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Specifications for coal, peat exploration

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Table of Contents

Foreword 4
1 Scope 5
2 Normative references 5
3 Purpose and task of coal, peat exploration 5
4 Basic principles for coal, peat exploration 6
5 Working level of coal, peat exploration 6
5.1 Stage division 6
5.2 Pre-survey stage 6
5.3 General survey stage 7
5.4 Detailed survey stage 8
5.5 Exploration stage 10
6 Coal geological exploration control level 13
7 Coal resources/reserves classification and type conditions 14
7.1 Resources/reserves classification basis 14
7.2 Coal resource/reserve classification and type conditions 15
8 Coal resources/reserves estimation 18
8.1 Coal resource quantity calculation indexes 18
8.2 Basic requirements for the division of calculation segments of various types of resource quantities 19
8.3 General requirements of resources/reserves estimation 19
8.4 Determination method of depth of coal stratum with dirt band 20
8.5 Estimation of dirt band and detached material within open exploration coal stratum 20
9 Coal stratum methane and other profitable mine exploration 21
10 Peat exploration 21
10.1 Peat pre-survey 21
10.2 Peat general survey 21
10.3 Peat detailed survey 23
10.4 Peat exploration 23
10.5 Peat resource/reserve estimation 24
11 Data recording, integrated research and report compilation 26
Annex A 27
Annex B 28
B.2 Exploration research of hydrogeological conditions in exploration area (well field) 28
B.3 Engineering geological exploration work 30
B.4 Environmental geological work 31
Annex C 36
C.1 Exploration and evaluation of coal seam gas 36
C.2 Exploration and evaluation of other beneficial minerals 36
Annex D 38
D.1 Degree of structural complexity is divided into four types 38
D.2 Stability degree of coal seam is divided into four types 39

D.3 Requirements of selecting basic line distance for drilling engineering 40
D.4 Control degree of peat exploration engineering 40
Annex E 42
Annex F 44
Annex G 47
G.1 Classification of hydrogeological investigation type 47
G.2 Engineering quantity of hydrogeological investigation 48
G.3 Classification of hydrogeological investigation type of open-pit coal mines 51
G.4 Pumping test quantities of open-pit coal mine exploration 54
Annex H 55
H.1 According to the lithology of open-pit slope rock stratum, physical and mechanical properties, development degree of structural surface, open-pit slope can be divided into three categories 55
H.2 Exploration work arrangement of open-pit slope 55
H.3 According to the lithology of peeling rock stratum as well as physical and mechanical properties, the overburden can be divided into three categories 56
H.4 Exploration engineering arrangement of open-pit overburden 56
Annex I 57
Annex J 59
J.1 Scoping study 59
J.2 Pre-feasibility study 59
J.3 Feasibility study 60

Foreword

"Coal Resource Geological Exploration Specifications" issued by National Commission of Mineral Reserves in December 1986 and "Peat Resources Geological Exploration Specifications" (trail operation) that were jointly issued by Ministry of Geology and Mineral Resources and Ministry of Coal Industry come into force (trail) have played active promoting roles in the coal and peat exploration.

To enable coal and peat explorations to comply with the social and economic development requirements in China as well as consistent with GB/T 17766-1999 "Solid Mineral Resources/Reserves Classification", it is necessary to revise "Coal Resource Geological Exploration Specifications" and "Peat Resources Geological Exploration Specifications" (trail operation).

This Standard is formulated on the basis of the summary of experiences getting from coal, peat geological exploration and the collection of opinions get from public solicitation, discussion and revision. Since the date of this Standard coming into force, "Coal Resource Geological Exploration Specifications" issued by National Commission of Mineral Reserves and "Peat Resources Geological Exploration Specifications" (trail operation) that were jointly issued by Ministry of Geology and Mineral Resources and Ministry of Coal Industry have been abolished.

Annex A in this Standard is normative.

Annex B, C, D, E, F, G, H, I, and J in this Standard are informative.

This Standard was proposed by Ministry of Land and Resources of the People's Republic of China.

This Standard shall be under the jurisdiction of National Technical Committee on Geological Mines of Standardization Administration of China.

Drafting organization of this Standard: China National Administration of Coal Geology

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This Standard shall be interpreted by Ministry of Land and Resources of the People's Republic of China.

Specification for coal, peat exploration

1 Scope

This Standard specifies purpose, tasks, stage division, working level requirements, exploration methods and principles of coal, peat geological exploration as well as the classification conditions and estimation principles on coal, peat resources/reserves.

