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**Technical specification for land reclamation and ecological
restoration of metal mine**

金属矿土地复垦与生态修复技术规范

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3 Terms and definitions

Mine land reclamation and ecological restoration is defined as the activity that, for the geological environment damage, land destruction and vegetation damage caused by the extraction of mineral resources, relies on human support and guidance together with natural restorative capacity and takes preventive and restorative measures so that the mine geological environment becomes safe and stable, the destroyed land is reclaimed for use and the ecosystem function is restored or improved; a note abbreviates it to reclamation and restoration. A reference ecosystem is an ecosystem that can serve as the target or benchmark of ecological restoration, a note adding that it usually includes the ecosystem before damage, a local ecosystem not degraded by human activity, and an ecosystem able to adapt to ecological and environmental change that is occurring or can be foreseen. Land destruction is the process and state in which the original function of the land is partly or wholly lost through mine production and construction activity.

The site terms defined are the open pit, the mining site where the mineral is extracted after the overlying rock and soil have been stripped; the waste dump, the site where the rock and soil stripped in open-pit mining and the waste rock from underground workings are heaped, also called a spoil dump or rock dump; the tailings reservoir, the place formed by damming a valley mouth or enclosing ground, used to store the tailings discharged after ore dressing; the heap leaching site, the place where the ore is heaped and low-grade metal extracted by drip or spray leaching; and the in-situ leaching site, the leaching ground where metal minerals are extracted by in-place leaching or by in-place leaching through underground boreholes. Ground surface movement area is the range affected by the horizontal and vertical displacement of the surface caused by the goaf formed by underground metal mining.

Natural restoration is defined as stopping human disturbance of the ecosystem so as to lighten the load, and relying on its self-regulating and self-organizing capacity to let it succeed and renew itself in an orderly direction. Landform reshaping is forming a new landform in harmony with the surrounding landscape, by orderly dumping and land shaping, on the basis of removing geological environment problems and controlling latent pollution risk and soil erosion hazard, according to the way the mine landform has been damaged and the degree of destruction and taking account of the original relief. Soil reconstruction is the reconstitution of the soil matrix on destroyed mine land by engineering, physical, chemical and biological measures so as to form a soil profile structure and fertility fit for vegetation growth. Vegetation reconstruction is the rebuilding of a lasting and stable plant community by selecting pioneer and site-adapted species and carrying out their

arrangement, planting and tending, having regard to climate, altitude, slope, aspect, the composition of the surface material and the thickness of the effective soil layer. Landscape construction is the building of an ecosystem in harmony with the surrounding landscape, following the integrated protection and restoration of mountains, rivers, forests, farmland, lakes, grassland and sand, and taking full account of the structural adjustment and optimal allocation of land, water, biological resources and the human settlement environment during the reintegration of the point, line, area and network landscape of the mining area. Adaptive management is the method and process of gaining experience by monitoring and assessing the management and practical measures already taken and of correcting and improving them as the ecosystem changes.

4 General requirements and basic principles

4.1 The metal mine site and the surrounding ecosystem are to be treated as one whole. On the basis of the importance of the ecosystem function of the place where the mine lies, of the human settlement environment and of economic and social development, and having regard to natural conditions, relief, the ecological and environmental problems of the mine and their degree of harm, the concept of integrated protection and systematic treatment of mountains, rivers, forests, farmland, lakes, grassland and sand is to be held to; areas of the mine site that can be restored are to be reclaimed in good time during extraction, following the laws of ecological succession and the inner mechanism of the ecosystem, so that with sound techniques and models the geological environment of those areas becomes stable, the destroyed land is reclaimed for use, ecosystem function is restored and raised, the biodiversity of the mining area is recovered, green mine construction is advanced and harmony between people and nature is achieved.

4.2.1 Protection first and control at source. The siting and alignment of metal mine land and the design of the production process system are to be optimized so that the effect on sensitive targets such as basic farmland, basic grassland, important protected species, protected areas, water sources and cultural relics is reduced at the source; sound source control measures are to remove geological environment hazards and control environmental pollution and soil erosion so that a safe, stable and pollution-free state is reached; and engineering, biological and chemical reclamation measures are to restore the damaged ecosystem.

4.2.2 Unified planning and coordinated implementation. The targets, direction, standards and measures are to be aligned with territorial spatial planning, mineral resource planning, territorial ecological restoration planning and the mineral resource development and utilization plan, and to be in harmony with the current land use and the surrounding landscape; the reclamation design is to be unified with the mining design and its technical measures and timing closely combined with the extraction process, so that over the whole life of the mine extraction and reclamation proceed together and, along with green mine

construction, mitigation and protection, preventive control and reclamation measures are taken in step, so that the geological environment is treated in good time, the destroyed land is reclaimed and ecosystem function is restored, with the best restoration effect and the best state of use sought.

4.2.3 Combination of human restoration and natural recovery. According to the geological stability of the mine, the suitability for reclamation and the ecological resilience, the principle of tillage where tillage is fit, forest where forest is fit, grassland where grassland is fit, wetland where wetland is fit, waste where waste is fit and sand where sand is fit is to be held to; the damaged ecosystem is to be restored by human measures of mitigation and protection, preventive control and reclamation, while respecting, conforming to and protecting nature and making full use of natural restorative capacity, so that the composition and structure of the local biological community are gradually restored and the restored ecosystem becomes self-maintaining and self-regulating.

4.2.4 Systematic treatment and functional improvement. The reclaimed land is to be aligned with territorial spatial planning, mineral resource planning and territorial ecological restoration planning, and through whole protection, integrated treatment and systematic restoration the geological environment is to become stable, the destroyed land reclaimed and ecosystem function restored; planning and implementation are to follow the requirements of biodiversity protection, which is to be carried through the whole process by way of landform reshaping, soil reconstruction, vegetation reconstruction and landscape construction.

4.2.5 Public participation and monitoring throughout. Over the whole life of mine development and reclamation, contact with the stakeholders is to be kept up and they are to be given active and meaningful opportunities to take part, so that the drafting, implementation, monitoring, evaluation and adaptive management of the plan reflect their views, and progress is to be reported and updated to them so that fairness and inclusiveness are ensured. The stakeholders include the land users, communities, government, regulators and enterprises within the mine area, together with investors, industry peers, academia and the media; local traditions, customs, social expectations and the vision of the enterprise are to be respected, so that the benefit to the local community, the environment and the mining industry is maximized.

6 Baseline survey and problem identification and diagnosis

6.1 The baseline survey covers natural conditions, the socio-economic and cultural setting, mine production and construction, the current geological environment, land destruction and reclamation, and ecological status. Natural conditions cover geographic position, relief, climate, hydrology, the regional geological outline, regional hydrogeology, soil condition, soil erosion and animal and plant resources. The socio-economic survey covers the population, agricultural population, arable land per head and production conditions of the last three