Abstract

This paper describes the system used to classify the resources and reserves of all minerals and fuels in Ukraine. The classification system is part of an official procedure determined by the Ukrainian State Commission on Reserves. Following preparation of resource estimates the results are registered with the State, which maintains an official inventory of all mineral resources. This paper compares the Ukrainian system to, and finds it compatible with the United Nations International Framework of resource classification. The UN system is based on economics of production and mineability.

1. GENERAL CLAUSES

1.1. The classification defines the common principles of the calculation and state registration of the reserves and the estimation of mineral resources for the State Fund of Ukraine.

1.2. The prospected and preliminary estimates reserve of resources and also the perspective resources of oil and gas are calculated and registered in the State balance of the Ukrainian mineral resources based on the results of geological exploration works (GEW). This includes all of test mining and drilling carried out during the process of commercial development of mineral deposits. The balanced and, conditionally balanced reserves and resources of solid, liquid and gas-like mineral resources are subjected, to state registration. These estimates underwent the examination and estimation of the Ukrainian State Commission on the reserves of mineral resources (SCR), and also the additional reserves discovered during deposit development. New deposits (fields) are added to the State balance according to the decisions of the State Commission of Reserves (SCR).

1.3. The perspective and prognostic estimated mineral resources are quantitatively estimated for the limits of all prospective areas based on the results of geological, geophysical, geochemical and other evaluation methods.

1.4. The reserves are calculated and registered, the resources are estimated separately for type of mineral resources and the direction of their commercial usage.

1.5. The reserves of the complex fields of the main and jointly bedded mineral resources and also the present useful components must undergo estimation and registration. The necessity of their commercial usage is established by the standards on mineral raw materials. The reserves of associated mineral resources and components are calculated and registered according to the "Demands of complex studying of the mineral resource deposits which are sent to the State examination estimation".

1.6. Quantitative estimation of prospective and prognostic resources is complex. For this aim the demands as to the quantity and quality of mineral resources and also the presence of useful components in them have been used. Is also necessary to take into consideration the standards of the known analogical deposits together with the possible changes of these demands in the nearest future.
1.7. Estimation and registration of the mineral reserves and the available useful commercial components are made in the case of their presence in the earth. Recoverable reserves of mineral resources are established according to the optimal system of development, which is substantiated by variational technical-economical calculations. These reserves include the losses during extraction, enrichment and processing of raw materials. The reserves of the associated useful components, which are accumulated during the processing of mineral raw materials in goods concentrates, products of metallurgical or another redistribution are calculated and registered so by the presence in the earth, as in the products and minerals which are extracted. For oil, gas-condensate, natural and dissolved gas and the other included useful components both the total and recoverable reserves are estimated and registered.

1.8. The estimation of the mineral resources quality is carried out according to the possible directions of their using correspondingly to the standards and demands of the acting standards and technical conditions and taking into consideration the technology for extracting and processing of the raw materials. At this point the composition of useful and harmful components, the forms of their location and the peculiarities of their distribution in the products of redistribution and waste materials of production are established.

1.9. Estimation and registration of the mass and volume of the reserves and quantitative evaluations of the mineral resources are made in the units of mass and volume. Exploitational reserves of underground waters are estimated and registered, and prognostic resources are evaluated in cubic metres per day. Steam-water mixture in tonnes per day. In industrial waters the quantity of components with commercial value (in tonnes) is established. These components may be obtained in the deposits during the calculation terms of its development without taking into consideration the losses during waters processing. By the deposits of heat-energetic waters, except the exploitational reserves, the heat-energetic power of the field is estimated (in gigajoule, megawatt, tonnes of conditional fuel).

1.10. The application of this classification for different kinds of mineral resources is regulated by the corresponding instructions of the Ukrainian State Commission on the reserves of mineral resources.

2. CLASSES OF MINERAL RESERVES AND RESOURCES BY THE DEGREE OF THEIR STUDYING AND TRUSTWORTHINESS

2.1. Mineral resources that are evaluated based on geological data studying in the areas of the earth, on the earth’s surface, in the water and gas sources and on the bottom of water reservoirs as good for commercial exploitation by the conditions of bedding, quantity and quality compose the current mineral resources, and together with the accumulated production — the initial mineral resources of the objects of geological investigation.

2.2. Depending on their determination mineral resources are subdivided into the reserves of mineral resources of the discovered deposits (pools) and the mineral resources of the undiscovered deposits (pools) in the perspective areas of the earth.