This Standard is applicable to the design and compilation at each stage of coal, peat exploration, exploration construction, geological research, compilation and approval of geological report, and estimation and evaluation of coal, peat resources/reserves which can also be served as the evaluation basis for mining right transfer, exploration and development financing.

2 Normative references

The provisions in following documents become the provisions of this Standard through reference in this Standard. For dated references, the subsequent amendments (excluding corrigendum) or revisions do not apply to this Standard, however, parties who reach an agreement based on this Standard are encouraged to study if the latest versions of these documents are applicable. For undated references, the latest edition of the referenced document applies.

GB/T 13908-2002 General requirements for solid mineral exploration

GB 50215-94 Code for the colliery design coal mining industry

GB 50197-94 Code for engineering design for open pit coal mine

GB/T 12719-91 Exploration specification of hydrogeology and engineering geology in mining areas

3 Purpose and task of coal, peat exploration

The purpose and task of coal, peat exploration are to provide geological data for long-term coal construction planning, mining area overall development planning, and primary mine (outdoor) design.

4 Basic principles for coal, peat exploration

4.1 Coal, peat exploration must be based on the actual conditions of explored area and the actual needs of coal production and construction. Coal, peat exploration means should be correct and rational; technical and economic benefit should be noted. With rational investment and guaranteed short construction period, the best geological achievements should be obtained.

4.2 Coal, peat exploration must be guided by modern geological theory. Advanced technical equipment and exploration method should be applied to improve the accuracy of exploration achievements, and applied to the needs of mine construction technical development.

4.3 For coal and peat exploration, it must insist on the principle - “coal oriented, synthesized exploration and evaluation”, make full use of and rationally protect mineral resources and exploration, evaluation work of other accompanied mines, especially exploration and research of coal stratum methane and underground water resource (hot water).

5 Working level of coal, peat exploration

5.1 Stage division

Coal, peat exploration is divided into four stages: pre-survey, general survey, detailed survey, and exploration. The stage of exploration can be adjusted based on the actual conditions of working area and exploration right possessor (exploration investors, such as state, mine enterprise, owner, construction organization and geological exploration organization, the same as follows). Exploration can follow four-stage sequence; the stages can also be combined or crossed. In detailed survey and exploration stages, exploration-right possessor should confirm the requirements of geological exploration by referencing this Standard.

5.2 Pre-survey stage

5.2.1 Pre-survey should be conducted based on the prediction of coal filed or areal geology investigation. Its task is to find coal resources. The result of pre-survey is to evaluate whether the discovered coal resource has further geological value. When coal resource with further value is found through pre-survey, general survey should be generally continued. If coal resource with further value is not discovered through pre-survey or coal resource is not discovered, the geological conditions in the working area should be summarized.

5.2.2 The requirements of pre-survey working level:

a) Primarily confirm the stratigraphic sequence in working area and confirm the age of

5.5 Exploration stage

5.5.1 Exploration task

Exploration task is to provide geological data for the feasibility research and primary design on mine construction. Exploration is generally in the unit of well field. The key exploration area is the earlier stage mining area[1)] of mine (or first level, the same as follows) and primary stage mining area[2)]. Exploration achievement should satisfy the position to confirm wellbore, horizontal transportation lane, and general air return way. Delimitate primary stage exploration area and confirm the needs of mining technology; assure the boundary of well field and mine design capacity do not vary due to geological factors and assure not affecting the coal washing and processing and designated industrial purpose due to coal quality data.

5.5.2 Exploration working level

5.5.2.1 For the well field of planned medium sized or above mine with relative high degree of mechanization, the general requirements of exploration working level are as follows:

a) Control the structure on the boundary of well field, where the plane position of the boundary structural line related to the earlier stage mining area within mine should be controlled within 150m;

b) Survey the fault zone within earlier stage mining area with difference level equal to and greater than 30m, survey the fault zone with difference level equal to and greater than 20m within primary stage mining area (the area with dip-angle gentle, simple structure, and good seismic geological condition is 15m ~ 10m); give evaluation to the small structured development degree, distribution range and mining effect;

c) Control the floor contour line of main exploitable stratum within the earlier stage mining area and when coal stratum inclination is less than 10°, control the contour line of coal stratum floor within primary stage mining area within 10m~20m;

d) Survey the location and thickness variation of mining stratum, confirm the continuity of exploitable coal stratum and control the exploitable area of exploitable coal stratum within earlier stage mining area (including the variation of depth and

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1) Earlier stage mining area (first level): the mining division area with gentle stratigraphic dip angle not delimitating according to the burial depth of coal stratum but according to the mine adopting partition expansion method and satisfying the mine design production capacity and the corresponding service time limit is earlier stage mining area. It is equivalent to the shallowest level generally guaranteeing the designed production capacity and the leveled served time limit when arranging the exploration level according to coal stratum burial depth, that is the first level.

