Foreword

This code is developed by Dadi Engineering Development (Group) Co., Ltd. With other involved organization according to the requirements of Document JIANBIAO [2013] No.6 issued by the Ministry of Housing and Urban-Rural Development (MOHURD) of the People's Republic of China-"Notice on Printing and Distributing 'the Development and Revision Plan of National Engineering Construction Standards in 2013'".

During the preparation of this code, the team conducted extensive investigation and research, and earnestly summarized the experience of design and production of open pit mine drainage in recent years, and referenced the specifications and standards for open pit mine drainage in related industries, and extensively solicited opinions, and finalized the draft after review.

This code consists of 7 chapters, covering: general provisions, terms and symbols, groundwater control, surface water prevention and open-pit drainage, auxiliary projects, energy conservation and emission reduction and integrated uticization, security protection.

The provisions printed in bold type are mandatory ones and must be implemented strictly.

The Ministry of Housing and Urban-Rural Development is in charge of administration of this code and explanation of its mandatory provisions. The China Coal Construction Association is responsible for its routine management of the code, and Dadi Engineering Development (Group) Co., Ltd. in charge of explanation of specific technical contents. During implementation process of this code, all units are required to earnestly sum up their experiences, combined with engineering practices. If there is any need for modification or supplementation, please give feedback to Dadi Engineering Development (Group) Co., Ltd. (Address: No. 15 Floor, Office Building, Boya International Center, 1st Road, Lize, Beijing, Postcode: 100102, Fax: 010-82847309), for future reference.

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Contents

1 General provisions

1.0.1 This code is drawn up with the purpose of regulating the design for coal open pit mine dewatering and drainage, preventing and reducing water disasters, and ensuring safe production.

1.0.2 This code is applicable to the design of dewatering and drainage for the coal open pit mine, including new, renovation or extension projects during the stages of pre-feasibility study, feasibility study and engineering design.

1.0.3 Domestic and foreign advanced technologies, practical experiences and mature and reliable new technologies, techniques, equipment and materials shall be actively adopted in the design of dewatering and drainage for the open pit coal mine.

1.0.4 The design of dewatering and drainage for the coal open pit mine shall be conducted at the same time. The technical proposal shall be determined based on the technical and economic comparison.

1.0.5 In the design of dewatering and drainage for the open pit coal mine, the regulations of this code must be implemented, and besides, the requirements of the current national standards and codes related shall be confirmed.

2 Terms and symbols

2.1 Terms

2.1.1 Hydrogeological condition

A general term referring to the occurrence, distribution, recharge, runoff, discharge, quality and quantity of groundwater and the related geological conditions.

2.1.2 Dewatering

Works adopted to drain the aquifer that threatens mining, transportation and dumping of open pit mines through various drainage projects according to reasonable economic and technical principles.

2.1.3 Groundwater control

Works adopted to intercept and drain the aquifer that threatens mining, transportation, and dumping of open pit mines through interception and drainage projects according to reasonable economic and technical principles.

2.1.4 Open pit drainage

Technical measures employed to ensure safe work in the mining yard using reasonable, technical and economical drainage methods to remove the gathered precipitation, surface water, and groundwater in the pit.

2.1.5 Surface water prevention and drainage

Technical measures utilized to prevent the flow of surface water into open pits or dumping sites, to improve stripping capacity, and to ensure work safety in pits or dumps.

2.1.6 Dewatering and control of groundwater and surface water

A general term referring to groundwater control, open-pit drainage and surface water prevention and drainage.

2.1.7 Movable substation

A complete power distribution set of devices comprising a primary power supply device, a power transformer, a secondary power distribution and protection device, a chassis and a protective casing, which can be moved as a whole or disassembled.

2.1.8 Distributed control system

A microprocessor based control system for centralized monitoring, operation, management, and decentralized automatic control of production process.

2.2 Symbols

2.2.1 Normal rainfall runoff:

a_j–runoff coefficient of each section;

F_j–catchment area of each section;

H_1–monthly average precipitation during the rainy season;

Q_1–normal rainfall runoff.

2.2.2 Storm runoff:

a_i–runoff coefficient of each section;

F_i–catchment area of each section;

H_2–the amount of storm during time interval T for a design frequency;

Q_2–storm runoff during time interval T.

2.2.3 Water-inrush coefficient:

M–thickness of coal bed floor aquifuge;

p–hydraulic head pressure exerted on coal bed floor aquifuge;

T_s–water-inrush coefficient.

2.2.4 Water quality of open pit drainage:

SS–suspended solids;

COD_{cr}–chemical oxygen demand measured by the potassium dichromate method.

3 Groundwater control

3.1 General requirements

3.1.1 The design of drainage in the pre-feasibility study stage of open pit mines shall be based on reviewed and filed preliminary or detailed geological exploration reports, while in the feasibility study phase and the preliminary design phase shall be based on reviewed and filed detailed geological exploration report.

