Classification of Solid Mineral Resources and Reserves in Vietnam

In Vietnam the Classification of Solid Mineral Resources and Reserves is applied in tow stage:

1. Before June 2006

2. Since June 2006 until now.

I. Before June 2006.

Before June 2006, in Vietnam was applied the the Soviet (USSR) Classification of Solid Mineral Resources and Reserves.

The Soviet approach was centred on a document called the TEO (technico-economicheskiye obosnovaniye = technical-economic characterisation) and the TER (technico-economicheskiye raschoti = technical-economic calculations). The TEO is broadly equivalent to the western pre-feasibility study, but it is much more formalized, and its preparation follows a defined set of procedures. It takes into account factors such as technical options and commercial aspects, as well as the environmental implications of a planned project.

The former Soviet system for classification of reserves and resources, developed in 1960 and revised in 1981, is still used today in Russia and other CIS republics.

Essentially, it divides mineral concentrations into seven categories, in three major groups, based on the level of exploration performed: fully explored reserves or resources (A, B, C_1), evaluated reserves or resources (C_2) and prognostic resources (P_1, P_2, P_3).

Reserves and resources that can be matched to the usual international categories are classified into five main classes designated by the symbols A, B, C_1, C_2 and P_1. Capital letters are used to designate ores that are economic. Sometimes, the same group of letters are written in lower case when the mineralization is considered sub-economic. Alternatively, and more commonly, a simple classification into classified (A,B,C_1,C_2)

“balansovye” (balance) = commercially exploitable reserves and unclassified

“zabalansovye” (out-of-balance) = uneconomic resources is used.

Synonyms of “balansovye” and “zabalansovye” which are often met, and used descriptively, are “konditsionniye” (conditioned) and “nekonditsionniye” (unconditioned).

The resource/reserve categories are defined below (please note that the terms ‘reserves’ and ‘resources’ are to a large extent interchangeable here, and do not have the very distinct meanings that are placed on them by the international reporting codes):-

Category A The reserves in place are known in detail. The boundaries of the deposit have been outlined by trenching, drilling, or underground workings. The quality and properties of the ore are known in sufficient detail to ensure the reliability of the projected exploitation.

Category B The reserves in place have been explored but are only known in fair detail. The boundaries of the deposit have been outlined by trenching, drilling, or underground workings. The quality and properties of the ore are known in sufficient detail to ensure the basic reliability of the projected exploitation.

Category C_1 The reserves in place have been estimated by a sparse grid of trenches, drillholes or underground workings. This category also includes reserves adjoining the boundaries of A and B reserves as well as reserves of very complex deposits in which the distribution cannot be determined even by a very dense grid. The quality and properties of the deposit are known tentatively by analyses and by analogy with known deposits of the same type. The general conditions for exploitation are known. The ore tonnage is derived from estimates of strike length, dip length and average thickness of the ore body. Allowance for barren blocks may be made statistically.

Category C_2 These reserves are based on an extremely loose exploration grid, with little data. The limits of the orebody are defined mainly by extrapolation within known geological structures, and from comparison with other similar deposits in the vicinity. The grade and mineral properties of the orebody are determined from core samples and comparison with similar mineral deposits in the area. The reserves have been extrapolated from limited data, sometimes only a single hole. This category includes reserves that are adjoining A, B, and C_1 reserves in the same deposit.

Prognostic Resources are estimated for mineralization outside the limits of areas that have been explored in detail and are often based on data from trenches and from geochemical and geophysical surveys.

Category P_1 Resources in the P_1 category may extend outside the actual limits of the ore reserves defined in the C_2 category. The outer limits of P_1-type resources are determined indirectly by extrapolating from similar known mineral deposits in the area. P_1 is the main source from which C_2 reserves can be increased.

Category P_2 These resources represent possible mineral structures in known mineral deposits or ore-bearing regions. They are estimated based on geophysical and geochemical data. Morphology, mineral composition and size of the orebody are estimated by analogy with similar mineralized geologic structures in the area.

Category P_3 Any potential ore-bearing deposits are classified as resources in the P_3 category. The presence of these resources relies on the theoretical definition of a "favourable geological environment". Resource figures are derived from figures of similar deposits in the region.

Estimates of Prognostic Resources (P_1, P_2, and P_3) routinely depend on assumptions and projections regarding the probable dimensions (length, width and depth) and grade of the deposit that are subject to confirmation by more detailed investigations.

In decision-making on a new mining project, the categories that are normally taken into account are A, B, C_1, and C_2. There is, therefore, a broad equivalence between these and the western proved plus probable reserves.

Deposit Categories

Deposits are categorised by their complexity and by their size and shape. These two categorisation systems overlap to a significant extent (i.e. they are not orthogonal), in that complexity class I deposits tend also to be in shape/size group 1.

Complexity classes:

I. no structural complexity, uniform thickness, homogeneous grades

II. more complex, non-uniform thickness, significant grade variability

III. highly complex structure, significant variations in thickness and very uneven grade distribution

IV. extremely complex structure, extreme variations in thickness and in grade distribution

Size/shape groups:-

- **Group 1 deposits -** Large deposits, simple in form, with uniform distribution of minerals (examples: coal, some iron and disseminated copper deposits). A normal density of drillholes allows the definition of a high level of A and B reserves.
- **Group 2 deposits -** Large deposits with different and sometimes complicated forms and uneven distribution of minerals (examples: some iron and sedimentary copper deposits). Only up to B category reserves may be defined with a normal grid of drillholes. A combination of drilling and underground workings may be necessary to define the reserves. Category A reserves can be established only by close spaced drilling and underground workings.
- **Group 3 deposits -** Smaller sized deposits with uneven distribution of minerals (examples: some veins, skarns, dykes, and pegmatite deposits). Drillholes can only establish C1 reserves. B reserves can be established only with underground workings.
- **Group 4 deposits -** Smaller sized deposits similar to Group 3 deposits or with even more complex shapes (examples: some veins, skarns, dykes, pegmatite deposits and gold placers). Category A reserves cannot be established with drilling or a normal grid of underground workings. Drilling in combination with underground workings is necessary to establish category B reserves.
- **Group 5 deposits -** Small pocket deposits. Category A and B reserves cannot be established. Only category C reserves can be established, by systematic prospecting.

