



Kinetic Development Group Limited

South Africa 2×33000 kVA

Pre-feasibility study report

**MCC BERIS ENGINEERING AND
RESEARCH CORPORATION**

February 2024



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BERIS



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1. Project general analysis and market analysis

1.1 Overview

1.1.1 Project name

Kinetic Development Group Limited South Africa 2×33000 kVA High carbon ferrochrome project

1.1.2 Project construction unit

Kinetic Development Group Limited

1.1.3 Site of the Project Construction

South Africa energy and metallurgy Special Economic Zone

1.1.4 Design unit

MCC BERIS ENGINEERING AND RESEARCH CORPORATION

1.1.5 Enterprise Overview

Kinetic Development Group Limited ("Power Development" or "The Group") was incorporated in the Cayman Islands in July 2010. In March 2012, it was listed on the main board of the Hong Kong Stock Exchange with the stock code of 1277. The group is a comprehensive coal enterprise, and the business covers the whole industry chain of coal production, washing, loading, transportation and coal trade.

1.2 Design Basis

(1) Design contract signed by Kinetic Development Group Limited and MCC BERIS ENGINEERING AND RESEARCH CORPORATION.

(2) The superior documents, meeting minutes, agreements, fax signed and approved by both parties related to the project design.

(3) The topographic map of the construction site provided by Party A.

(4) Other original drawings, documents and technical requirements required by Party A for Party B's design.

(5) The main technical standards adopted by Party B.

1) Quality management and quality assurance.

2) Civil engineering geological survey report and seismic



intensity.

3) The design adopts relevant national standards.

4) The products shall implement the relevant national standards.

(6) Relevant mandatory regulations and codes / standards, especially mandatory standards for environmental protection, energy conservation, seismic, fire prevention, explosion prevention, pressure vessel, and national and metallurgical industry.

1.3 Significance and advantages of the project construction

The South African Energy and Metallurgy Special Economic Zone (hereinafter referred to as the "Special Economic Zone") is a national energy and metallurgical economic zone approved by the South African government in accordance with the laws of the South African Special Economic Zone. It enjoys the preferential tax treatment of the South African Special Economic Zone and all the preferential treatment of the South African policy of encouraging foreign investment. The South African government has issued an operating license to the South African Energy Management Base Co., Ltd. to develop and manage the Energy Management Special Economic Zone. Located in Limpopo Province, South Africa, covering an area of 60 square kilometers, the region is adjacent to Zimbabwe, Mozambique and Botswana. The reserves of open-pit coke mines around the SAR are more than 10 billion tons. South Africa has more than 83% of the world, manganese resources account for more than 81% of the world, and the high-grade reserves of vanadium resources rank first in the world. There are other rich stainless steel raw material mine resources in the region: iron ore, silicon ore, nickel ore limestone, etc. The national railway, highway and power supply network run through the zone, 500 kilometers away from the large port terminal of Maputo, Mozambique. The Limpopo River is 30 kilometers away from the zone and is an important source of water for the zone.

SAR project will build 20 million tons / year coal washing plant, 3.3 million kw coal power plant, 3 million tons of coke plant and 390000 kw waste heat power plant, annual output of 3 million tons of high carbon iron plant, annual output of 500000 tons of iron manganese plant, 3 million tons of stainless copper plant, 1 million tons of high vanadium steel plant and 1 million tons of high manganese steel plant, and annual output of 5 million tons of gold lime plant, 1.2 million tons of titanium dioxide



plant and 150000 tons of vanadium pentoxide plant. The SAR will build supporting government administrative service centers (business administration, customs, taxation, etc.), service centers for staff living areas (staff dormitories, hotels, shopping malls, hospitals, etc.) and integrated logistics service centers for road, railway and sea transportation (to provide point-to-point direct logistics services for the project).

The SAR will establish a mine resource supply center to provide mining resources for metallurgical furnaces for the SAR project plant. SAR project energy for gold integration advantages: set coal washing coal plant coke carbon plant power plant a ferroalloy iron a copper smelting plant a dragon energy gold production process, blast furnace molten and ferroalloy thermal steel to improve smelting recovery, reduce the energy consumption of metallurgy, the energy treatment gold whole process advantage, unique. South Africa Energy and Metallurgy Special Economic Zone Management Co., Ltd. provides all preferential policies and guaranteed and competitive resource supply and supporting service facilities for the project investors. The SAR has mining resources of various metallurgical raw materials, land, water resources, power plants, coke chemical plants, sewage treatment plants and other infrastructure.

Ferroalloy plants, steel mills, stainless steel plants of metallurgical projects in the Special zone will open investment to the world, introduce strategic investors for the best projects, and to build the most competitive energy metallurgy special zone in the world.

When the HKSAR is completed, it will have the following significance:

- 1) Using resources for deep processing to increase added value and increase employment is in line with South Africa's domestic industrial development strategy.
- 2) Industrial agglomeration and the integration of the upstream and downstream of the industrial chain are conducive to promoting the local infrastructure construction
- 3) Products to meet the global market demand and support the economic development in Africa.
- 4) Develop the advantages of China-Africa production capacity cooperation under the Belt and Road Initiative.
- 5) Transfer China's excess steel capacity and reduce China's high energy-consuming pollution.

South Africa is rich in chromium mineral resources, with UG 2 all coming from



South Africa, and mainly from Limpopo Province, where the project is located. Therefore, the construction of ferroalloy production facilities in South Africa has unique advantages in raw materials.

The price of chromium ore used in the production of alloy in this project is \$100 cheaper than Tianjin price excluding VAT, the price of electricity is 5 cents per kilowatt hour, and the price of coke is \$250 per ton. The price of raw materials is significantly lower than that of domestic, so the alloy produced after the project is put into operation has low cost and has a strong competitiveness. High carbon-chrome iron water heat delivery production of stainless steel, reduce energy consumption, reduce the production cost of stainless steel.

The project is located in South Africa Energy Special Economic Zone. The customs duty within the special zone is free, the income tax within the special zone is 15%, and the income tax outside the special zone is 28%. The construction of ferroalloy production facilities in the special zone has obvious tax advantages.