2) Primary stage mining area: the mining area which is the first reaching the production capacity (or among the first ones which are mined) is called as primary stage mining area or first mining area.

reached the control requirements at exploration stage.

7.2.2 Classification of explored coal resources/reserves

7.2.2.1 Exploitable reserve (111): the proved exploitable part of economic basic reserves. Exploration work level has reached the working level of exploration stage. Feasibility research is conducted to prove mining is economic during the time of calculation and the confidence levels of the results of calculated exploitable and feasibility evaluation are high.

7.2.2.2 Proved (investigable) economic basic reserves (111b): the difference with (111) lies in this type is expressed by the quantity not deducting design and exploration loss.

7.2.2.3 Pre-exploitable reserve (121): the difference with (111) lies in that this type, only pre-feasibility research is carried out and high confidence level of estimated exploitable reserve and ordinary confidence level of feasibility evaluation.

7.2.2.4 Proved (pre-investigable) economic basic reserve (121b): the difference with (121) lies in that this type expressed by the quantity not deducting design and exploration loss.

7.2.2.5 Exploitable (investigable) marginal economic basic reserve (2M11): exploration working level has reached the working level requirements of exploration stage. Feasibility research indicates that when mining is confirmed as economic but close to the edge of profit and loss, it can be turned into economic only when technical and economic conditions are improved. The confidence levels of estimated basic reserve and feasibility evaluation result are high.

7.2.2.6 Proved (pre-investable) marginal economic basic reserve (2M21): the difference with (2M11) lies in that for this type, only pre-feasibility research is conducted and high confidence level of estimated basic reserve is high but ordinary confidence level of feasibility evaluation result.

7.2.2.7 Exploitable (investigable) sub-marginal economic resource quantity (2S11): exploration working level has reached the working level at exploration stage. Feasibility research indicates that when confirming mining is not economic, the substantial increase of mineral product price or substantial decrease of cost, exploration can become economic. The confidence levels of estimated resource quantity and feasibility evaluation result are high.

7.2.2.8 Proved (pre-investigable) sub-marginal economic resource quantity (2S21): the difference with (2S11) lies in that feasibility research is conducted for this type and high confidence level of estimated resource quantity and ordinary confidence level of feasibility evaluation result.

7.2.2.9 Proved intrinsic economic resource quantity (331): the exploration working level has reached the working level at exploration stage. Not feasibility research or pre-feasibility research but summary research is conducted. The economic meaning lies

8.3.4 When coal stratum inclination angle is less than 60°, resource/reserve is estimated from plane projection diagram. When inclination is equal to or greater than 60°, resource/reserve is estimated from vertical projection view or vertical developed view.

8.3.5 When coal stratum inclination is less than 15°, coal stratum fake depth and horizontal projected area are utilized for resource/reserve estimation; when inclination is equal to or greater than 15°, true thickness of coal stratum and inclined area must be utilized for estimation.

8.3.6 Analyze the reasons leading extreme thick point, thin point or un-exploitable point throughout coal stratum which should be processed based on specific conditions.

8.3.7 Estimation method and various estimation parameters of resources/reserves should be confirmed based on specific conditions. Try to popularize and use domestic and international advanced technologies and realize microcomputer processing in an all-around manner. The result of resource/reserve estimation is in ten thousand tons, the decimals of which should be rounded-off.

8.4 Determination method of depth of coal stratum with dirt band

8.4.1 The dirt band with single coal stratum less than 0.05 m within coal stratum can be combined with coal sub-stratum, the depth of which should be calculated. The ash content (or calorific value), sulfur content of full stratum after being combined with dirt band should comply with the relevant stipulations on estimation indexes.

8.4.2 When dirt band depth within coal stratum is equal to or greater than the minimum exploitable depth of coal stratum, coal sub-stratum is regarded as independent coal stratum, which is used for resource/reserve estimation (or non-estimation). When dirt band depth is lower than the minimum exploitable depth of coal stratum and coal sub-stratum depth is equal to or greater than dirt band depth, the total of upper and lower coal sub-stratums is regarded as the applied depth.

8.4.3 For complex structured coal stratum and composite coal stratum which cannot be compared with coal sub-stratum, when the total depth of dirt band is not greater than 1/2 the total depth of coal sub-stratum, the total depth of sub-stratums is regarded as the depth of coal stratum. When the total depth of dirt band is greater than 1/2 the total depth of coal sub-stratum, the handling is in accordance with 8.4.1 and 8.4.2.