2.3. Depending on the degree of geological study completed mineral resources are subdivided into two classes: prospected (proved) and preliminary estimated (probable).

2.4. Prospected (proved) reserves of mineral resources are the reserves with quantity, quality, technological properties, mining-geological, hydrogeological and other conditions of bedding were studied in the degree suitable for their commercial exploitation. The main parameters of the prospected reserves, which stipulate the project decisions as to the production and processing of raw materials and environment prospection, are established by the data of immediate measurements or investigations done by the uniform volumetrical network in the
contours of the deposits with the limited extrapolation, based on the data of geological, geophysical, geochemical and other investigations. The main predestination of the prospected reserves is the projecting of the building of mining enterprises and the fields development.

2.5. The preliminary estimated (probable) reserves of the mineral resources are the reserves of which quantity, quality, technological properties, mining-geological, hydrogeological and other conditions of the bedding that have been studied to the degree suitable for the technical-economical evaluation for either commercial exploitation or test-commercial development. The main parameters of the preliminary estimated reserves of mineral resources, which influence the choice of methods of extracting and processing the war materials, are estimated mainly on the basis of the data extrapolation of measurements or investigations, located in the field limits by rare or uneven network. Extrapolation is grounded by the analogy with the prospected pools (deposits), and also by the data of geological, geophysical, geochemical studying bowels of the earth. The main purpose of the preliminary estimated reserves is the projecting of further prospecting of test-commercial development of the field and its preparation for the commercial exploitation.

2.6. Depending on the degree of geological study and reliability of the mineral resources of perspective underground deposits are subdivided into two classes: perspective and prognosed.

2.7. Perspective mineral resources are the resources of certain geological commercial type, quantitatively estimated based on results of geological study in the limits of productive regions with the known fields of mineral resources of the same geological-commercial type. Perspective resources take into consideration the possibility of discovering of the new deposits (pools) of mineral resources, the existence of which is stipulated by the positive evaluation of the established existence of mineral resources, geophysical, geochemical and other anomalies whose nature and perspectiveness are proven. Quantitative evaluations of the deposit (pool) parameters are determined on the basis of geological interpretation of geophysical and geochemical data or statistical analogy. The main use of the perspective resource estimation is planning prospecting and exploration.

2.8. Prognosed mineral resources are the resources that take into consideration the potential possibility of the fields forming of certain geological-commercial types, based on positive stratigraphical, paleographical, lithological, tectonical, mineraogenic and other preconditions, established in the limits of regional geological structures with undiscovered commercial fields. Quantitative evaluation of the prognosed resources is done on the basis of assumed similar parameters with the analogous geologic structures where discovered deposits of mineral resources of the same geological-commercial type. The main use of the prognosed resources is planning of regional and prognosing-geological works.

2.9. The instructions for using the classification for the deposits of separate kinds of mineral resources define the categories of explored deposits of the mineral resources in the limits of classes by the degree of geological studying and trustworthiness.

3. RESERVES AND RESOURCES GROUPS BY THE DEGREE OF THEIR PREINVESTMENT STUDY

3.1. Rational and effective geological study of the subsurface earth with the aim of discovering or prospecting the mineral resources deposits envisages the optimal succession of geological-exploration works (GEW). In order to determine the expediency of investing the next stage of geological-exploration works or the building of mining enterprise the geological-economical evaluation (GEE) of the objects of geological studying are done. Pre-investment studies of these objects envisage the establishing in detail of mining-geological, technological and technical-economical characteristics of the mineral resources deposits, and also the social,
ecological, lawful and other conditions of the field development and the realization of raw materials or the products of their processing.

3.2. The primary geological-economical evaluation (GEE-I) is done for the basing of expediency of the investing the exploration-prospecting works in the earth's areas perspective for discovery of mineral resources. GEE-I is carried out on the grounds of qualitative evaluation of perspective resources and is given in the form of technical-economical suppositions (TESp) as to their possible commercial importance.

3.3. The preliminary geological-economical evaluation (GEE-II) is done with the aim of basing the expediency of commercial exploitation of the deposit (area) of mineral resources and the investing of successive prospecting and preparation for their development. GEE-II is done on the ground of the preliminary evaluated reserves of mineral resources and is given in the form of technical-economical report (TER) on the expediency of further prospecting or test-commercial development of the deposit (area).

3.4. The detailed geological-economical evaluation (GEE-III) is done with the aim of establishing the industrial activity effectiveness of the mining enterprise, which is created on the basis of prospected reserves of mineral resources and includes the technical-economical substantiation (TES) of the standards for their evaluation.