1.4 Design content and scope

1.4.1 Design content

The scale of the project is planned according to the overall planning of the annual output of 125,000 tons, and 2×33,000 kVA electric furnaces and their supporting facilities are built.

The design shall include general, electric furnace smelting system, raw material system, pellet and roasting process, general transportation, power supply and distribution and electrical facilities (including 132kV transformer station), water supply and drainage system (water, turbidity circulating water system), including ventilation, dust removal, thermal and gas facilities, computer, telecommunications, mechanical repair, inspection, construction, structure, energy analysis and evaluation, environmental protection, occupational safety and health and fire protection, labor and training, project investment estimates, technical economy and evaluation, etc.

The engineering design shall comply with the Code for Design of FerroAlloy Process and Equipment of the Ministry of Housing and



Urban-Rural Development, PRC.

Main facilities within the Project scope include:

- ◆ High-carbon ferrochrome production workshop
- ◆ Chromium mine shaft furnace baking workshop (reserved)
- ◆ Raw materials, batching and feeding system
- ◆ charcoal dry
- ◆ Furnace gas purification and dust removal system
- ◆ Dust removal system in the production area
- ◆ Compressed air preparation
- ◆ 132KV (power supply) substation and the capacitor compensation device
- ◆ Power supply and distribution, electrical control, automation instruments, telecommunications facilities
- ◆ Whole-plant control system
- ◆ Industrial TV monitoring system
- ◆ machine repair shop
- ◆ Electrode shell production workshop
- ◆ Water source is connected to the production plant purification water supply system
- ◆ Net ring water system
- ◆ Turbring water system
- ◆ Production and living water supply and drainage system
- ◆ Whole-plant fire protection system
- ◆ Ventilation and air-conditioning system
- ◆ General map of transport and roads, walls, gates
- ◆ Factory area office building
- ◆ Laboratory room
- ◆ Raw material storage yard, spare parts warehouse, finished product warehouse, etc



◆ Raw materials into the factory, finished products factory loadometer duty room

◆ Fire protection, safety, environmental protection and other basic facilities

◆ slag disposal pit

1.5 Guiding ideology and principles of design

1. comply with the requirements of Ferroalloy and Electrolytic manganese Industry of the Ministry of Industry and Information Technology, and the new enterprises meet the requirements of relevant national policies.

2. Vigorously develop circular economy with the scientific outlook on development. With high level of equipment, design, production, construction quality, production standards as the goal.

3. The design adopts advanced, mature and reliable technology and equipment, reaching the domestic leading level.

4. In line with the guiding ideology of saving investment, elaborate design, reasonable layout.

5. Waste gas, waste water, waste residue and noise shall be strictly treated according to the requirements of relevant environmental protection laws and regulations, so as to meet the standards, and do a good job in the greening and beautification of the factory.

6. Improve labor safety, health and fire fighting facilities to ensure the physical and mental health and life safety of workers.

7. In terms of process flow and equipment selection, advanced energy-saving equipment is adopted to reduce energy consumption and improve the competitiveness of enterprises.

1.6 Production scale and product variety scheme

This project proposes 2×33000 kVA semi-closed electric furnaces for the production of high carbon ferrochrome, and the smelting product is FeCr55C 10.0. Two furnaces are set up in a workshop.



The production scale of this project is: the annual output of 125,300 tons. The chemical composition is shown in the table below:

High-carbon ferrochrome (GB / T 5683-2008) brand and chemical composition

the name of a shop	% Chemical composition									
	Cr			C	Si		P		S	
	scope	I	II		I	II	I	II	I	II
		Not less than								
FeCr67C6.0	62.0~72			6.0	3.0		0.03		0.04	0.06
FeCr55C600		60	52	6.0	3.0	5.0	0.04	0.06	0.04	0.06
FeCr67C 9.5	62.0~72			9.5	3.0		0.03		0.04	0.06
FeCr55C10.0		60	52	10.0	3.0	5.0	0.04	0.06	0.04	0.06

1.7 Market analysis

1.7.1 Product market analysis

In 2023, the steel market is carrying forward in the collision of "strong expectations and weak reality", the steel price low shock cycle is prolonged and the cost is always high, overcapacity, industry losses are prominent. Chromium ore prices remain at a high level for a long time, continue to give ferrochrome strong cost support, guarantee the iron stability, but most of the time iron rise less than cover ore prices, factory profits shrink, and with the north large new capacity production, high carbon chromium iron supply record high, the contradiction between supply and demand, factory upside down, industry chain game.

(1) Price analysis

In 2023, the price fluctuation of high carbon ferrochrome narrowed to less than 1,000 yuan. Taking the price in Inner Mongolia as an example, it has been fluctuating between 8350-9300 yuan / 50 base tons, the price band duration is shortened, the average annual price is 8796 yuan / 50



base tons, 207 yuan / 50 base tons higher than the average annual price last year, and basically maintained a relatively high level throughout the year.

Under the effect of rising cost, the price of high carbon iron chromium steadily increased and reached the highest point of 9300 yuan / 50 base tons. However, as the strong expectations of the consumer market failed to cash in, iron prices began to turn downward run. The market fluctuated greatly, first, the surge of imported iron chromium flow caused the pressure of the iron price correction, and then, the increase of production enterprises to promote the positive adjustment of supply and demand relationship, and finally driven by the rising cost, the iron price increased significantly. Stainless steel market turned good, steel production continues to maintain a high level, good plus the market to buy gas recovery, high prices continue to emerge, iron prices to stand on the "9" prefix. But at the end of the quarter, steel prices plunged, market confidence was frustrated, iron prices once again into the correction channel. Large new production capacity in northern China successively reached production, the pattern of "supply increase and demand reduction" in the ferrochrome market was formed, and the cost support weakened. The decline of iron price expanded and fell to the lowest point at the end of 8350 yuan / 50 base tons at the end of the year. Due to the influence of the factors of production reduction and power rationing, the supply of ferrochrome decreased, and the iron price remained firm after a small rise.