8.5 Estimation of dirt band and detached material within open exploration coal stratum

8.5.1 Estimation requirements of coal stratum dirt band

a) Dirt content rate in each coal stratum should be estimated;

b) For the dirt band with the depth equal to or greater than 1m in coal stratum, dirt content rate should be estimated respectively.

sample of sporopollenin and ^{14}C sample from exploratory pit (well). The quality of sample must be guaranteed which should be protected from pollution.

10.2.5.3 Sample quality: the wet sample in naked peat from modern swamp should not be less than 2kg and the mass of buried peat should not be less than 1kg.

10.2.5.4 Package and sample delivery: sample is generally packed in a plastic bag or other bags made of the material not easily being polluted. The sample label is placed between two layers of plastic bag or bundled on the upper part of sample bag. The tape with SN written on it should be affixed outside the bag. The sample for physical and chemical analysis should be dried in dark place firstly and then delivered to laboratory for test.

10.2.5.5 Sampling quantity and general analysis items of peat: confirmed based on the integrated utilization of evaluation. Peat sample taken at general survey stage should generally undergo physiochemical property. General analysis items include color, natural water content, hygroscopic moisture, dry content, fiber content, pH value (water immersion, salt immersion), total sulfur, calorific value, crude ash, organic, total humic acid, total nitrogen, total phosphorus and total potassium. To make a rational utilization of peat, select a small amount of representative sample from general survey area to conduct sulfur and ash analysis (Si, Al, Fe, Ca, Mg, K, Na oxides, etc.), organic composition analysis (total humic acid, fulvic acid, hymatomelanic + humic acid, pitch A, fiber, half-fiber and lignin) and microelement semi-quantitative spectrometric analysis and element composition (C, H, N, O, and S) analysis. In addition, sporopollenin and vegetation residue analysis should be carried out on the sample taken from a small amount of representative section system. ^{14}C age determination should be conducted if conditions permitted.

10.3 Peat detailed survey

The enclosure of detailed survey area should be based on large scale geological mapping and many exploration means and methods. Take the sample from the system which is more intensive than that at general survey stage. Evaluate whether peat resource in detailed survey area is of working value. If necessary, enclose the exploration range and evaluate the controlled, deductive and predicted resource/reserve. The controlled resource/reserve proportion is confirmed by referencing annex E.

10.4 Peat exploration

10.4.1 Purpose: survey the range, reserve quantity and quality of proved mine within the enclosed area for peat detailed survey and conduct integrated evaluation and provide necessary technical design data for mining.

10.4.2 Tasks:

a) Survey the detailed peat distribution range, area and mineral stratum depth, number of stratum and peat quality variation;

into two grades, peat-to-be with organic matter content of 30%~50% and greater than 50% peat.

10.5.1.2 The classification conditions of resource/reserve are as follows based on the specificity of peat and mine resource (classification in accordance with feasibility research degree and economic meaning refers to 7.1 and 7.2):

a) Proved: resource/reserve as the basis for the mining design of mining area, the conditions of which are:

1) Control mineral body shape, occurrence and depth variation and accurately enclose boundary;

2) Divide peat grade, and master the quality variation of peat;

3) Find out the mezzanine that affects the mineral reserve;

4) Survey the depth of covering layer and lithology and lithofacies variation;

b) Controlled: a basis to confirm the further exploration deployment and formulate the peat resource development and utilization planning, the conditions of which are:

1) Basic control of mineral body shape, occurrence and mineral stratum depth variation, main mineral body boundary must adopt engineering control;

2) Basic confirmation of quality grade and variation;

3) Interlayer such as sediment or rotten wood which has larger impact on mineral body has been found out;

4) Get a primary understanding of covering layer depth, and lithology and lithofacies variation;

c) Deductive: to further deploy detailed geological survey and long-range mine construction planning, it is required to have a primary understanding of mineral body range, stratum depth, occurrence and quality;

d) Predicted: pre-survey of area with peat resource and sufficient data to estimate resource quantity.

10.5.2 General stipulations on resource/reserve estimation

10.5.2.1 Estimation index: organic matter content in peat is >30%. It is not allowed to take decay peat, humus and black soil with organic matter content <30% as peat; peat stratum depth is exposed peat (excluding grass layer on modern swamp surface) >0.3m; buried peat stratum depth is >0.5m; stripping ratio should be less than 3.