3.5. Thus the mineral reserves and resources by the degree of their preinvestment studying are divided into three groups:

- To the first group the reserves of mineral resources are related reserves, on the basis of which the detailed geological-economical evaluation (GEE-III) is done of the effectiveness of commercial activity of mining enterprise which is projected for their development. The materials of GEE-III, including TES of stable standards for mineral raw materials, underwent the examination and were estimated by the Ukrainian State Commission on the reserves of mineral resources.

- To the second group the reserves of mineral resources are related reserves on the basis of which the preliminary geological-economical evaluation (GEE-II) of their commercial importance is done. The TER materials on the expediency of the field further prospecting, including TES of temporary standards of mineral raw materials, underwent the examination and were approved by the Ukrainian State Commission on the reserves of mineral resources or by the client (investor) of the exploration works.

- To the third group of the resources and reserves of mineral resources are related these, on the basis of which the primary geological-economical evaluation (GEE-I) of the possible commercial importance of the earth's perspective area is done. The TES materials on the expediency of further exploration works and the parameters of recommended standards for mineral raw materials underwent the examination and were approved by the client (investor) of exploration works or the Ukrainian State Commission on the reserves of mineral resources.

4. RESERVES GROUPS BY THEIR COMMERCIAL IMPORTANCE

The classes of mineral resources and useful components are divided into three groups: their commercial importance

a) balanced,
b) conditionally balanced,
c) out of balance.
a) *Balanced* reserves are reserves that at the moment of evaluation accordingly to the technical-economic calculations *may be economically extracted and used with modern techniques and technology of production and processing* of the raw materials, which provide the keeping of demands of the rational using of the *bowels* and the protection of natural environment.

b) *Conditionally balanced* reserves are reserves the effectiveness and production and using of which at the moment of evaluation cannot be precisely established, and also the reserves that correspond to the demands for the balanced reserves, *but cannot be used because of unsolved, unlawful, ecological and other questions.*

c) *Reserves out of balance* are reserves the production and using of which at the moment of evaluation are not economically justified. However, in future they may become of commercial importance.

Only in their balance perspective and prognosed resources are evaluated on the basis of assumed parameters only in their balance part. Out of balance and conditionally balanced components of perspective and prognosed resources are not estimated.

5. GROUPS OF MINERAL RESOURCES DEPOSITS BY THE COMPLEXITY OF THEIR GEOLOGICAL STRUCTURE

5.1. By the complexity of geological structure the deposits of mineral resources or their areas, which are envisaged for the development by individual enterprises, are divided into four groups:

- To the first group belong deposits (areas) of simple geological structures with undeformed or weakly deformed bedding of the deposit, consistent quantitative or qualitative parameters of the mineral resources pools, even distribution of the main useful and harmful components.

- To the second group belong deposits (areas) of complex geological structure with inconsistent quantitative or qualitative parameters of the pools of mineral resources, uneven distribution of the main useful of harmful components.

- To the third group belong deposits (areas) of very complex geological structure with changing quantitative of qualitative parameters of the reserves of mineral resources, very uneven distribution of the main useful or harmful components.

- To the fourth group belong deposits of extremely complex geological structure with sharply changing quantitative or qualitative parameters of the deposit of mineral resources, with absolutely uneven distribution of the main useful or harmful components.

During the determination of the geological structure complexity in the field are used the indices of changing of the main deposit parameters which contain no less than 70% of the raw material reserves.

The instructions for using the classification for different kinds of mineral resources envisage the using of quantitative evaluations of changing of the mineral resources pools parameters and the indices of the raw materials quality for the establishing the groups of complexity of the field (area) geological structure.
6. PREPARATION OF THE MINERAL RESOURCES DEPOSITS (AREA) FOR COMMERCIAL EXPLOITATION

6.1. The state of preparation of mineral resources for commercial exploitation is determined by the decisions of the Ukrainian State Commission on the Reserves of Mineral Resources. The decision is made following examinations of the materials of geological-economical estimations of the deposits (areas) of mineral resources, taking into consideration the conclusions of the clients and performers of geological surveys, the investors of the mining facilities construction, which are projected on the basis of these reserves, and also the demands of the legislation of nature protection and the legislation on the earth's bowels.

6.2. The state of geological study of the reserves of the deposits (areas) mineral resources, which are prepared to the commercial exploitation and are transferred to the users of the bowels must correspond to the following conditions:

6.2.1. Balanced reserves of the main and jointly bedded mineral resources and the available in the adjoining useful components of commercial importance were estimated by the Ukrainian State Commission on the Reserves of Mineral Resources.