(2) Analysis of the supply-and-demand relationship

In terms of supply, since 2019, the domestic output of high-carbon ferrochrome has been rising steadily. In 2023, the national cumulative output of high-carbon ferrochrome was 7.3595 million tons, an increase of 905,200 tons year on year, an increase of 14.02%. The output increase significantly increased, and the total output continued to create a new high. Inner Mongolia as the main origin of domestic high carbon



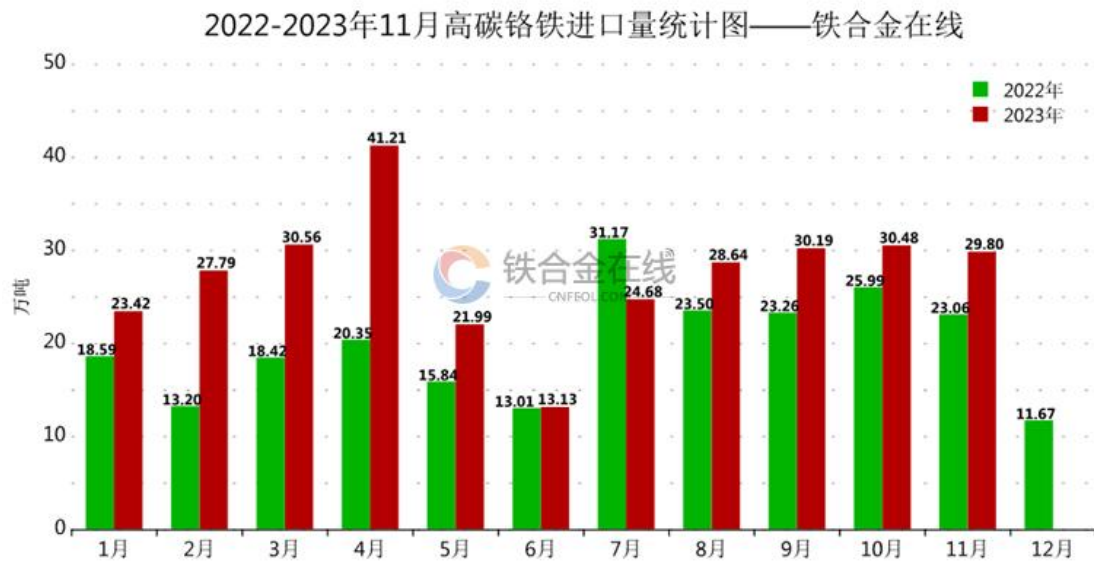
ferrochrome, 2023 production ratio continued to rise 7%, from electricity price, freight, technology, and many other aspects, Inner Mongolia is still the most prominent production advantage a origin, large factory capacity expansion, and new capacity access conditions moderately, create conditions for local production increase. Other producing areas such as Guizhou, Guangxi, Sichuan and other old high-carbon ferrochrome producing



areas, due to the cost advantage is no longer, the start time of most factories is reduced, so the output proportion shows a declining trend year by year.

高碳铬铁各产量产量占比				
地区	2023年产量（万吨）	2023年占比	2022年占比	增减
湖南	15.80	2.15%	2.04%	0.11%
山西	57.61	7.83%	7.95%	-0.12%
四川	34.03	4.62%	5.44%	-0.82%
内蒙	459.58	62.45%	55.11%	7.34%
贵州	46.31	6.29%	9.77%	-3.48%
广西	34.68	4.71%	6.80%	-2.09%
西北（甘肃、青海、新疆）	44.38	6.03%	4.18%	1.85%
其他地区	43.56	5.92%	8.72%	-2.80%

According to customs statistics, the cumulative import of high-carbon ferrochrome was 3.2403 million tons from January to December 2023, an increase of 859,700 tons year-on-year increase of 36.11% year-on-year. In the first half of the import ferrochrome supplier clearing early inventory, lead to high carbon ferrochrome imports rose to high levels, in addition overseas ferrochrome consumption decline, European procurement benchmark price sharply, as well as the external factors such as stainless steel production accelerate the imports of high carbon ferrochrome back to the Chinese market, so that high carbon ferrochrome import data surge this year. Among them, the top three import source countries are still: South Africa accounted for 58.41% (up 10.12% year on year), Kazakhstan accounted for 21.91% (down 2.50% year on year), and India accounted for 11.18% (down 0.98% year on year). Zimbabwe's imports also fell this year, accounting for 6.27 percent from 10.99 percent last year.



In terms of demand, the total output of stainless steel crude steel in 31 stainless steel plants in 2023 was roughly 35.21 million tons, an increase of 3.23 million tons year-on-year, an increase of 10.10%. Among them, the output of 200 series was 11.21 million tons, 300 series was 18.13 million tons, and 400 series was 5.87 million tons. In 2023 high carbon chrome total supply (including output, imports, chromium) about 13.49 million tons, the total demand (including stainless steel, carbon steel,



silicon chromium, etc.) about 12.61 million tons, from the perspective of supply and demand, because this year the ferrochrome supply increment is significantly greater than the demand on the increment, the annual high carbon ferrochrome is roughly 880000 tons of excess, even considering steel stock cycle and delivery time difference, excess theoretical value is still high, the contradiction between supply and demand the overall trend of expansion. From March to April, the production of high carbon iron chromium and imports fluctuated, while the production of stainless steel did not follow up simultaneously, resulting in a monthly excess value of more than 200,000 tons. In the second quarter, as the output of steel mills continued to break through to the high level, and the internal and external supply of high chromium both fell, there was a certain supply gap in May and June, and the supply and demand relationship was positively adjusted. In the third quarter, the new production capacity began to accelerate, and the high chromium supply continued to refresh the high level, leading to the re-emergence of the contradiction between supply and demand. At the end of the year, as the factory inversion became more serious, the production camp of enterprises in southern China expanded, and the situation of oversupply eased slightly.