10.5.2.2 For complex structured mineral resource/reserve estimation, when interlayer

B.3.6 The focal point of open-pit overburden strength exploration is the earlier mining area and is to make the appropriate control of the region. Classification of open-pit overburden and exploration engineering arrangement can be carried out according to the opinions of the explorer and the reference of Annex H.

B.3.7 Open-pit slope exploration and overburden strength exploration shall be carried out with the geological exploration and hydrogeological investigation in order to make full use of geological exploration and hydrogeological investigation drill holes, a hole multi-purpose. Special exploration drill hole can be arranged only when there is no geological and hydrogeological drill hole for use. Open-pit engineering geological exploration shall combine engineering geological mapping, drilling engineering geological observation, test for physical and mechanical properties of the rock, geophysical logging and other means; comprehensively research the relationship between various physical parameters and test indexes of physical and mechanical properties. Engineering geology – hydrogeology composite histogram (table) shall be established to make the analysis and comparison of rock strength, weak layer and weak plane. In the areas of more complex terrain conditions, landslides, dilapidation and other geophysical phenomenon shall be investigated, and the stability of natural slope shall be studied.

B.4 Environmental geological work

B.4.1 Task of environmental geological work

Based on the comprehensive research of the natural geographical and geological environment status of exploration area (mine field), ecological environment problems and environmental pollution that may arise in the coal mine construction and production process shall be forecasted and evaluated.

B.4.2 Environmental geological work

B.4.2.1 General-survey stage shall investigate the natural geographical and geological environment status of regions and exploration areas, understand the intensity of regional historical earthquakes and modern earthquakes as well as new tectonic activities, know the impact of the existing industry on the environment, and take a small quantity of representative samples for the analysis of pollutant sources (contaminants), when necessary.

B.4.2.2 Detailed exploration stage shall combine hydrogeology and engineering geological exploration, understand the present status of environmental geology within the exploration area, know the main factors and hazard levels of causing environmental pollution, and take representative samples for the analysis of the existing pollutant sources (contaminants) in the exploration area. A preliminary evaluation on environmental geology of exploration area shall be made.

B.4.2.3 Prospecting stage shall do the following work:

a) Conduct a regional stability exploration to focus on the collection of historical

and prospecting stage needs not supplement the sampling work;

b) Detailed exploration stage initially identifies the mine field of nitrogen – methane zone, the control of prospecting stage on the tendency of mine field shall have not less than three exploration lines, the density of sampling points shall be 0.5 points/km^2 ~ 1.5 points/km^2, and the sampling points shall be emphatically arranged at the first level;

c) Detailed exploration stage has preliminarily identified the mine field of methane zone, the mine field of nitrogen – methane zone and methane zone and the mine field with carbon dioxide content greater than 5 m^3/t coal, and strictly encrypts the sampling control on the main minable coal seam with high content of methane (or carbon dioxide), the number of sampling points shall be accounted for over 50% of the number of seeing coal drill holes, and the sampling points shall be emphatically arranged at the first level;

d) If it is included in the aforesaid circumstances listed in Article B.4.3.4b) and Article B.4.3.4c), exploration stage shall make a detailed study on the gas composition, content and change of gradient of various main minable coal seams, further divide the gas zone, combine mine field structure, coal-bearing stratum lithology, coal seam thickness, coal quality, hydrogeology, ground temperature and other geological conditions, analyze the geological factors affecting the gas occurrence, properly encrypt the sampling for the main gas logged coal seam and anticline, neighboring of major structural zone, thick coal seam and other areas suitable for gas enrichment, and directly take coal seam roof and floor samples to understand the gas occurrence in the surrounding rock.

B.4.3.5 General requirements of coal sample for gas analysis test items have three aspects:

a) All coal samples for gas test shall make the coal industry analysis and measure the gas composition and content;

b) If it is included in the circumstances listed in Article B.4.3.4b) and Article B.4.3.4c), prospecting stage shall additionally test the following items, not less than five points for each of the main minable coal seam (for small mine field with an area of less than 5 km^2, it shall be determined according to the actual needs), namely, firmness coefficient of the coal (f), initial velocity of gas emission (Δp), adsorption isotherm line test of coal to methane (a, b), coal porosity and permeability, coal seam gas pressure (measured in drill hole);

c) All coal samples for gas test shall have a detailed description of coal structure.

B.4.4 Identification of coal dust explosion

During the prospecting stage, each minable and locally minable coal seam shall have two to three samples for identification of coal dust explosion, measure the length of flame and

Annex C

(Informative)

Exploration and Research of Coal Seam Gas and Other Beneficial Minerals

C.1 Exploration and evaluation of coal seam gas

C.1.1 The pre-exploration stage shall carry out the coal seam gas geological survey of field and adjacent mines, understand the developmental state and direction of coal cleat, and investigate the gas situation of adjacent mines.