3.1.2 For coal fields with complex hydrogeological conditions, the reliability and degree of hydrogeological exploration shall be analyzed and evaluated according to the current national standard GB 12719 *Exploration Specification of Hydrogeology and Engineering Geology in Mining Areas* and mine water control requirements. When hydrogeological exploration data cannot meet the requirements of dewatering design, supplementary hydrogeological exploration shall be proposed.

3.1.3 When surface water recharges groundwater during dewatering, measures such as rechanneling, anti-seepage and interception shall be adopted for the surface water system.

3.1.4 Groundwater control measures such as dewatering or interception must be taken in the following cases:

1 Groundwater has a serious impact on mining, transportation and dumping of open pit mines.

2 Groundwater reduces the stability of open pit slopes, and the pit slope or dump slope may become unstable.

3 When confined aquifer below coal seam floor has high water pressure and abundant water, water inrush may occur during mining.

3.1.5 When using the pre-draining method to reduce the groundwater level, the pre-draining time and the drawdown of the water level shall be determined according to the mining and stripping propulsion and the development of the descending section strength requirements, and the hydrogeological conditions shall be considered.

3.1.6 Groundwater regime observation system shall be established for open pit mines where groundwater control systems have been set up, or mining has been threatened by groundwater.

3.1.7 When groundwater dewatering has a serious impact on important constructions, local wells, and farmland irrigation around the open pit mine, prevention and control measures shall be taken.

3.1.8 Dewatering water shall be used comprehensively as water resources.

3.2 Groundwater control methods

3.2.1 The groundwater control method shall be determined according to the hydrogeological conditions of the mining area accompanying with technical and economic comparison.

3.2.2 For aquifers with a hydraulic conductivity greater than 2m/d, vertical well dewatering method on surface should be adopted for groundwater control.

3.2.3 When groundwater recharge conditions are poor, the horizontal well dewatering method should be adopted to reduce the groundwater pressure of the open pit slope or to discharge the remaining water

in the aquifer.

3.2.4 For unconsolidated aquifers characterized by simple hydrogeological conditions, shallow depth, small thickness and stable occurrence, open drainage ditch and blind drainage ditch should be adopted for groundwater control.

3.2.5 Roadway method should be adopted for groundwater control in the following cases:

1 Groundwater can be drained by adits.

2 Aquifers with complex hydrogeological conditions and small hydraulic connections, or aquifer thickness, water pressure and water permeability varies greatly, buried deep and not suitable for dewatering by vertical surface wells.

3.2.6 The underground water barrier method should be adopted for groundwater control in the following cases:

1 The hydrogeological conditions are complex, and it is difficult to reduce the groundwater level by dewatering effectively.

2 The underground water barrier method can be adopted for unconsolidated aquifers with abundant recharge, a continuous floor aquifuge and shallow depth.

3.2.7 When underground water barriers are used to intercept groundwater, the stability of the pit slope shall be ensured when choosing the location of the barriers.

3.3 Hydrogeological calculations

3.3.1 Groundwater inflows to the open pit shall be estimated by choosing appropriate calculation methods based on the hydrogeological conditions of the mining area and the location of the pit. For mining areas with complex hydrogeological conditions and detailed hydrogeological exploration, numerical methods should be used to calculate the groundwater inflow, and the groundwater level after dewatering shall be predicted.

3.3.2 The initial groundwater level of an aquifer should be determined based on data from continuous monitoring of groundwater level lasting at least one hydrological year.

3.3.3 Hydrogeological calculations shall comply with the following provisions:

1 For the calculation of the groundwater inflow to the pit, the highest groundwater level from monitoring in the calculation area shall be adopted.

2 The drainage capacity for groundwater storage shall be determined according to the specific yield of the aquifer, the drainage area, and the progress of stripping of the pit.

3 The drainage capacity of groundwater control facilities shall be greater than the sum of groundwater recharge capacity and drainage capacity for groundwater storage.

4 The dynamic groundwater level and water pressure shall meet the open pit mining safety requirements.

3.3.4 When calculating the yield of the dewatering wells, the hydraulic jump may not be considered for unconfined aquifers. When determining the groundwater depression curve, the influence of hydraulic jump shall be considered.

3.3.5 When the head of the confined aquifer under the coal seam floor is higher than the top surface of the overburden layer, the water-inrush coefficient method shall be used to check the inrushed water, and if necessary, pressure relief measures must be taken.

3.4 Dewatering project layout

3.4.1 The dewatering wells should be drilled where the aquifer has a large thickness and high permeability, while the level of the aquifer floor is low.

3.4.2 Permanent dewatering well rows should be located close to the protected area and 20m away from the final pit limit.

3.4.3 Horizontal dewatering wells should be drilled where groundwater gathers, and the pit slope is prone to slide.

3.4.4 The open and blind drainage ditches should be laid on the surface or berm with artesian conditions, and the mechanical erosion of the slope shall be checked. Slope protective measures must be taken when necessary. The gradient of the longitudinal slope of the open ditches shall be determined by hydraulic calculation according to the rock properties and the embankment types. For soil ditches, the gradient should be 2‰ to 3‰. If applicable, the geomembrane may be used in open and blind drainage ditches.