(3) Chromite market trend

From January to December 2023, the cumulative import of chromium ore was 18.332,600 tons, an increase of 3.325,200 tons year on year and 22.16% year on year. The total consumption of chromium ore from January to December 2023 was 17.9578 million tons, and the consumption of chromium ore was slightly greater than the consumption. Due to high carbon iron chromium capacity continue to rise up, chromium ore just need to further enhance, and the port chromium ore rights more concentrated, foreign price control quantity and individual month shipping delay factors, chromium ore prices are high throughout the year, including may port chromium ore inventory fell to 1.4 million tons, break the record low, when the price



increase is the most significant. After the fourth quarter, due to the increase of ferrochrome factories, the factory stopped reducing production, and the concentration of South Africa concentrate to the port, the chromium ore was both up and down, the purchasing intention of the factory was reduced, and the chromium ore port inventory was also repaired, and gradually returned to a reasonable level.

(4) Future development direction

The overall cost performance of chromium concentrate in South Africa is weakened, and the ratio of chromium ore raw materials in the factory continues to be diversified towards adjustment. However, due to the high concentration of main resources and the rigid demand of sintering process, its leading role on the ore price is difficult to shake for the time being.

After the rise of overseas ferrochrome production capacity, Indonesia stainless steel industry meets the self-sufficiency of raw materials, the import of high carbon ferrochrome back to the domestic market may further increase, bringing a negative impact on the market.

There are still a lot of new production capacity of high carbon ferrochrome "on the road", and the trend of large-scale and centralization is obvious, the supply growth is likely to continue to lead the demand growth, and the living space of southern factories is squeezed again.

Under the profit-seeking mentality, the increase of chromium ore is the general trend, but the increase of ferrochromium is also continuing, so although the center of gravity of chromium ore price may be moderately moved down, the support for the iron price is still strong.

1.7.2 Advantages of our project construction

(1) Raw material price advantage

At present, China's high carbon ferrochrome smelting chromium ore relies on imports from South Africa, Zimbabwe and other places, and this project chooses to invest and build in Limpopo Province, South Africa, which is rich in coal resources and chromium ore resources. Rich coal resources help build power plants to provide cheap electricity for smelting. Compared with the domestic electricity price depression in



Inner Mongolia, it has an obvious price advantage. Chromium mineral resources are the raw materials needed for electric furnace smelting, and the price is 100 US dollars cheaper than Tianjin price excluding value-added tax. The project is chosen to be built in South Africa, which has an extremely obvious freight rate advantage.



And due to the excessive pursuit of chrome powder ore cost performance in the past, the vast majority of domestic enterprises choose pellet + ore furnace smelting process. At present, compared with chromium powder concentrate, the arrival price of chromium block mine in Tianjin port is lower. This project can choose the process of block mine into the furnace. Compared with the pellet process, the construction investment can also achieve the purpose of investment saving.

(2) Human resource advantage

Compared with the increasing labor cost in China, this project is built in South Africa, which also has a certain labor cost advantage.

(3) Policy advantages

The project is located in South Africa Energy Special Economic Zone. The customs duty within the special zone is free, the income tax within the special zone is 15%, and the income tax outside the special zone is 28%. The construction of ferroalloy production facilities in the special zone has obvious tax advantages.

(4) Industrial chain advantage

Several major steel producers in the African steel market are South Africa, Egypt, Libya and Algeria, which account for almost half of Africa's steel production.

South Africa is located at the strategic point of the southern tip



of the African continent. South Africa is one of the BRICS countries and the Southern African Customs Union (SACU). It is an important gateway for economic, political, cultural and cultural exchanges in other aspects with other countries on the African continent, and also one of the preferred destinations for multinational companies to invest in Africa.

South Africa is the second largest economy in Africa and is a middle-income developing country. Its gross domestic product (GDP) accounts for about one-fifth of Africa, with a total population of more than 62 million.

In the long run, there are many favorable conditions for South Africa's economic development, and its growth potential needs to be tapped urgently. South Africa is at the crossroads of the Atlantic Ocean and the Indian Ocean, with a coastline of nearly 3,000 kilometers and an exclusive economic zone of 1.5 million square kilometers. It is rich in Marine fisheries, oil and gas resources. There are many kinds of mineral resources, large reserves and good grade. The reserves of platinum, gold, iron ore, manganese, nickel, uranium, chromium and coal all rank among the top in the world. It has excellent infrastructure in communications, highways, ports and energy, and its research and development and innovation capacity in some areas reaching world standards, providing a sound foundation for industrialization. Finance, law, telecommunications and other services are developed, and the commercial supporting facilities are relatively complete. Low-skilled workers are abundant and are the base of manufacturing and service outsourcing in Africa. The black middle class is growing stronger and has some consumption potential. In the long run, South African steel demand is in course to grow.

In conclusion, after the completion of the project will have the following significance:

1) Using resources for deep processing to increase added value and increase employment is in line with South Africa's domestic industrial



development strategy.

2) Industrial agglomeration and the integration of the upstream and downstream of the industrial chain are conducive to promoting the local infrastructure construction

3) Products to meet the global market demand and support the economic development in Africa.

4) Develop the advantages of Belt and Road " China-Africa production capacity cooperation.

5) Transfer China's excess steel capacity and reduce China's high energy-consuming pollution.

1.8 Main technical and economic indicators of the project

The main technical and economic indicators of the project are shown in Table 1-3.