C.1.2 The focal point of exploration and research of coal seam gas is in the general-survey stage. Exploration and evaluation work of coal seam gas shall be arranged and made with the general-survey of the coal simultaneously. It shall focus on understanding the basic characteristics of coal seam gas occurrence in the exploration area, and assess the prospects for further work.

C.1.3 If it is discovered that the methane content of the main minable coal seam in the exploration area is equal to and greater than 8 m^3/t, it shall choose drill holes for well testing of the main coal seam, test the coal seam's permeability, reservoir pressure and crustal stress, and take the coal core to conduct the determination of gas content, vitrinite reflectance measurement and adsorption test in order to obtain the data of the ground-up development possibility of coal seam methane. It shall also conduct mud logging (gas logging) work, if necessary.

C.1.4 When the coal seam gas with resources prospect is found, it shall review in the geological report; if necessary, special geological data of coal seam gas exploration shall be submitted.

C.2 Exploration and evaluation of other beneficial minerals

C.2.1 In the pre-exploration and general-survey stage, based on a detailed study of the relevant information of the area and adjacent area, describe, identify, sample and analyze the known seam and rock stratum having some industrial significance, have a rough idea of the type of beneficial minerals and its distribution range, thickness and grade. Rock stratum with ore-bearing characteristics, rock stratum used as building materials and unconsolidated sediment shall have a detailed hierarchical description and take samples for analysis test. It shall select some prospecting trenches, prospecting wells, small coal mines and a small amount of drill holes, make systematic sampling for all coal seams (including partings and roof and floor) and carbon mudstone, do first spectral analysis and carry out the quantitative analysis based on the content of trace elements. It shall also choose one or two drill holes, sample all rock strata for spectral analysis respectively, and

Annex D

(Informative)

Type classification of degree of structural complexity and stability degree of coal seam as well as basic line distance of drilling engineering

D.1 Degree of structural complexity is divided into four types

D.1.1 Simple structure: the occurrence of coal-bearing strata does not change very much along the strike and trend, the faults are rare, with no or little affected by magmatic rocks. It mainly includes:

a) The occurrence is close to the level, and there is little slow wave fluctuation;

b) Gently inclined to inclined simple monocline, syncline or anticline;

c) Relieved folds with small number and single direction.

D.1.2 Medium structure: the occurrence of coal-bearing strata has some changes along the strike and trend, the faults are developed preferably, and sometimes the local is affected by magmatic rocks. It mainly includes:

a) The occurrence is gentle, developing relieved folds along the strike and trend, or with a certain number of faults;

b) Simple monocline, syncline or anticline, with many faults, or there are local small-scale folds and reverse;

c) Steeply inclined or inverted monocline, syncline and anticline; or simple folds, with few faults.

D.1.3 Complex structure: the occurrence of coal-bearing strata has changed considerably along the strike and trend, and the faults are developed, sometimes severely affected by magmatic rocks. It mainly includes:

a) Fault-block structure seriously damaged by several groups of faults;

b) Based on monocline, syncline or anticline, the secondary folds and faults are well developed;

c) Close folds, with a certain number of faults.

D.1.4 Very complex structure: the occurrence of coal-bearing strata has dramatic changes, and the faults are developed greatly, sometimes severely damaged by magmatic rocks. It mainly includes:

Annex F

(Informative)

Sampling and Test Workload

F.1 For type and quantity of coal samples taken by various stages, please see Table F.1.

F.2 For analytical test item and quantity of coal samples taken by various stages, please see Table F.2 and F.3.

F.3 For peat sampling quantity and analytical test item of prospecting stage, please see Table F.4.