6.2.2. The volumes of total reserves and resources of the field (area) in its geological limits were established as to the degree of their geological studying, reserves and resources of the neighbouring undeveloped fields of mineral resources which are taken into consideration at the projecting of construction (reconstruction) the mining objects for the establishing of possible perspectives of the enterprise development, the bordering depth and the development area, the choice of the way of uncovering the pools' mineral resources, the places of laying of the mine shafts, the location of industrial constructions, access roads and so on.

6.2.3. The volumes of balance prospected and preliminary evaluated reserves of mineral resources were established which are used for the projecting of construction (reconstruction) of the mining objects, the possibility of these reserves development is substantiated without damage for the mineral resources pools which are left in the earth's bowels.

6.2.4. The quantity of the prospected reserves of the first class of geological studies provides the activity of mining objects for the period of returning of capital investments into prospecting and commercial exploitation of the field.

6.2.5. The dangerous ecological factors are established and estimated which influence or may influence the state of natural environment and human health during prospecting and development of the field, processing of raw materials, storage of industrial waste; the rational complex of the measures as to environment protection and the people's health is worked out; the background parameters of the environment state are established; preliminary consent are obtained for special use of plots of land with the aim of the mineral resources extraction according to the legislation.

6.2.6. The profitableness of industrial activity of mining object is grounded by technical-economical estimations which is projected on the basis of the reserves of mineral resources established by the State examination, taking into consideration the expenses for additional prospecting of mineral resources, the effectiveness of capital investments into the field (area) development is provided at the level of income average norm.

6.3. For the projecting of construction of mining and processing objects in the field of the first and second groups of the geological structure complexity the prospected reserves of mineral resources of the first class of geological studying are used; in the fields of the third and fourth groups of the geological structure complexity the prospected and preliminary estimated reserves of mineral resources of the first and second class of geological studying in the ratio
which is determined by the instructions of the classification as to the separate kinds of mineral resources.

6.4. By the agreement of the interested users of the earth’s bowels under conditions of economical risk the transfer of the preliminary estimated reserves of the deposits of mineral resources may be realized before their examination and estimation by the Ukrainian State Commission on the reserves of mineral resources with following obligatory estimation. In such cases the reserves studying, which are transferred to commercial exploitation, may not correspond to the demands of points 6.2 and 6.3 of this classification, on condition that geological studying provides the establishing and evaluation of harmful ecological factors connected with the deposit exploitation, according to point 6.2.5.

6.5. In the deposits which are brought into development the additional prospecting and exploitation prospecting are carried out.

6.5.1. The additional prospecting of the developed deposits is carried out in their insufficiently studied parts (flanks, deep or upper horizons, separated areas, etc.) and is done consequently according to the plans of productive works.

6.5.2. The exploitation prospecting which leaves behind the development of productive works, must specify the data on morphology, inner structure, conditions of the pools bedding and development and the quality of their mineral resources by data of drilling the additional wells and of hole-making of the mining-preparatory and other workings. The exploitation prospecting, which accompanies the productive works, must specify the quantitative and qualitative indices of the mineral resources pools by data of drilling and investigations in development and regime wells, investigations in the cleaning mining workings, etc.

6.5.3. In the result of carrying out the additional prospecting and exploitation prospecting of the deposits (areas) of the developed mineral resources the transferring of preliminary evaluated reserves into prospected ones, and also the calculation and registration of the established reserves are made.

6.6. In the developed deposits of mineral resources the uncovered, prepared, ready for extraction and also being present in the protecting pillows of mining-capital and mining-preparatory workings of the reserves of mineral resources are estimated and registered separately with their dividing into classes and groups according to the degree of geological studying and their commercial meaning.

6.7. The recalculation and the examination of the reserves of mineral resources are made by the State in the following cases:

– if in the result of mining or additional exploration works or the investigations as to the pool regime of mineral resources in the developed deposits the summary prospected balance reserves increases for more than 50% in comparison to the preliminary evaluated ones by the Ukrainian State Commission on the reserves of mineral resources, or if the written-off and envisaged for the writing off the prospected reserves as those that were not proved or inexpedient for production by technical-economical (mining-technical) reasons, exceed the norms established by legislation;

– if the revision of the standards demands and technical conditions as to the quality and quantity of mineral resources, the technology of their processing leads to decreasing of summary balance prospected reserves of the deposits of mineral resources of more than 20% or their increasing for more than 50%.