Table 1-3 of major technical and economic indicators

order number	name of index	unit	quantity	remarks
1	Product output			
	high carbon ferro-chrome	Tons / year	125329	
2	Raw fuel consumption			
(1)	chrome ore	The t / t chromium-series alloy	2	
(2)	Reducing agent (coke and blue carbon)	The t / t chromium-series alloy	0.5	
(3)	Silica stone (or dolomite)	The t / t chromium-series alloy	0.174	
3	Electric furnace facilities			
	33,000 kVA electric furnace	short for Taizhou	2	
4	Annual working hours	sky	330	
5	Total calculated load of electrical equipment	MW	55.303	
6	Energy media indicators			



order number	name of index	unit	quantity	remarks
6.1	Water system indicators			
	Total production water consumption	m ³ /h	2972	
	Production of new water replenishment amount	m ³ /h	17	
	Production water circulation rate	%	98.8%	
	domestic consumption	m ³ /h	5	
	Household drainage	m ³ /h	4	
	Production displacement	m ³ /h	0	
6.2	Compressed air consumption	N m ³ /min	66	
7	energy consumption			
	high carbon ferro-chrome	kgce /t	877	
11	manpower quota	human being	235	
12	Investment composition			
13	gross weight of	t	About 4500	in two



order number	name of index	unit	quantity	remarks
	equipment			copies
14	Estimated amount of steel	t	About 6500	
15	Estimate the amount of concrete	m ³	About 9000	
16	total investment			
	Static investment in engineering	Ten thousand dollars	4828.09	
	Among them: construction fee	Ten thousand dollars	1740.41	
	equipment investment	Ten thousand dollars	1949.39	
	fabricating cost	Ten thousand dollars	689.51	
	Other fees	Ten thousand dollars	218.87	
	budget allowance	Ten thousand dollars	229.91	



2 ferroalloy process

Kinetic Development Group Limited South Africa 2×33000 kVA high carbon ferrochrome project plans to build 2×33000 kVA semi-closed high carbon chromium electric furnace, smelting product FeCr55C 10.0. Two furnaces are set up in a workshop, with a total of one workshop.

2.1 Product varieties and production scale

2.1.1 Product varieties

The design product of this workshop is high carbon ferrochrome alloy. The chemical composition and brand of the product are in accordance with the national standard (GB / T 5683-2008), as shown in Table 1-1.

High (GB / T 5683-2008) brand and chemical composition Table 1-1

the name of a shop	Chemical composition of the (%)									
	Cr			C	Si		P		S	
	scope	I	II		I	II	I	II	I	II
		Not less			Not greater than					
FeCr67C6.0	62.0-72			6.0	3.0		0.03		0.04	0.06
FeCr55C6.0		60.0	52.0	6.0	3.0	5.0	0.04	0.06	0.04	0.06
FeCr67C9.5	62.0-72			9.5	3.0		0.03		0.04	0.06
FeCr55C10.0		60.0	52.0	10	3.0	5.0	0.04	0.06	0.04	0.06

2.1.2 Production scale

The design production capacity of electric furnace is 125000t/a, 330 working days.

2.2 Supply and technical requirements of main raw materials and auxiliary materials

The raw materials required for high-carbon ferrochrome projects are mainly ferrochrome block ore, silica (or dolomite) and reducing agent (coke and blue carbon). Ore must be graded before entering the furnace. The powder ore is baked into the furnace after the vertical furnace



(reserved). The particle size distribution of the furnace raw materials should be reasonable.

1. Chromium block ore

The chemical composition of qualified typical South African chromium deposits is detailed in Table 2-2.

Table 2-2 of typical South African chromium mineral chemicals

Cr ₂ O ₃	Fe	Cr/Fe	SiO ₂	Al ₂ O ₃	MgO	P	S	Shuifen	fineness (mm)
42	19.1	1.5	8	12	13	0.006	0.007	3%	10~70

2. Silicite

The technical conditions of silica are shown in Table 2-3.

Chemical Composition of silica Table 2-3

chemical composition (%)			fineness (mm)
SiO ₂	Al ₂ O ₃	P ₂ O ₅	20~80
>97	<1.0	0.02	Of them less than 20mm are not more than 5%

3. Metallurgical coke

Composition of Chemical Composition of metallurgical coke Table 2-4

fixed carbon	ash content	S	fugitive constituent	Shuifen	fineness
>82%	<13%	≤0.6%	<2%	≥1%	5~25mm

4. Electrode paste

The electrode paste adopts fully enclosed paste, and its physico-chemical indexes meet the provisions of YB / T5215-2015, as shown in Table 2-5.

Electrode paste and chemistry index Table 2-5

name	Closed paste	
	No. 1	No. 2
ash content /%≤	4.0	6.0



volatile matter /%	12.0~15.5	12.0~15.5
Compressive strength / MPa	18.0	18.0
Resistor / ($\mu \Omega \cdot m$) $\leq$	65	75
Volume density / (g / cm^3) $\geq$	1.40	1.40
extensibility /%	5~20	5~20

5. See Table 2-6 for raw material consumption:

Raw material consumption (consumption of two electric furnaces) Table 2-6

Raw material name	unit consumption t/t	Daily dosage t / d	annual consumption t/a	fineness /mm
Chromium block mine	2.000	760	250656	10-70
coke	0.500	193	63416	5-25
Dinas rock	0.174	66	21807	20-80
carbon paste	0.025	9	3133	—

Note: The above consumption amount does not consider the loss amount.