3.4.5 The roadways shall be built in a continuous aquifuge or an aquitard, if there is no aquifuge or aquitard upon and under the coal seam, the roadways can be arranged in the aquifer. When the roadways are arranged on the floor of an unconsolidated aquifer, the depth of the roadway embedded in the floor should be 0.5m to 1.0m. The gradient of the longitudinal slope of the roadways should not be less than 2‰.

3.4.6 The underground water barrier shall be built on a continuous aquifuge with a hydraulic conductivity less than 5×10^{-8} m/s, and the depth of the bottom of the barrier embedded in the aquifuge shall not be less than 1m. Stability and seepage shall be calculated for the barrier. The strength of the barrier shall also be calculated based on the maximum difference of the hydraulic head between both sides of the barrier if a concrete barrier is used.

3.4.7 The structure of the dewatering wells shall be determined according to the lithology and structure of the stratum, the groundwater depth, the drilling techniques, etc., and shall meet the following requirements:

1 The diameter of the wells for pump installation shall be determined according to the well completion requirements.

2 The variable and opening diameters of the wells and their corresponding lengths shall be determined according to the stratum and drilling techniques.

3 The well depth shall be comprehensively determined according to factors such as the depth and thickness of the aquifer in the open pit.

3.5 Dewatering equipment and well filter

3.5.1 The drainage equipment for dewatering wells and roadways should be selected according to water quantity and quality. Based on the technical and economic comparison, horizontal pumps can be used as the drainage equipment for roadways.

3.5.2 The drainage capacity of the pumps in dewatering wells shall be calculated assuming the running times of the pumps are 24h daily. The number of dewatering wells shall be 1.2 times the calculated number.

3.5.3 The number of standby and maintenance pumps for dewatering wells shall be 40% to 50% of the

number of working pumps; when the number of working pumps is less than 10, it shall not be less than 50% of the number of the working pumps.

3.5.4 The number of roadway drainage pumps, sump volume, etc., shall comply with the relevant provisions of the current national standard GB 50215 *Code for Design of Mine of Coal Industry*.

3.5.5 The types of filter shall be selected according to the characteristics of the aquifer as specified in Table 3.5.5.

Table 3.5.5 Type of filters

Characteristics of aquifer	Type of filters
Hard/ semi-hard and stable rock layer, no silt and sand incoming	No filter
Semi-hard, broken and unstable rock layer, no silt and sand incoming	Filter pipe(perforated plate or slotted-type)
Rock layer with silt and sand incoming	Wire-wrapped filter(metallic or non-metallic filter pipe), gravel-packed filter
Pebble, gravel, sand, coarse sand, medium sand	Filter pipe, wire-wrapped filter or gravel-packed filter
Fine sand, silt	Wire-wrapped filter, mesh filter, gravel-packed filter

3.5.6 The materials of the filter shall be determined according to groundwater quality, stress conditions, and economic feasibility.

3.5.7 The specification and thickness of the gravel pack, the hole size or slot opening of the filter pipe and the porosity of the open area of the wire-wrapped filter shall comply with the relevant provisions of the current national standard GB 50296 *Technical Code for Tube Well*.

3.5.8 The allowable water inflow rate through the filter tube of dewatering wells should not be more than 0.03m/s.

3.5.9 The diameter of the filter shall be determined according to the design yield, the maximum outside diameter of the pump and motor and the allowable water inflow rate through the filter tube. The minimum inside diameter must not be less than that specified in Table 3.5.9.

Table 3.5.9 Inside diameter of filter

Type of filter	Inside diameter of filter(mm)
Filter of dewatering wells	When the well depth is less than or equal to 90m, it shall be 70mm larger than the maximum outside diameter of the pump and motor; When the well depth is more than 90m, it shall be 100mm larger than the maximum outside diameter of the pump and motor
Penetrating filter	50
Drive-in filter	25
Filter of monitoring wells	50

3.5.10 The porosity of the open area of filter pipe should be 20% to 35% for steel pipes, 20% to 25% for cast iron pipes, 15% to 20% for reinforced concrete and asbestos cement pipes, and 10% to 13% for plastic pipes.

3.5.11 For dewatering wells in unconsolidated aquifers, a sediment tube with a closed bottom shall be installed, and the length shall not be less than that specified in Table 3.5.11.

Table 3.5.11 Length of sediment tubes

Aquifer thickness in well(m)	Length of sediment tubes(m)
<30	3
30–90	5
>90	7–10

3.6 Dewatering pipes

3.6.1 The dewatering pipes around the open pit should be laid away from the boundary of the surface pit limit.

3.6.2 The water flow angle at the junction of the draining pipes and the joint between the trunk pipe and the branch pipe shall not be less than 90°.