– if the exceeding of real terms of exploitation of the deposit (area) reserves of mineral
resources over the adopted ones at their State examination and evaluation is reached in the extent that leads to the reconstruction of mining objects in connection with the changing of exploitation conditions.

7. CODIFICATIONS SYSTEM USED IN THE CLASSIFICATION OF THE MINERAL RESERVES AND RESOURCES

As shown in Table I, classified mineral reserves and resources are identified by three-numerical codification. The first number indicates the degree of commercial importance of mineral reserves. Number 1 means "balance reserves", number 2 — "conditionally balance reserves" and number 3 — "outbalance reserves".

The third code numbering indicates the degree of geological investigation and trustworthiness of the mineral reserves and resources. Number 1 means "prospected reserves", number 2 — "preliminary estimated reserves", number 3 — "perspective resources", and number 4 — "prognosticated resources".

The second code numbering indicates the degree of technical-economical investigation of the mineral resources and detail geological-economical evaluation of the deposit (area). Number 1 means that the mineral resources has undergone detailed geological-economical evaluation (GEE-I) and were estimated by the State Commission of Ukraine for Reserves of Mineral Resources on the basis of the technical-economical substantiation (TES) of the standards for reserves evaluation. Number 2 means that mineral resources has undergone preliminary geological-economical evaluation (GEE-II) and were tested by the State Commission of Ukraine for Reserves of Mineral Resources or by client (investor) on the basis of technical-economical report (TER) on their readiness for commercial development. Number 3 means that mineral resources has been subjected to initial geological-economical evaluation (GEE-III). Number 0 indicates that geological-economical evaluation was never carried out.

8. GENERAL REMARKS RELATED TO THE CLASSIFICATION PROJECT

The project of Classification of the mineral reserves and resources of the State Fund of Ukraine foresees the solution of the following main tasks:

- adaptation of the existing system of estimation and registration of the mineral reserves to the conditions of the transitional period of market economics and legislation of Ukraine;
- ensuring the possibility of the Ukraine Classification for inclusion to the international system of reserves reporting;
- ensuring the possibility of a Classification that can be used for all kinds of mineral resources;
- preservation of the clauses of the existing classification which do not contradict with the new economical and political conditions.

The Classification is based on the most general criteria of investigations and trustworthiness of reserves and resources, which are common for all kinds of mineral resources. It is envisaged that the instructions in using the Classification for certain types of mineral resources will include questions related to the reserves investigation in sufficient details that will allow independent estimate.

The requirements related to the preparation for commercial exploitation of the deposits may also be given in the instructions on the use of the Classification and the exact regulations related to the development of technical-economical substantiations (TES), technical-economic reports (TER), technical-economic suppositions (TESp). All of these are still being prepared.
<table>
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<tr>
<th>UN International Framework</th>
<th>Detailed exploration</th>
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<td>Ukrainian system</td>
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<td>Feasibility study</td>
<td>detailed preinvestment estimation (TES)</td>
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<td>1. (1.1.2)</td>
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<tr>
<td>Prefeasibility study</td>
<td>preliminary preinvestment estimation (TER)</td>
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<tr>
<td>Geological study</td>
<td>primary preinvestment estimation (TESp)</td>
<td>1-3 (2.3.1-3)</td>
<td>1 (3.3.1)</td>
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**UN Framework**
1. Economic
2. Marginally economic
3. Subecononomic
1-3. Economic-subeconomic

**Mineability**

**Ukrainian system**
1. Balanced
2. Conditionally balanced
3. Out of balance
1-3. Indivisible balance and out of balance

(1.1.1) —
Figure indices of reserves and resources
Introduction of the proposed Classification for each groups of mineral commodities has to be done gradually after instructions on the use of the Classification system has been prepared.

The groups of mineral commodities, for which preparation of the instructions on the application of the Classification is anticipated, are the following:

1. Coal, petroliferous shales
2. Oil and gas — is being developed
3. Underground waters
4. Ferrous and non-ferrous metals — is being developed.
5. Noble metals
6. Rare, rare-earth, dispersed metals
7. Radioactive elements
8. Raw materials for metallurgy — is being developed
9. Mining-chemical raw materials — is being developed
10. Building and facing raw materials

In contrast to the existing Classification the new system is hoped to achieve:

- estimation and registration of the country’s mineral reserves and resources, taking into consideration losses during production and processing;
- differentiation of the reserves according to their geological trustworthiness and commercial values and separate them according to their degree of preinvestment investigation.