Table F.1 Type and Quantity of Coal Samples Taken by Various Stages

Types of coal samples		Quantity taken and requirements
Coal core samples		Seeing coal points reaching the predetermined thickness of reserve/resource estimate shall be taken fully
Coal seam samples		Qualified exploration area (mine field) shall take as far as possible
Volumetric mass (weight) coal samples		Qualified exploration area (mine field) shall take one to two points
Screening coal samples, floating-sinking coal samples, coal and gangue mud test samples		Determine according to the sampling conditions and needs: if coal samples are screened, floating-sinking test, coal and gangue mud test must be done simultaneously
Optional coal core test samples and gangue mud test samples		Seeing coal points shall be not less than 10% ~ 20%; the initial mining area of prospecting stage (first level) shall reach 30%, and open-pit mine slotting area shall reach 50% ~ 100%
Coal rock samples		Select one or two minable seeing coal points with standard hole, and do the coal petrographic constituents identification and vitrinite maximum reflectivity measurement; measurement shall be also increased when there are special requirements
Coal sample determination of weathered and oxidizing zone	Strip weathering along the outcrop	Take one or two groups from small coal mines, the exploration area without small coal mines shall have two weathered and oxidizing zones of controlling minable coal seam by section, all minable coal seam points with drill hole passing through the weathered and oxidizing zone shall take samples
	Planar weathering along the surface	All minable coal seam points passing through the weathered and oxidizing zone shall take samples, prospecting stage (including open-pit exploration) shall be in the initial mining area, the swing range of boundary line of weathered zone in the exploration line shall be controlled within 100 m ~ 125 m

Annex G

(Informative)

Classification and Exploration Workload of Hydrogeological Investigation Type

G.1 Classification of hydrogeological investigation type

G.1.1 According to the moisture spatial characteristics of direct water filling aquifer, the hydrogeological investigation of coal deposits is divided into three types:

a) Type I, mineral deposits based on pore aquifer, known as pore water filling deposit;

b) Type II, mineral deposits based on fissure aquifer, known as fissure water filling deposit;

c) Type III, mineral deposits based on karstic aquifer, known as karstic water filling deposit; it is divided into two sub-types according to the different ways of water filling:

1) Sub-type I, karstic water filling deposit based on roof water inlet;

2) Sub-type II, karstic water filling deposit based on floor water inlet.

G.1.2 According to the water yield property and recharge conditions of direct water filling aquifer, combined with the relationship between coal seam and local base level of erosion, various deposits are divided into three types:

a) Type I, mineral deposits with simple hydrogeological conditions, including the following situations:

1) Coal seam is located above the water table or in the seasonal variation zone, taking atmospheric precipitation as the main water filling source;

2) Specific yield of direct water filling aquifer q <0.1 L/(s • m);

b) Type II, mineral deposits with medium hydrogeological conditions, including the following situations:

1) Specific yield of direct water filling aquifer 0.1≤q≤1.0 L/(s • m);

2) Specific yield of direct water filling aquifer 1.0<q≤2.0 L/(s • m), but the recharge conditions are poor, and the contact with the surface water body is not close; or the water-resisting rock stratum between direct water filling aquifer and coal seam is more stable, with better water resistant performance, the head pressure is not high and the water guide of fault zone is weak;

<table>
<tr><td rowspan="4"></td><td></td><td>stage</td><td colspan="3"></td><td colspan="3" rowspan="4"></td></tr>
<tr><td rowspan="2">Surface water</td><td>General-survey stage</td><td colspan="3">Set station to observe if necessary</td></tr>
<tr><td>Detailed exploration stage and prospecting stage</td><td colspan="3">Set enough stations to observe the areas having impact on the mining</td></tr>
<tr><td>Geophysical phenomenon</td><td>General-survey stage, detailed exploration stage and prospecting stage</td><td colspan="3">Set stations to observe the areas having impact on the mining</td></tr>
<tr><td colspan="2" rowspan="2">Geological drill holes of exposing floor direct water filling aquifer hole/km^2</td><td>General-survey stage and detailed exploration stage</td><td colspan="3">A small amount</td><td colspan="3">A small amount</td></tr>
<tr><td>Prospecting stage</td><td>Accumulated 0.5</td><td>Accumulated 0.6</td><td>Accumulated 0.7</td><td>Accumulated 0.4</td><td>Accumulated 0.5</td><td>Accumulated 0.6</td></tr>
<tr><td colspan="2" rowspan="2">Quaternary encryption hole</td><td rowspan="2">Detailed exploration stage and prospecting stage</td><td colspan="3">Encrypting buried outcrop of coal seam</td><td colspan="3" rowspan="2">The same as left</td></tr>
<tr><td>500 m ~ 750 m</td><td colspan="2">250 m ~ 500 m</td></tr>
<tr><td colspan="2">Rock and soil samples</td><td>Detailed exploration stage and prospecting stage</td><td colspan="3">In addition to drill holes on the engineering geological prospecting line, select representative drill holes for stratified sampling</td><td colspan="3">Select representative points for stratified sampling according to the requirements</td></tr>
<tr><td colspan="2">Water samples</td><td>General-survey stage, detailed exploration stage and prospecting stage</td><td colspan="3">Select representative points for sampling</td><td colspan="3" rowspan="3">The same as left</td></tr>
<tr><td colspan="2">Ground geophysical prospecting</td><td>General-survey stage, detailed exploration stage and prospecting stage</td><td colspan="3">Ground geophysical prospecting shall be carried out generally</td></tr>
<tr><td colspan="2">Hydrogeological logging</td><td>Detailed exploration stage and prospecting stage</td><td colspan="3">Quaternary encryption hole and special hydrogeological hole shall conduct hydrogeological logging</td></tr>
<tr><td colspan="9">Note: in the table, direct – direct water filling aquifer; indirect – indirect water filling aquifer.</td></tr>
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<tr><td>Detailed exploration stage</td><td>0.1~0.2</td><td>0.2~0.4</td><td>0.3~0.6</td></tr>
<tr><td>Prospecting stage</td><td>Accumulated 0.5~1.0</td><td>Accumulated 1.0~1.5</td><td>Accumulated 1.5~2.5</td></tr>
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<tr><td colspan="2">Water samples</td><td>General-survey stage, detailed exploration stage and prospecting stage</td><td colspan="2">Select representative points for sampling</td><td colspan="3" rowspan="2">The same as left</td></tr>
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</table>