3.6.3 Steel, cast iron or plastic pipes should be used for dewatering pipes. Steel pipes should be used for frequently moved dewatering pipes. Open drainage ditch should be used if applicable.

3.6.4 For long dewatering pipes, a mud discharge valve and an exhaust valve shall be installed at the lowest and highest point of pipes, respectively.

3.6.5 The foundation of dewatering pipes shall be determined according to the material of the pipes, the connection form and the geological conditions. For a soft foundation with an uneven settlement, the pipe foundation shall be strengthened.

3.6.6 Metal pipes shall be protected against external corrosion. Coal tar epoxy coating should be used for the external anti-corrosion of buried metal pipes; the anti-corrosion coating for exposed pipes shall be selected according to meteorological and environmental factors.

3.6.7 The pipe connection type shall be determined according to the material of the pipes and geological conditions. A rigid or flexible joint can be used. Confluent pipes should adopt flexible joints. A flexible joint shall be used when the pipe passes through silt, fine sand layers and below the highest groundwater level, or when the seismic fortification intensity for the region is 8 degrees.

3.6.8 When pipes cross railways and roads, protective measures such as protective casings or trenches shall be taken.

3.6.9 The minimum cover soil thickness of pipes shall be determined according to factors such as freezing conditions, external load, pipe performance, anti-floating requirements, etc., and anti-freezing and thermal insulation measures shall be taken as required. The thickness of the top cover soil shall not be less than the maximum depth of the local frozen soil. Pipes that pass through farmlands in non-cold regions shall not impede tillage. Pipes laid in farmland shall have a minimum soil cover thickness of 1.0m.

3.6.10 Expansion and contraction caused by temperature difference shall be considered for exposed pipes, and corresponding compensation measures shall be taken as needed.

3.6.11 The number of pipes and materials of different varieties and specifications shall be kept in reserve. The spare number of pipes of different materials shall be selected according to the following provisions:

1 Prestressed reinforced concrete pipes shall be 10% to 15%;

2 Cast iron pipes shall be 7% to 12%;

3 Steel and plastic pipes shall be 5% to 10%.

3.6.12 For the design of permanent dewatering pipes and ancillary facilities refer to the relevant national standards.

3.7 Observation of groundwater regime

3.7.1 The layout of the groundwater regime observation system shall be determined according to the degree of influence of groundwater on open pit mining and hydrogeological conditions, and shall comply

with the provisions of article 3.1.6 of this code.

3.7.2 Groundwater regime observation well networks should be arranged centering on the pit. The wells shall be intensified in the main water incoming direction, around the pit, near the surface water body and on both sides of the water conducting structure belt.

3.7.3 The depth of observation wells shall be based on the groundwater level controlled by observation. The opening diameter of the observation wells shall be greater than 91mm and should be greater than 150mm in cold areas.

3.7.4 The material and specification of the filter can be determined in accordance with the provisions of articles 3.5.5, 3.5.6, 3.5.7 and 3.5.10 of this code.

3.7.5 Observation well head should be 0.5m above the ground surface, and it is better to install a protective device at the well head.

4 Surface water prevention and open-pit drainage

4.1 Open-pit drainage

4.1.1 The drainage methods of open pits shall be comprehensively determined in consideration of the groundwater control and surface water prevention system.

4.1.2 The water discharge of the open pit shall include the precipitation runoff and groundwater inflow into the pit. Drainage of the pit shall be carried out by means of water prevention, drainage, storage or their combinations, and shall meet the following requirements:

1 For open pits with terrain height differences, gravity drainage shall be adopted.

2 Sectional interception drainage should be adopted if applicable.

3 Pit water storage and drainage can be adopted when water storage at the bottom of the pit has a small impact on mining.

4 When pumps are used for drainage, portable or semi-fixed pumping stations can be used, and submersible pumps are preferred.

5 When water inflow is large, the storage space at the bottom of the pit is limited, and there are available old or usable drainage roadways in the pit, the drainage method of water storage in the roadway can be adopted based on the technical and economic comparison.

4.1.3 The design of roadway drainage shall comply with the relevant provisions of the current national standard GB 50215 *Code for Design of Mine of Coal Industry*.

4.1.4 Drainage design of the pit shall meet the following requirements:

1 The calculated normal rainfall shall be the annual monthly average rainfall of the rainy season for 10 years or more;

2 The calculation of the runoff in the pit shall be based on the long-duration storm;

3 The calculation of the runoff of the drainage ditch shall be based on the short-duration storm rainfall.

4.1.5 The design storm frequency for drainage design of open pits shall not be less than 50a for large pits and 20a for medium pits.

4.1.6 The discharge time limit if the collected water formed by storm runoff shall be less than that specified in Table 4.1.6.

