reduction process (Corex)**
Moisture	%	X	X	X	X	X	X	X	X
Ash	%	X	X	X	X	X	X	X	X
Volatiles	%	X	X	X	X	X	X	X	X
Total sulphur	%	X	X	X	X	X	X	X	X
Calorific content	MJ/kg	X	X	X			X	X	X
Ultimates	%	X	X	X		X	X	X	
Ash composition	%	X	X	X	X	X	X	X	X
Ash fusion temperature (AFT)	° C	X	X	X	X	X	X	X	X
Hardgrove index (HGI)		X	X	X			X	X	
Index of abrasion	mg Fe		X	X			X	X	
Petrographic composition	%	X	X	X	X	X	X	X	X
Random reflectance ($\overline{R}_r$)	%	X	X	X	X	X	X	X	X
Sizing	%	X	X	X	X	X	X	X	X
Dilatometer					X				
Plastometer					X				
Swelling index		X			X			X	X
Phosphorus	%	X	X		X				X
Forms of sulphur	%	X	X				X		
Chlorine	%	X	X				X		
Fluorine	%	X	X				X		
Trace elements	%	X	X				X		
Decrepitation									X
Bulk density	g/m^3				X				X
CO_2 reactivity					X				X

G.3 — National and international standardized test methods

Table G.3 — National and international standardized test methods

1	2	3	4	5	6
Parameter	**AS**	**ASTM D**	**BS**	**ISO**	**SANS**
Relative density	1038.21.1.1 1038.21.1.2 2434.4			5072	
Sampling	2617 4264.1 4264.3	2234 4596 5192	1017-1	5069-1; 9411-1 13909-1; 13909-2; 13909-3; 14180	10135-1
Sample preparation		2013		1988 13909- 4	10135-2
Float and sink tests	4156.1	4371	7067	7936	
Equilibrium moisture	1038.17 2434.3	1412	1016-21	1018	
Total moisture	1038.1; 2434.1	2961 3302	1016-1	589; 1015	5921; 5922; 5923
Moisture in analysis sample	1038.3; 1038.4; 2434.5; 2434.7	3172 3173 5142	1016-104.1	331; 5068; 11722	5924; 5925
Ash	1038.3; 1038.4; 2434.8	3172 3174 5142	1016-104.4	1171	131 5926
Volatiles	1038.3; 1038.4; 2434.2	3172; 3175; 5142	1016-104.3	562; 5071-1	50
Total sulphur	1038.6.3.1 1038.6.3.2 1038.6.3.3; 2434.6.1	1757 3177 4239 5016	1016-106.4.1; 1016-106.4.2	334; 351	334
Gross calorific value	1038.5	1989 5865	1016-105	1928	1928
Carbon Hydrogen Nitrogen Oxygen	2434.6.1 1038.6.1; 1038.6.2; 1038.6.2	3176; 3178; 5373 3178; 5373 3179; 5373 3176	1016-6; 1016-106.1.1; 1016-106.1.2 1016-6; 1016-106.1.1; 1016-106.1.2 1016-6; 1016-106.2; 1016-6	609; 625 609; 625 333; 11725 1994	5938 5938
Major and minor elements, or ash composition	1038.14.1 1038.14.2 1038.14.3	1757; 3682; 4326; 5016; 6349	1016-14		
Ash fusion temperature	1038.15	1857	1016-113	540	43
Hardgrove grindability index	1038.20	409	1016-112	5074	5074
Index of abrasion	1038.19		1016-111	12900	
Petrographic composition	2856.1; 2856.2	2797 2799	6127.2 6127.3	7404-2 7404-3	7404-2 7404-3
Random reflectance	2856.3	2797; 2798	6127.5	7404-5	7404-5
Size analysis	3881	4749	1016-109	1953	6079
Roga (caking)				335	
Gray-King coke test	1038.12.2		1016-107.2	502	
Dilatometer	1038.12.3	5515	1016-107.3	349; 8264	6072
Plastometer	1038.12.4.1; 1038.12.4.2; 2137	2639			
Swelling index	1038.12.1	720	1016-107.1	501	5933; 5934