II. Since 2006 until now

Base on UN Framework Classification ("UNFC") ENERGY/WP.1/R70 1997 with the reference and comparison of different national mineral resource and mineral reserve classification systems, nn 07 June 2006, the Minister of Natural Resources and Environment of Vietnam signed Decision No 06/2006/QD-BTNMT promulgating Regulations on classification of solid mineral resources and reserves. The Regulations stipulate the unified principles for classifying mineral reserves and resources in basic geological survey for mineral resources, mineral activities and inventory of solid mineral reserves and resources.

The Regulations apply to the agencies responsible for State management of mineral resources; Vietnamese organizations and individuals, foreign organizations and individuals engaged in basic geological survey for mineral resources and mineral activities within the territory of Vietnam.

According to this Regulations, solid mineral resources classified as two groups: determined solid mineral resources and prognosis solid mineral resources.

1. Determined solid mineral resources group classified into 2 categories: reserves and resources.

a) Type of reserves were classified into 3 levels:

- Proved mineral reserves (111);
- Probable Mineral Reserves (121);
- Probable Mineral Reserves (122).

b) Type of resources were classified into 6 levels:

- Feasibility mineral resources 211;
- Probable mineral resources 221;
- Prefeasibility mineral resources 222;
- Measured mineral resources 331;
- Indicated mineral resources 332;
- Inferred mineral resources 333.

2. Prognosis solid mineral resources group classified into 2 categories

- Reconnaissance resources 334a
- Reconnaissance resources 334b

TABLE OF CLASSIFICATION OF SOLID MINERAL RESOURCES AND RESERVES

<table>
<tr><th rowspan="2">The Level of Geological research
The level of economic efficiency</th><th rowspan="2">Proved</th><th rowspan="2">Probable</th><th rowspan="2">Inferred</th><th colspan="2">Reconnaissance</th></tr>
<tr><th>Prognosis</th><th>Presume</th></tr>
<tr><td rowspan="2">Economic</td><td>Reserves 111
①</td><td colspan="4" rowspan="2"></td></tr>
<tr><td>Reserves 121
②</td><td>Reserves 122
②</td></tr>
<tr><td rowspan="2">Potentially economic</td><td>Resources 211
①</td><td colspan="4" rowspan="2"></td></tr>
<tr><td>Resources 221
②</td><td>Resources 222
②</td></tr>
<tr><td>Undetermined economic</td><td>Resources 331
③</td><td>Resources 332
③</td><td>Resources 333
③</td><td>Resources 334a</td><td>Resources 334b</td></tr>
</table>

① Feasibility study.

② Prefeasibility study.

③ Essential Study

(111) Proved mineral reserves, (211) Feasibility mineral reserves, (221) Probable mineral reserves, (222) Prefeasibility mineral resources, (331) Measured mineral resources, (332) Indicated mineral resources, (333) Inferred mineral resources, (334) Reconnaissance.

III. Reconciliation of Russian and International Reporting Systems

A broad equivalence between the classifications may be presented as:-

Russian	International reporting Code, JORC, etc
A,B	Proved Reserve / Measured Resource
C_1	Proved or Probable Reserve / Indicated Resource
C_2	Probable reserve / Indicated Resource / Inferred Resource
P_1	Inferred Resource
P_2	Reconnaissance Mineral Ressources (or UNFC code 334)
P_3	no equivalent

CONVERSION GUIDE RESERVES AND SOLID MINERAL RESOURCES

The Level of Geological research	The level of use of reserves of solid mineral resources		Reserves and resources categories	
			Old (USSR)	**New**
1. Mines has explored, has already studied the feasibility, designed to exploit or mine have not exploited	Reserves were mobilized into the exploitation		A, B and/or part of C_1	**Reserves** 111
			C_1 and/or part of C_2	**Reserves** 122
	Out balance reserves and reserves not yet mobilized exploitation		A, B and/or part of C_1	**Resources** 211
			C_1 and/or part of C_2	**Resources** 222
			C_2	**Resources** 333
			P_1	**Resources** 334a
2. Mine has explored, but not yet studied feasibility, not designed to exploit or mine have not exploited	Reserves have been approved by the Council reviews the mineral reserves or competent agencies	Reserves in the balance is calculated according to the norms remains consistent with the present	A, B and/or part of C_1	**Reserves** 121
			C_1 and/or part of C_2	**Reserves** 122
			C_2	**Resources** 333
			P_1	**Resources** 334a
		Reserves in the balance is calculated according to the norms no longer fit the current time	A, B and/or part of C_1	**Resources** 331
			C_1 and/or part of C_2	**Resources** 332
			C_2	**Resources** 333
			P_1	**Resources** 334a
	Reserves have not been approved by the Council reviews the mineral reserves or competent agencies		A, B	**Resources** 331
			C_1	**Resources** 332
			C_2	**Resources** 333
			P_1	**Resources** 334a
3. The deposits has been surveyed or basically investigated geological mineral resources			C_1	**Resources** 332
			C_2	**Resources** 333
			P_1	**Resources** 334a
			P_2, P_3	**Resources** 334b