Table 4.1.6 Discharge time limit

Discontinued working face(%)	30	50	70	100
Time limit for collected water(d)	15	7	5	3

4.1.7 The normal rainfall runoff and storm runoff shall be calculated by the runoff coefficient method. The soil and rock runoff coefficient shall be measured. If the measured value is lacking, it can be selected according to Table 4.1.7.

4.1.8 The water discharge of the open pit can be divided into normal rainfall discharge and storm discharge, and shall meet the following requirements:

Table 4.1.7 Runoff coefficient

Serial number	Types of rock and soil	Runoff coefficient
1	Mudstone, sandy mudstone, tuff, sandstone, limestone	0.6–0.7
2	Heavy clay	0.7
3	Light clay, loam, sandy clay, humus	0.5–0.6
4	Coal, macroporous loess, loess	
5	Silt	0.2–0.5
6	Fine sand, medium sand	0–0.4
7	Coarse sand, gravel	0–0.2
8	Soil dump	0.2–0.4
9	Rock dump	0–0.2

Notes: 1 The runoff coefficients of the 1st to 7th types of rocks and soils in the table shall be reduced by 0.1 to 0.2 when used for long-duration storm runoff calculation.

2 When there is a small number of cracks in the coal rock, the runoff coefficient shall be reduced by 0.1 to 0.2; when there are medium cracks, it shall be reduced by 0.3 to 0.4.

1 When groundwater flows into the open pit mine, the water discharge shall include groundwater inflow. Normal rainfall discharge and storm discharge shall not be lower than normal rainfall runoff and storm runoff.

2 Normal rainfall runoff can be calculated as follows:

$$Q_1 = \frac{H_1 \sum a_j F_j}{30 \times 24} \tag{4.1.8-1}$$

Where: Q_1–normal rainfall runoff(m^3/h);

a_j–runoff coefficient of each section;

H_1–monthly average precipitation during the rainy season(m);

F_j–catchment area of each section(m^2).

3 Storm runoff can be calculated as follows:

$$Q_2 = H_2 \sum (a_i F_i) \tag{4.1.8-2}$$

Where: Q_2–storm ruoff during time interval T;

H_2–the amount of storm during time interval T for a design frequency;

a_i–runoff coefficient of each section;

F_i–catchment area of each section(m^2).

4.1.9 The drainage equipment of the open pit shall be selected according to the drainage period and shall meet the following requirements:

1 The running time of the drainage pumps is assumed to be 20h per day.

2 For open pits with small storm water drainage, the same type of pump should be chosen for storm water drainage pumps and normal rainfall drainage pumps at the same mining level.

3 When the storm water discharge is 3 times or more of the normal rainfall discharge, different types of pumps can be selected for the storm drainage pump and the normal rainfall drainage pump.

4 For normal rainfall drainage pumps, standby and maintenance pumps shall be equipped, and the number shall be 50% of the working pumps.

5 Standby and maintenance pumps are not required for storm drainage pumps.

4.1.10 The volume of the sump of the drainage pumping station in the pit should not be less than the 0.5h discharge of the drainage pump for the normal rainfall.

4.1.11 The selection of drainage pipes shall meet the following requirements:

1 Meeting the requirements of the working pressure.

2 The diameter of normal rainfall drainage pipes should be determined to assume an economical flow rate of 1.5m/s to 2.2m/s; for storm dewatering pipes, the flow rate is no more than 3.5m/s.

3 The number of drainage pipes shall not be less than two, and each shall meet the requirements of normal rainfall drainage, and all drainage pipes shall meet the requirements of storm drainage.

4.1.12 The layout of the equipment of pumping stations shall comply with the relevant provisions of the current national standard GB 50014 *Code for Design of Outdoor Wastewater Engineering*.

4.1.13 The technical requirements for the drainage pipes of open pits shall comply with the provisions of Section 3.6 of this code.

4.2 Surface water prevention

4.2.1 When open pits are threatened by floods, special water prevention and drainage facilities shall be established. The open pits with large water inflow shall be provided with drainage (interception) ditch and dam.

4.2.2 The water prevention and drainage system of open pits shall have the feasibility of combining with local surface water bodies, flood control and drainage systems.

4.2.3 The design of large scale flood control projects such as river diversions and flood prevention reservoirs shall comply with the relevant national standards.

4.2.4 The construction materials of flood control dams shall be taken locally. When it is possible, the dams can be built with the stripping materials.

4.2.5 Flood peak discharge of small and medium rivers and natural gullies shall be determined according to the measured data from local hydrological stations. When there is a lack of measured data, the following methods can be used for calculation. If possible, other methods shall be used to check:

1 Geomorphic investigation method;

2 Simplified formula method of RIH (Research Institute of Highway, Ministry of Transport);

3 Local empirical formula method.

4.2.6 Flood control standards shall be determined according to the scale of open pits, service life and other factors, and shall comply with the provisions of Table 4.2.6-1 and Table 4.2.6-2.