Annex I

(Informative)

Exploration Work of Small Coal Mines

I.1 In areas with scant coal resources, for the mine fields only suitable for building small coal mines with an annual output of 90,000 tons (excluding 90,000 tons), the work can be carried out according to the requirements of this annex.

I.2 Exploration of small coal mines shall be based on large-scale geological mapping or general survey, follow the principle of one-time complete exploration, and submit the exploration report of small coal mines.

I.3 Work level of small coal mine exploration shall be based on the actual needs of the explorer and be determined by reference to the final work level of general survey. Inferred and predicted resources shall be calculated, the proportion of the inferred resources can be generally 20% ~ 50%. Inferred resources shall be distributed in the shallow portion and the initial mining area.

I.4 Geological mapping is the basic work of small coal mine exploration. In the areas with exposed bedrock or thin coverage, the exploration shall combine slot well prospecting, shallow drilling, old kilns and production wells, and sufficiently conduct ground geological study. The scale of geological mapping is generally 1:5000. Drilling and pitting work shall not be carried out before implementation of adequate research on the surface geology.

I.5 The areas with suitable topography and geological conditions shall take the pitting as an important means of small coal mine exploration. Pitting arrangement can be utilized for the development of small coal mines in the future shall be considered.

I.6 Drilling arrangement shall be based on the characteristics of small coal mine exploration, and shall be arranged in a targeted manner in the initial mining area of coal seam shallow or near the wellhead location to improve the control of coal seam and structure.

I.7 For the mine fields planning to build small coal mines with an annual output of 30,000 tons, only surface geological work is done usually. If really necessary, a small amount of controlled drill holes can be arranged.

I.8 Minable coal seam of all exploration drill holes shall take coal core samples and adopt coal seam samples from prospecting wells or existing small coal mines. Test items are mainly industrial analysis of raw coal and float coal, total sulfur, calorific value, caking index of float coal, plastic layer and bulk density, if necessary, other test items can be increased. Screening and floating-sinking tests are generally not made, if really necessary, easy optional test coal samples can be taken.

from a general and macroscopical view, and provide the basis for determining whether the prospecting is carried out, recommending projects and preparing project proposals.

Pre-feasibility study work shall be completed by the organizations with a certain qualification.

J.3 Feasibility study

It is a detailed evaluation on the economic significance of deposit development. It shall normally be carried out after the prospecting. It is required to make a careful investigation, statistics and analysis on the resource reserves, production and consumption of the mineral at home and abroad; conduct an analysis, research and forecast of quantity demanded, product variety, quality requirements, prices and competitive in domestic and foreign markets. At work, it shall make the analysis and research on resource conditions, and fully consider the impact of various factors of geological, engineering, environment, law and the government's economic policies. It shall conduct the investigation and research, analysis and calculation, multi-program comparison on the aspects of the enterprises' production scale, mining methods, expansion plans, smelting technological processes, product programs, selection of the main equipment, water and electricity supply, overall layout and environmental protection, use the market prices in the evaluation to determine the total investment, production and operation costs, sales revenue, profit, cash inflow and outflow. The result can detailedly assess the technical and economic reliability of the proposed project, calculate different resource/reserve types, and draw a basic understanding whether the proposed project shall be built and how to build.

Through the demonstration and evaluation of feasibility study, it will provide the basis for the relevant departments to make investment decisions, prepare and issue the design mission book, and determine the project construction plans.

Feasibility study work shall be completed by the organizations with a certain qualification.

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