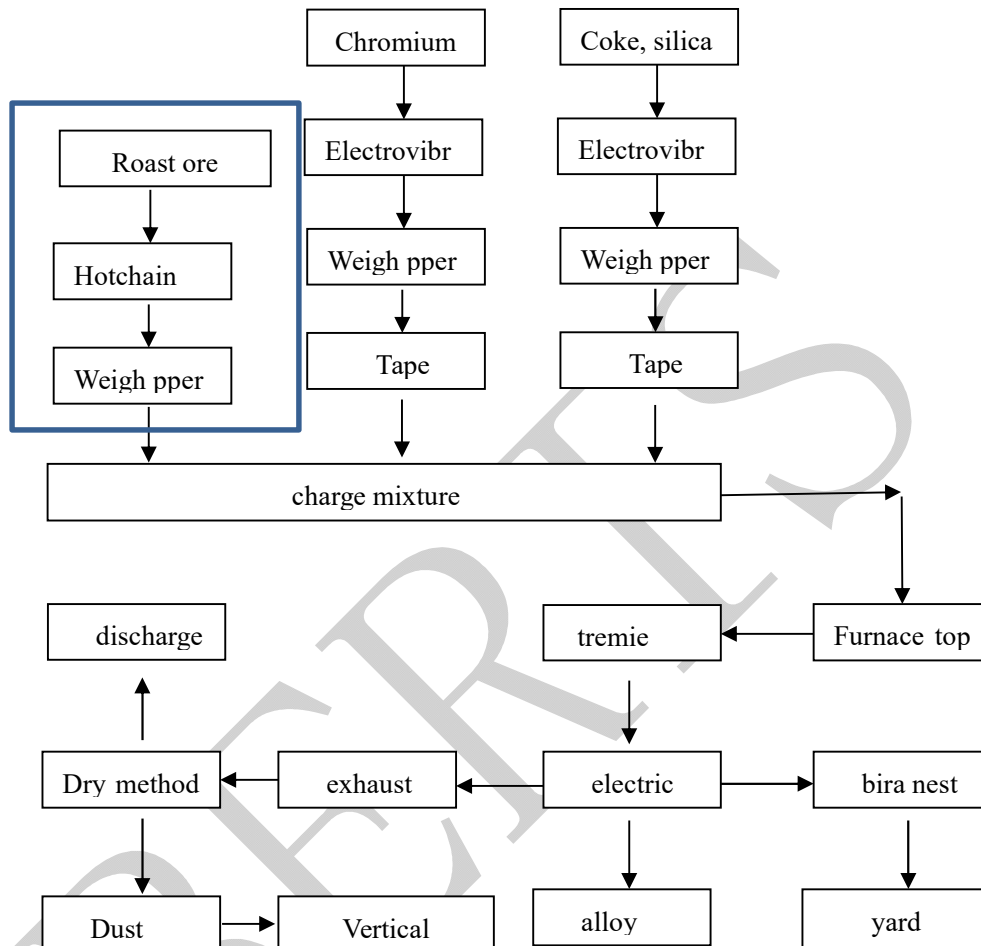
6、Material balance table

Table 2-7

order number	income			pay		
		quality kg	scale		quality	scale
1	Chromium block mine	100	77.90%	high carbon ferro-chrome	50.23	39.13%
2	carbonaceous reducing agent	23.89	18.61%	bira nest	42.36	33.00%
3	slagging constituent	4.48	3.49%	Gas (conversion)	35.78	27.87%
	amount to	128.37	100.00%	amount to	128.37	100.00%

2.3 Production process and main equipment parameters

.3.12. Brief description of the production process flow



Two 33000 kVA semi-closed high carbon ferrochrome alloy electric furnaces are arranged in one workshop. Semi-closed high carbon ferrochrome alloy electric furnace includes feeding and unloading, electrode operation, furnace furnace, product casting and other processes.

High carbon ferrochrome alloy is a product of carbon reduction with chromium ore as raw material, silica as slag flux, and carbon reducing agent (coke) in the electroheated furnace. It is an electrothermal process of continuous melting and intermittent oven.

Qualified coke carbon, silica and ferrochromium block ore are sent



by the belt conveyor to the daily material bin of the batching station for storage. Reserved chrome powder ore ball production facilities. After the batching is transported to the electric furnace through the belt, and add it to the bin, and be added to the furnace through the material pipe.

At 2.67 hours interval, open the iron port with the iron opening machine, the liquid ferrochrome alloy flows into the molten iron bag, and the slag flows into the slag bag through the molten iron bag. The iron chartered car and the slag tank truck are pulled out by the electric iron truck into the pouring span, lifting the iron bag for slag picking treatment after casting. The cooled high carbon ferrochrome alloy is processed into qualified grain size in the finished product across the strong crushing line, and the product sieve is remelted in the ingot mold. The slag bag is lifted by a crane, the slag flows into the dry slag pool through the dry slag chute, and the cooled dry slag is sent to the dry slag storage area.

The electrode shell manufactured from the electrode shell and the broken electrode paste transported from the electrode paste reservoir are raised from a 5-ton bridge crane to the + 25.10m platform to add the long electrode shell and the electrode shell to supplement the regular consumption of the electrode in smelting.

Electrode hydraulic lifting and pressing can be automatic and manual realization, workshop feeding, high carbon ferrochrome alloy electric furnace feeding and high carbon ferrochrome alloy electric furnace condition control are controlled by PLC system.

2.3.2 Calculation of electric furnace production capacity

Iron exit system: three times per shift (iron exit interval time: 2.67h)

Annual working time of electric furnace: 330 days.

Annual shutdown time of electric furnace: 35 days.



Among them: middle repair once a year, a 10 days.

Minor repairs occur once a month, once for a day.

Unplanned furnace shutdown, 7 days.

In addition, overhaul once every 5 years, once every 30 days.

Power factor $\cos \phi$: 0.82 (after compensation)

Power grid fluctuation coefficient: 0.98.

Time utilization coefficient: 0.91.

Power consumption per unit product: 3,050 kWh / t

Average hourly output of electric furnace (one set):

$$Q = \frac{33000 \times 0.82 \times 0.98 \times 0.91}{3050} = 7.91(t)$$

Maximum hourly output of electric furnace (one set):

$$Q = \frac{33000 \times 0.82}{3050} = 8.87(t)$$

Average daily output of electric furnace (one set):

$$Q = 7.91 \times 24 = 189.9(t)$$

Maximum daily output of electric furnace (one set):

$$Q = 8.87 \times 24 = 213(t)$$

Annual output of electric furnace (one set):

$$Q = 189.9 \times 330 = 62664(t)$$

Annual output of 2 electric furnaces:

$$Q = 62664 \times 2 = 125328(t)$$

2.3.3 Main parameters of the electric furnace

The main parameters of the electric furnace are shown in the following table:

order number	name	unit	quantity	remarks
1	Furnace diameter	mm	10800	
2	Height of furnace shell	mm	4350	



3	Furnace diameter	mm	8800	
4	Furnace depth	mm	2700	
5	Diameter of electrode	mm	1270	
6	Circle diameter of the electrode pole center	mm	3600	adjustable
7	Number of iron ports	individual	2	
8	Electrode lift speed	m/min	0.5	
9	Electrode current density	A/cm ²	5.1	

2.3.4 Main parameters of electric furnace transformer

The main parameters of the electric furnace transformer are shown in the following table:

order number	name	unit	quantity	remarks
1	Transformer rated capacity	kVA	3×11000	
2	Number of transformer stations	short for Taizhou	3	monophase transformer
3	Primary side voltage	kV	35	
4	Secondary side voltage	V	250-400	
5	Secondary side voltage level		Grade 32 (grade difference of 5V)	



6	Common voltage on the secondary side	V	300	
7	Common current on the secondary side	A	63510	
8	voltage regulation mode		load voltage regulation	Y/Δ changing-over
9	number of phases	each other	3	
10	supply frequency	Hz	50	

2.4 Structural type of electric furnace

The structure type of the electric furnace is semi-closed, fully hydraulic and fixed electric furnace.