Table 4.2.6-1 Flood control standards for river diversions, dams and drainage ditches

Scale of open pit	Recurrence interval (a)			
	Small river diversions and dams		Drainage ditches	
			Type Ⅰ	Type Ⅱ
	Design	Check	Design	Design
Large	50–100	100–300	50–100	20–50
Medium	20–50	50–100	20–50	20

Notes: 1 Drainage ditches of Type Ⅰ are those endanger pit safety when flooding occurs;

2 Drainage ditches of Type Ⅱ are those do not endanger pit safety when flooding occurs;

3 If the service life is short and the consequences of flooding are not serious, the lower limit shall be taken.

Table 4.2.6-2 Design recurrence interval of flood-regulation reservoirs

Capacity of flood-regulation reservoirs (10^4m^3)	Recurrence interval(a)	
	Design	Check
<100	30	200–300
100–1000	50	300–500

4.2.7 When open pits and mines share the same flood control projects, the flood control standard shall comply with the relevant provisions of the current national standard GB 50215 *Code for Design of Mine of Coal Industry*.

4.2.8 Design of drainage ditches shall meet the following requirements:

1 The distance between the ground drainage ditch and the surface pit limit should not be less than 50m.

2 The design of the drainage ditch of mining and dumping sites shall avoid landslides of the pit slopes caused by leakage, the longitudinal slope should not be too much, and the difference in gradients should not be too large.

3 The stony drainage ditches should adopt a rectangular cross section, while the soil ones should adopt a trapezoidal cross section. The soil drainage ditch can be reinforced with mortar rubble or grouted rubble masonry. The reinforcement thickness should not be less than 300mm, and if applicable, geomembrane should be used.

4 The minimum radius of the curved section of the surface drainage ditch shall not be less than 5 times the width of the water surface with respect to the design water level.

5 The intersecting angle between the surface drainage ditch and the river shall be less than 60°, and the bottom elevation of the drainage ditch outlet shall be higher than the normal water level of the river.

6 The safety height of the drainage ditches shall be determined according to the designed water depth. When the water depth is greater than or equal to 2m, the safety height shall not be less than 0.5m; when the water depth is less than 2m, the safety height shall not be less than 0.3m.

4.2.9 A sedimentation tank shall be provided at the outlet of the drainage ditch.

4.2.10 River diversions shall meet the flood control and safety requirements of the open pit mine. The distance between the new river channel and the surface pit limit shall be determined according to the technical assessment of the impact of the river on the slope.

4.2.11 The river diversion projects shall be approved by local water conservancy authority and shall be completed by a design unit with corresponding qualifications.

4.2.12 When there is waterlogging in the mining and dumping sites, drainage measures shall be taken. When the geomorphic conditions are appropriate, interception methods shall be used or dumped soils to fill the ground.

4.2.13 In the natural channels upstream of the mining sites and dumps, dams should be built, and the standard can be determined according to the stripping and dumping plans. When the accumulated water cannot be naturally evaporated, the portable pumping stations can be used for distributed drainage.

4.2.14 The safety height of flood control dams shall not be less than 0.5m in plain areas and no less than 1.0m in hilly areas.

5 Auxiliary projects

5.1 Power supply and automatic control

5.1.1 The classification of power load for dewatering and drainage in open pit mines shall comply with the following provisions:

1 When dewatering roadway inspection and maintenance are needed, the water pump shall be the first class load.

2 The drainage pump station of excavation site shall be the second class load.

3 The drainage equipment not belonging to the first and second load can be the third load.

5.1.2 The power supply voltage of drainage equipment shall be determined by technical and economic comparison according to the power consumption capacity, characteristics of power consumption equipment, power supply distance and other factors, and 10(6)kV or 0.4kV should be used.

5.1.3 The open pit drainage pump station shall have two circuits for power supply. In case of failure of the primary circuit, the other circuit shall meet the normal starting load and maximum drainage load.

5.1.4 The number of transformers in the dewatering well pump station substation shall not be less than 2. In case of failure of one of the transformers, the remaining transformers shall meet the normal starting load and maximum drainage load.

5.1.5 The dewatering well pumps should supply power by an independent overhead line. When the single circuit line cannot meet the power supply requirements, the multi-circuit distribution line can be used by the ring or radiation way. The electrical control equipment for the (semi) underground pump house shall be installed outside the pump house.

5.1.6 Mobile substation should be adopted for the dewatering well pumps distribution facility. Within the permissible power supply distance, each mobile substation shall distribute power to multiple dewatering well pumps.

5.1.7 The grounding mode of distribution system of drainage equipment shall comply with the following provisions.

1 For the 10(6)kV power supply system, neutral direct grounding mode shall not be used.

2 TN-S or IT system should be used for low voltage distribution.

5.1.8 Distributed control system should be set up for drainage equipment of dewatering wells.

5.1.9 The selection of equipment for the distributed control system for dewatering well pumps shall be determined according to the quantity and distribution of pumps.

5.2 Construction and ventilation

5.2.1 The dewatering pump house in severe cold and cold areas should adopt the reinforced concrete structure, and an anti-freeze structure should be adopted.