Table G.3 *(concluded)*

1	2	3	4	5	6
Parameter	**AS**	**ASTM D**	**BS**	**ISO**	**SANS**
Fischer assay				647	6073
Drop shatter		440			
Tumbler		441			
Phosphorus	1038.9.1 1038.9.2 1038.9.3		1016-9	622	5937
Forms of sulphur	1038.11	2492	1016-106.5	157	
Carbonate carbon or CO_2 in coal	1038.23	1756	1016-106.7	925	5940 5941
Chlorine	1038.8.1 1038.8.2	2361; 4208	1016-8; 1016-106.6.1	352; 587	
Fluorine	1038.10.4	3761; 5987			
Arsenic	1038.10.2	4606	1016-10	601	
Cadmium				15238	
Boron	1038.10.3				
Mercury	1038.10.5	3684; 6414		15237	
Selenium	1038.10.2	4606			
Trace elements	1038.10.1	3683			
Bulk density	3899				
Degree of oxidation		5263			
Classification	2096	388		11760	

Annex H
(informative)

Reporting summary – Coal resource and coal reserve categories, terminology and reporting guidelines

Table H.1 —Summary of coal resource and coal reserve categories, terminology and reporting guidelines

1	2
Categories and terminology	**Guidelines**
1. Coal occurrence (see 3.10)	1. Can be any of the following: • areal extent of the seam is unknown; or • geological information is insufficient to define the seam as a coal resource; or • geological information indicates no reasonable or realistic prospects for exploitation. 2. Shall not be included in a coal resource estimate. 3. Tonnage figures shall not be reported.
2. Coal resource (see 3.25)	1. Sufficient geological information exists to allow a statement on the location, extent, tonnage, physical continuity and coal quality continuity of the coal deposit. 2. Shall have reasonable and realistic prospects for exploitation (< 50 years). 3. Includes the coal seam above the minimum thickness cut-off and coal quality cut-offs. 4. Subdivided in order of increasing geological confidence into reconnaissance coal resource, inferred coal resource, indicated coal resource and measured coal resource.
2.1 Reconnaissance coal resource (see 3.25.1)	1. Includes the full coal seam above the minimum thickness cut-off. 2. Coal quality shall be of economic interest. 3. Physical continuity may be assumed at a low level of confidence. 4. Minimum of one cored borehole, with quality data per 400 ha (< 2 km spacing) (or 0,25 boreholes per 100 ha) for multiple seam deposit types. 5. Minimum of one cored borehole, with quality data per 1 600 ha (< 4 km spacing) (or 0,0625 boreholes per 100 ha) for thick interbedded seam deposit types. 6. Tonnage and coal quality shall be reported on a gross in situ basis. 7. Tonnage estimates with unknown coal quality shall not be reported. 8. This category is required to be reported in the National Coal Inventory.

Table H.1 *(continued)*

1	2
Categories and terminology	**Guidelines**
2.2 Inferred coal resource (see 3.25.2)	1. Includes the coal seam above the minimum thickness cut-off and coal quality cut-offs. 2. Coal quality complies with criteria for reasonable and realistic prospects for exploitation. 3. Physical continuity may be assumed at a moderate level of confidence, but the assumption of coal quality continuity is neither a requirement nor a constraint. 4. Minimum of one cored borehole, with quality data, per 100 ha (< 1 km spacing) (or one borehole per 100 ha) for multiple seam deposit types. 5. Minimum of one cored borehole, with quality data, per 1 000 ha (< 3 km spacing) (or 0,10 boreholes per 100 ha) for thick interbedded seam deposit types. 6. Tonnage and coal quality shall be reported on an in situ basis or a mineable in situ resource basis. 7. This category is required to be reported in the National Coal Inventory and is under certain conditions acceptable to be reported to the Securities Exchange.
2.3 Indicated coal resource (see 3.25.3)	1. Includes the coal seam above the minimum thickness and coal quality cut-offs. 2. Coal quality complies with criteria for reasonable and realistic prospects for exploitation. 3. Physical continuity is confirmed, and coal quality continuity may be assumed, but not necessarily confirmed. 4. Minimum of four cored boreholes, with quality data, per 100 ha (< 500 m spacing) (or four boreholes per 100 ha) for multiple seam deposit types. 5. Minimum of one cored borehole, with quality data, per 100 ha (< 1 km spacing) (or one borehole per 100 ha) for thick interbedded seam deposit types. 6. Tonnage and coal quality shall be reported on an in situ basis or a mineable in situ resource basis. 7. This category is required to be reported in the National Coal Inventory and to the Securities Exchange.
2.4 Measured coal resource (see 3.25.4)	1. Includes the coal seam above the minimum thickness and coal quality cut-offs. 2. Coal quality complies with criteria for reasonable and realistic prospects for exploitation. 3. Physical continuity and coal quality continuity are confirmed. 4. Minimum of eight cored boreholes, with quality data, per 100 ha (< 350 m spacing) (or eight boreholes per 100 ha) for all deposit types. 5. Tonnage and coal quality shall be reported on an in situ basis or a mineable in situ resource basis. 6. This category is required to be reported in the National Coal Inventory and to the Securities Exchange.