2.4.1, furnace shell and furnace lining

The furnace shell is cylindrical. The furnace two is with two furnace shell, 150° layout. Furnace lining is made of thermal insulation and refractory material.

2.4.2 Electrode system

2.4.2.1 Electrode holder

A combined type of handle is used.

Technical features: The combined handle completely innovates the traditional electric furnace structure, eliminates the copper tile and the holding lock, and replaces the contact element. This structure makes several wings on the outer surface of the electrode shell, and the current is introduced into the furnace through the wing of the electrode of the contact element; the electrode voltage discharge is composed of another clamp that can be clamped or released. Contact elements and clamps completely replace the role of copper tile and lock, which is more flexible than copper tile and lock, and the material dosage is more economical.

2.4.2.2 Electrode lifting device



Electrode lifting adopts hydraulic lifting cylinder lifting.

2.4.2.3 Electrode voltage discharge device

The release device uses a clammer. The holding force of the electrode depends on the elasticity of the butterfly spring. When releasing the electrode, you use the liquid pressure to overcome the elasticity of the spring. The piezoidal electrodes use both programmed pressure drop and manual forms.

2.4.3 Smoke cover and smoke exhaust system

Smoke hood is a device to collect and remove a large amount of flue gas and dust produced in the smelting process of electric furnace. The smoke cover adopts semi-closed low smoke cover. In order to prevent the smoke cover from deformation during transportation, the smoke cover plate can be separated and installed after transportation to the site. It is composed of water-cooled steel skeleton, water-cooled cover plate, side wall, etc. The skeleton and the top cover are water-cooled, which also makes high-aluminum refractory castant, and the side wall of the hood is the inner-side of the water-cooled structure. The skeleton and the top cover are water-cooled, which also make high aluminum refractory castable. Two flue gas export pipes are set in the smoke hood, and the flue gas is cooled by the air cooler before the bag dust collector, and the treated flue gas is discharged according to the standard. The cigarette hood is provided with three electrode opening holes. The smoke hood is a regular hexagonal structure, and the top of the smoke hood is composed of six top cover plates of the water-cooled structure and three central cover plates of the top of the water-cooled structure. The center cover plate is sprayed with refractory castings.

2.4.4 Charging system of electric furnace

In order to meet the requirements of uniform distribution and a large amount of furnace charge in a short time, each electric furnace is equipped with a preheating bin and the furnace top bin, and the bin is equipped with a feeding level indicator device.

A total of 10 furnace material pipe, the material pipe into the furnace cover part of the water cooling.



2.4.5 Short net of electric furnace

The short net of electric furnace is pipe type, and the soft connection part is water-cooled cable. Compared with the plate short net, the current density is increased several times, and the weight of the corresponding short net is reduced a lot. At the same time, the short net, the conductive copper pipe on the electrode and the copper tile can form a cooling water loop, and the temperature of the tube short net is much lower than the plate short net. The electrical loss is correspondingly reduced, and the short net copper pipes are covered with insulation layer, which prevents the occurrence of short net short circuit accident.

The use of three single-phase transformers can make the current more balanced, solve the problem of bias, short network, short, small electric loss.

2.4.6 Water-cooled system

The body cooling of the electric furnace adopts the softening water closed circulation system, so that the cooling parts do not scale, prolong the service life of the cooling parts, and reduce the hot shutdown furnace.

2.4.7 Hydraulic system

Hydraulic station, as the power source of electrode lifting and electrode control, is composed of pump station, valve station and accumulator group.

2.5 Main auxiliary equipment of the electric furnace

2.5.1 The furnace front smoke exhaust system

The front smoke exhaust system is mainly composed of smoking cover, flue, flue butterfly valve and dust collector. There are two outlets of high carbon chromium electric furnace. 150° , for each other. When one of the group is working, open the adjacent flue butterfly valve of the group, close the other group of oven flue butterfly valve, so that the smoke in front of the furnace. Two furnace outlets are staggered, sharing a set



of furnace front smoke exhaust system.

2.5.2 open and block the iron mouth

The opening and blocking iron port machine is composed of guide rail, gun barrel, pitch device, walking device and air cylinder. Open the iron outlet to block the iron outlet in time after putting the iron water.

2.5.3 Furnace bottom fan

The furnace bottom fan is used to cool the furnace bottom to improve the service life of the furnace shell and the furnace bottom.

2.5.4 Iron-out equipment

The iron outlet mode of high carbon chromium ferroelectric furnace adopts molten iron bag + slag bag mode. Each electric furnace produces iron once every 2.67 hours, and each electric furnace uses 4 molten iron bags and 4 slag bags.

2.6 Workshop composition and plane layout

Two 33000 kVA high carbon iron chrome ore hot furnaces are arranged in a shape, with the center spacing of 37.5m. The workshop is equipped with electric furnace span, casting span, finished product finishing span and finished product span. The span of electric furnace is 81m and 30.6m wide; casting span, finished finishing span span 24m and length 153m. See the attached drawings for the specific layout of each span.

2.6.1 Electric furnace span

There are five platforms across the furnace span:

The elevation of the first layer is $\pm 0.0\text{m}$, and there are furnace body, iron slag discharge device, iron outlet smoke discharge device, etc.