5.2.2 Reinforced concrete pools are appropriate for dewatering water storage.

5.2.3 (Semi) underground dewatering well pump house shall be equipped with mechanical ventilation facilities; ventilation equipment shall be anti-explosion.

5.3 Dewatering and drainage disposal

5.3.1 Dewatering drainage and open-pit drainage are appropriate to be treated respectively.

5.3.2 The safety coefficients of dewatering drainage and open pit drainage treatment scales should not be less than 1.2 times the annual target-output groundwater discharge and normal open pit discharge, respectively.

5.3.3 The dewatering drainage quality shall be determined according to the measured data. When there is no measured data, it can be determined according to the water quality data of the coalfield geological site investigation report.

5.3.4 The open pit drainage quality shall be determined according to the measured data from the pit, local mining area or similar mining area. In the absence of measured data, regular indicators can be determined by the following data:

1 SS is 600mg/L to 3000mg/L.

2 Petroleum is 1.0mg/L to 20mg/L.

3 COD_{cr} is 100mg/L to 300mg/L.

4 Special water quality indicators such as acid and alkali, salt content, etc., can be determined according to the actual measurement or water quality parameters of the coalfield geological site investigation report.

5.3.5 The water treatment processes of dewatering drainage and open pit drainage shall be determined through technical and economic comparisons based on raw water quality, and quality requirements of reuse water and discharge water.

5.3.6 Adjusting pre-sedimentation tank shall be set up for the treatment of open pit drainage, and its capacity shall be determined according to the general precipitation combined with the working system of drainage pumps. In the absence of data, the capacity can be calculated by 6 to 10 hours' general precipitation. The quantity of adjusting pre-sedimentation tanks shall not be less than two or at least divided into two compartments that can be emptied separately, and a mud discharge facility shall be provided.

5.3.7 The open pit drainage during heavy rain may not be treated.

5.3.8 The discharging quality of dewatering drainage and open pit drainage shall meet the requirements of current national standards GB 20426 *Emission Standard for Pollutants from Coal Industry*, GB 8978 *Integrated Wastewater Discharge Standard* and the discharging standards confirmed by local environmental protection administration.

5.3.9 Dewatering and drainage treatment design shall perform the provisions of current national standards GB 50013 *Standard for Design of Outdoor Water Supply Engineering*, GB 50014 *Code for Design of Outdoor Wastewater Engineering* and GB 50810 *Code for Design of Water Supply and Drainage of Coal Industry*.

6 Energy conservation and emission reduction and integrated utilization

6.1 General requirements

6.1.1 Dewatering and drainage design shall comply with relevant national policies such as energy conservation, integrated utilization of water resources, and protection of the ecological environment.

6.1.2 Dewatering and drainage design shall maximize the integrated utilization of dewatering drainage and open pit drainage, and establish a circular economic production system.

6.1.3 Open pit mines shall construct collection and treatment facilities for water resource reuse to realize the integrated utilization of dewatering drainage and open pit drainage.

6.1.4 The gravity flow drainage is appropriate for dewatering and drainage design.

6.2 Energy conservation

6.2.1 The groundwater control plan shall be determined through technical and economic comparison based on energy conservation and the improvement of the integrated utilization level of water resources.

6.2.2 The layout of the dewatering well shall be reasonably done according to the progress of the open pit mining and stripping advancement and the development of the down section. The drainage pipeline layout shall be laid out according to the terrain.

6.2.3 Dewatering and drainage design shall adopt effective waterproof and drainage measures, and shall use blocking, intercepting, and guiding methods to prevent or reduce the amount of water flowing into the mining and dumping sites.

6.2.4 The construction materials for surface flood control dams shall be taken locally. The dam can be built with the stripping materials when it is possible. Ground waterproof and drainage system equipment shall use auxiliary mining equipment.

6.2.5 For the waterproof and drainage system, consideration shall be given to the feasibility of the integration of water systems such as natural water bodies, flood control and drainage, and agricultural irrigation and drainage.

6.2.6 Dewatering and drainage equipment and materials shall comply with the energy conservation standards. It is not allowed to use backward production processes with high energy consumption and high-energy consumed mechanical and electrical equipment that has been eliminated.

6.2.7 The drainage facilities shall be equipped with instruments for data collection.

6.2.8 Automatic control system should be set for drainage design.

6.2.9 The energy saving design of power supply and distribution system shall comply with the following provisions:

1 The power supply voltage and power supply mode shall be selected reasonably according to the power consumption capacity of drainage equipment.

2 The power supply and distribution facilities shall be close to the load center, and the section of conductor or cable shall be selected reasonably.

3 Centralized and local reactive power compensation devices shall be set up reasonably.

4 The high-voltage motors shall be used for motors with power of 200kW and above.

6.2.10 The energy conservation design for drainage control system shall comply with the following requirements:

1 The drainage pumps shall start-up in sequence, in order to avoid the impact on the power grid caused by pumps simultaneous starting.