Table H.1 *(continued)*

1	2
Categories and terminology	**Guidelines**
2.5 Marginally economic coal resource	Marginally economic or subeconomic coal resources are subdivided into a pre-feasibility or a feasibility coal resource depending on the level of the associated study.
2.6 Pre-feasibility coal resource (see 3.25.5)	1. Derived from an indicated coal resource (or more rarely from an inferred or measured coal resource) where a pre-feasibility study showed the coal resource to be only marginally economic. 2. Obtained from a mine plan, at pre-feasibility study level, based on coal resources that are not economic at the time of valuation, but borders on being so. 3. May become economic in the near future as a result of changes in economic, technological, legal, environmental, etc., factors or conditions. 4. Tonnage and coal quality are reported on an in situ or air-dried, uncontaminated basis. 5. This category is required to be reported in the National Coal Inventory. 6. Not to be reported to the Securities Exchange.
2.7 Feasibility coal resource (see 3.25.6)	1. Derived from a measured coal resource where a feasibility study showed the resource to be only marginally economic. 2. Obtained from a mine plan, at feasibility study level, based on coal resources that are not economic at the time of valuation, but border on being so. 3. May become economic in the near future as a result of changes in economic, technological, legal, environmental, etc., factors or conditions. 4. Tonnage and coal quality are reported on an in situ or air-dried, uncontaminated basis. 5. This category is required to be reported in the National Coal Inventory. 6. Not to be reported to the Securities Exchange.
3 Reporting of a coal resource **3.1 Gross in situ coal resources** (see 3.26)	Coal resources are reported per resource subdivision as either a gross in situ coal resource or in situ coal resource or a mineable in situ coal resource. 1. Includes the full coal seam above the minimum thickness and coal quality cut-offs. 2. Excludes dilution and contamination. 3. No loss factors to be applied. 4. Tonnage quoted on a gross tonnes in situ basis and coal quality reported on an in situ bed moisture or air-dried uncontaminated basis. 5. Subseams may be quoted separately, such that the sum of the subseams equals the full seam resource. 6. May be subdivided into different depth and thickness categories.

Table H.1 *(continued)*

1	2
Categories and terminology	**Guidelines**
3.2 In situ coal resource (see 3.27)	1. Includes the full coal seam above the minimum thickness and coal quality cut-offs. 2. Excludes dilution and contamination. 3. Geological loss factors shall be applied. 4. Tonnage quoted on an in situ basis and coal quality reported on an in situ bed moisture or air-dried uncontaminated basis. 5. Subseams may be quoted separately, such that the sum of the subseams equals the full seam resource. 6. May be subdivided into different depth and thickness categories.
3.3 Mineable in situ coal resource (see 3.29)	1. Includes the coal seam at the theoretical mining height and between the relevant minimum and maximum mining height coal quality cut-offs. 2. Includes dilution, but excludes contamination. 3. Geological loss factors shall be applied. 4. Tonnage quoted on a mineable in situ basis and coal quality reported on an in situ bed moisture or air-dried uncontaminated basis over the theoretical mining height. 5. May be subdivided into different depth and thickness categories.
4 Reporting of a coal reserve (see 3.31)	1. Economic evaluation and mine planning shall have been undertaken. 2. A coal reserve is the economically mineable portion or selection derived from measured or indicated coal resources (or both). 3. Maximum and minimum mineable thickness cut-offs and geological losses shall be applied. 4. Quality constraints, dilution, contamination and coal processing factors and moisture correction factors shall be applied. 5. Modifying factors such as infrastructure, marketing, legal, environmental, social and governmental factors shall have been considered. 6. Economic exploitation of coal reserves shall be reasonably justifiable at the time of valuation. 7. Surface and underground coal reserves shall be reported separately. 8. May be subdivided into thickness and depth categories for surface and underground mining. 9. Stripping ratio cut-offs shall be stated for surface mining. 10. Subdivided in order of increasing confidence into probable coal reserves and proven coal reserves.