2 Extraordinary energy-saving electrical components shall be selected.

3 Low loss electrical components shall be adopted.

6.3 Emission reduction and integrated utilization

6.3.1 Dewatering drainage and open pit drainage shall be integrated utilized to reduce emissions.

6.3.2 Reuse of dewatering drainage and open pit drainage shall meet the following requirements:

1 When reused for domestic water, the water quality shall meet the current national standard GB 5749 *Standards for Drinking Water Quality*;

2 When reused for car washing, the water quality shall perform the car washing requirements in current national standard GB/T 18920 *The Reuse of Urban Recycling Water - Water Quality Standard for Urban Miscellaneous Use*;

3 When reused for some other productions and greening, the water quality shall perform the dust-proof requirements in current national standard GB 50197 *Code for Design of Open Pit Mine of Coal Industry*.

6.3.3 The treatment process, scale, etc. of dewatering drainage and open pit drainage shall comply with the provisions of Section 5.3 in this code.

6.3.4 Reuse engineering design of dewatering drainage and open pit drainage shall follow the provisions of current national standards GB 50197 *Code for Design of Open Pit Mine of Coal Industry*, GB 50013 *Standard for Design of Outdoor Water Supply Engineering* and GB 50810 *Code for Design of Water Supply and Drainage of Coal Industry*.

7 Security protection

7.0.1 When groundwater drainage causes cracks, sink or collapse on the ground, it shall be protected within the delineated scope, and safety measures shall be taken.

7.0.2 When the dewatering well arranged around the working slope of mining sites are intercepted for use, the protection zone shall be delineated around the dewatering well and warning signs shall be set.

7.0.3 Dewatering and drainage equipment, well pipe, and drainage pipe materials shall be determined according to the characteristics of groundwater quality of the aquifer and corrosion prevention measures shall be taken.

7.0.4 The permanent ground drainage ditch should be arranged in the non-working slope of the open pit mine. The ground drainage ditch shall avoid the landslide section of the mining and external dumping site. The surface drainage ditch should not be less than 50m away from the surface pit limit.

7.0.5 Anti-seepage measures shall be taken for the ground drainage ditch that has an impact on the mining site and the dump slope.

7.0.6 When dewatering and drainage pipes pass through the road section, protection measures such as deep burial, casing or pipe culvert shall be taken.

7.0.7 Anti-seepage and anti-scouring measures shall be taken at the outlet of the drainage ditch, and warning signs shall be set up.

7.0.8 Open pit mine drainage shall not affect the mining and dumping site, and the safety of the ground surface facilities.

7.0.9 Electrical safety shall comply with the following requirements:

1 Earth leakage protection devices shall be installed for lines with AC voltage greater than 50V. The secondary protection shall be adopted for short circuits and single-phase grounding protection.

2 For the fully enclosed mobile substation, the box structure shall be grounded reliably.

3 The protection of electrical equipment shall comply with the current code of GB/T 9089 *Electrical Installations for Outdoor Sites Under Heavy Conditions*.

4 Direct tripping overload protection device should not be used for storm pump motor.

5 Interlocking devices shall be installed in the exhaust system and the maintenance entrance of the dewatering(semi)underground pump house.

Explanation of wording in this code

1 Words used for different degrees of strictness are explained as follows in order to mark the differences in implementing the requirements of this code.

1)Words denoting a very strict or mandatory requirement:

"Must" is used for affirmation, "must not" for negation.

2)Words denoting a strict requirement under normal conditions:

"Shall" is used for affirmation, "shall not" for negation.

3)Words denoting a permission of a slight choice or an indication of the most suitable choice when conditions permit:

"Should" is used for affirmation, "should not" for negation.

4)"May" is used to express the option available, sometimes with the conditional permit.

2 "Shall comply with..." or "shall meet the requirements of..." is used in this code to indicate that it is necessary to comply with the requirements stipulated in other relative standards and codes.

List of quoted standards

GB 50013 *Standard for Design of Outdoor Water Supply Engineering*

GB 50014 *Code for Design of Outdoor Wastewater Engineering*

GB 50197 *Code for Design of Open Pit Mine of Coal Industry*

GB 50215 *Code for Design of Mine of Coal Industry*

GB 50296 *Technical Code for Tuble Well*

GB 50810 *Code for Design of Water Supply and Drainage of Coal Industry*

GB 5749 *Standards for Drinking Water Quality*

GB 8978 *Integrated Wastewater Discharge Standard*

GB/T 9089 *Electrical Installations for Outdoor Sites Under Heavy Conditions*

GB 12719 *Exploration Specification of Hydrogeology and Engineering Geology in Mining Areas*

GB/T 18920 *The Reuse of Urban Recycling Water-Water Quality Standard for Urban Miscellaneous Use*

GB 20426 *Emission Standard for Pollutants from Coal Industry*