Table H.1 *(continued)*

1	2
Categories and terminology	**Guidelines**
4.1 Probable coal reserve (see 3.31.1)	1. Obtained from an economic mine plan, at pre-feasibility study level or at feasibility study level, and based on an indicated coal resource. 2. Obtained from an economic mine plan, at pre-feasibility study level, based on a measured coal resource. 3. This category is required to be reported in the National Coal Inventory and is acceptable for reporting to the Securities Exchange.
4.2 Proven coal reserve (see 3.31.2)	1. Obtained from an economic mine plan, at feasibility study level or at mining report level, based on a measured coal resource. 2. This category is required to be reported in the National Coal Inventory and is acceptable for reporting to the Securities Exchange.
5 Reporting of coal reserves **5.1 Mineable in situ coal reserve** (see 3.33; 3.36)	Coal reserves are reported per subdivision as either mineable in situ coal reserves, extractable coal reserves, ROM coal reserves or saleable coal reserves 1. This is the initial step in reserve calculations and may be reported in the National Coal Inventory or to the Securities Exchange. 2. Includes the coal seam at the theoretical mining height or at the practical mining height, which includes planned dilution. The mining height shall be quoted. 3. Obtained by applying the minimum and maximum mining height cut-offs and the mining layout loss to the in situ coal resource (includes geological losses). 4. No contamination, mining layout extraction and mining recovery efficiency factors shall be applied to the mineable in situ coal reserve. 5. Tonnage to be reported on a mineable in situ basis and quality to be reported on an in situ or an air-dried, uncontaminated basis over the selected interval.
5.2 Extractable coal reserve (see 3.38)	1. This is an intermediate step in reserve calculations and should <u>not</u> be reported in the National Coal Inventory or to the Securities Exchange. 2. Includes the coal seam at the practical mining height, which includes planned dilution. 3. Obtained by applying the mining layout extraction and mining recovery efficiency factors to the mineable in situ coal reserve (practical mining height). 4. Tonnage to be quoted on an extractable tonnage basis and quality to be reported on an in situ or an air-dried, uncontaminated basis.

Table H.1 *(concluded)*

1	2
Categories and terminology	**Guidelines**
5.3 Run of mine (ROM) (as delivered) coal reserve (see 3.42)	1. Reporting is compulsory in the case of the National Coal Inventory and the Securities Exchange. 2. Obtained by applying contamination and the ROM moisture correction factor to the extractable coal reserve. 3. The relevant contamination level and moisture correction factor used shall be reported. 4. Tonnage shall be reported on a wet contaminated basis (as delivered). 5. Coal quality may be reported on a wet contaminated basis (as delivered), or on an air-dried contaminated basis, or on a dry contaminated basis. 6. The basis for reporting coal qualities shall be stated.
5.4 Saleable coal reserve (see 3.48)	1. Reporting is compulsory in the case of the National Coal Inventory and the Securities Exchange. 2. In the case of a raw product only, the ROM coal reserve (as delivered) is equivalent to the saleable coal reserve. 3. Practical product yield is obtained by multiplying the theoretical product yield by the relevant coal processing factors. 4. Obtained by applying the practical product yield and the saleable moisture correction factor to the ROM coal reserve. 5. The relevant theoretical or practical product yields, product size range(s), and saleable moisture correction factor shall be reported. 6. Tonnage is reported on a wet product basis (as delivered). 7. Coal quality may be reported on a wet product basis (as delivered), or on an air-dried product basis, or on a dry product basis. 8. The basis for reporting coal qualities shall be stated. 9. In the case where the saleable coal reserves may be exploited for both a raw ROM product and a washed product, the saleable coal reserves shall be reported on a proportional basis, based on the proportions of raw product and washed product in order to avoid double accounting.

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