The second floor platform is an operating platform with an elevation of $+7.3\text{m}$, equipped with furnace cover, water-cooled distributor, control room and workshop office;

The third layer platform is a transformer platform, with the elevation of $+11.3\text{m}$, and a transformer room is arranged on the platform;



The fourth layer platform is an electrode operation platform with an elevation of + 17.5m, which is equipped with electrode guide device and electrode hydraulic control box, as well as the layout of hydraulic station and high voltage switch room, capacitor compensation room;

The fifth layer platform is the feeding platform, with the elevation of + 25.1m. The material bin is arranged on the platform, and the lower part has an electrode hanging system;

Under the roof of the workshop, there are two 5t electric single beam hanging crane, with the rail bottom elevation of 37.6m, used for lifting electrode shell, electrode paste;

2.6.2 Cast casting span

The casting span is 153m long and the span is 24m. The bags and cans containing molten iron and slag are pulled on the car and transported to the casting workshop. The molten iron bag is poured into the ingot mold by the crane hanging bag after the slag removal is finished. The casting is done by ingot casting. The iron ingot is broken and packaged after cooling.

The casting span is provided with two 50 / 10t cast bridge cranes with a rail surface elevation of 16.8m and 22.5m span.

2.6.3 Finfinished and finished product

The span is 153m and the span is 24m. .

The finished span and the finished span have two 16/3.2t hook bridge cranes, with rail surface elevation of 14.0m and span of 22.5m.

2.7 Main technical and economic indicators of the workshop

Main technical and economic indicators of the electric furnace workshop

order number	project	unit	metric	remarks
1	Capacity of transformer for	kVA	3×11000	An electric furnace



order number	project	unit	metric	remarks
	furnace			
2	Number of electric stoves	short for Taizhou	2	
3	Production of ferrochrome products	ten thousand t/a	12.5	
4	Number of days of electric furnace operation	d	330	
5	Main raw material consumption			
(1)	Chromium block mine	t/t chromium iron	2.0	
(2)	Coke and orchid charcoal	t/t chromium iron	0.50	
(3)	White dolomite and silica	t/t chromium iron	0.174	
(4)	carbon paste	kg/t chromium iron	25	
(5)	The electrode shell	kg/t chromium iron	2.5	



order number	project	unit	metric	remarks
(6)	refractory	kg/t chromium iron	17.5	
(7)	Power consumption per unit product	kWh/t	3050	



3 Raw material system and warehouse facilities

3.1 Design Basis and Principles

3.1.1 Design Basis

- Code for Design of Belt Conveyor Engineering
- Code for Process Design of Raw Material Field of Iron and Steel Enterprises
- Raw Material Preparation Design Manual for Iron and Steel Enterprises
- Design Manual of DTII (A) Belt Conveyor
- Selection Manual of Lifting and Transportation Equipment
- Rotary Dryer for Cement Industry
- Industry Standard for Rowing Dryer Machinery
- Code for Design of Iron Mine Pellet Engineering

3.1.2 Design principles

Optimize the process layout of conveying line to make the production process reasonable and smooth; and adopt mature, reliable, practical and advanced process and technical equipment to ensure the yield and quality of raw materials.

The general drawing layout strives to achieve compact process, smooth logistics, reasonable layout, beautiful environment and economical land use.

The level of automation control should be combined with the actual situation of China, using economic and practical, reliable, easy to operate technical equipment.

Drawing on the construction experience of similar projects in China, under the premise of ensuring advanced, reliable, mature and economic, the process equipment is based on the domestic design and manufacturing.

We will adhere to the strategy of sustainable development and earnestly implement relevant state standards and regulations on energy conservation, environmental protection, safety, sanitation, fire control



and earthquake resistance. Arrange advanced and effective environmental protection equipment, improve the comprehensive utilization level of "three wastes", promote energy saving, water saving and comprehensive utilization of resources, and do a good job in environmental protection and pollution control.

3.2 Main process facilities

The project plans to build two 33000 kVA semi-closed furnace furnaces and two 33000 kVA furnaces for the production of high carbon ferrochrome, and one furnace workshop. This design is mainly to block ore furnace process, reserved pellet facilities. The raw material system is composed of raw material shed, batching system, each system corridor, transfer station, as well as finished product crushing and storage facilities, etc. The main system system components are as follows:

1 The raw material field

Including chromium ore, coke, flux, fuel and other raw materials storage and corresponding treatment facilities.

(2. Drying facilities (reserved)

The drying system is composed of receiving bin, dryer, dust removal system, each transfer station, corridor and so on.

3. The batching system

The batching system is composed of the material bin of the batching system, each transfer station, the corridor, etc.

4) grinding system (reserved)

Including input tape machine, output tape machine, grinder and auxiliary equipment.

5. Ball-making system (reserved)

Including chrome ore grinding, ball, screening, each transfer station, corridor and other components.

(6. Roasting system (reserved)



The roasting system is mainly composed of vertical furnace and supporting auxiliary equipment.

3.2.1 Factory system

Work system: working 330 days a year, continuous working system, 3 shifts a day, 8 hours per shift.

3.2.2 Raw fuel consumption and requirements

The raw materials required for the high carbon ferrochrome project are mainly ferrochrome block ore, dolomite and silica and reducing agent. Ore must be graded before entering the furnace.

Raw material consumption is shown in Table 3-1 below (consumption of two electric furnaces)

Raw material name	unit consumption t/t	Daily dosage t / d	annual consumption t/a	fineness /mm
Chromium block mine	2.000	760	250656	10-70
Coke and orchid charcoal	0.50	193	63416	5-25
White dolomite and silica	0.174	66	21807	20-80

3.2.1.1

The raw materials of chromium block for ore heating furnace shall be transported into the factory by automobile according to the qualified particle size. Furnace entry requirements are as shown in Table Table 3-3.

Chemical composition of chromium block ore% Table 3-3

Cr ₂ O ₃	Fe	Cr/Fe	SiO ₂	Al ₂ O ₃	MgO	P	S	Shuifen	fineness (mm)
42	19.1	1.5	8	12	13	0.006	0.007	3%	10~70

3.2.3 Brief Description of the process flow



The raw material system accepts all off-plant raw materials for storage shed storage and scattered raw materials. All the scattered raw materials, combustion materials and auxiliary materials are directly stored in the raw material field by road transportation, and the stacking method is made by the loader.

Most of the original, combustion and auxiliary materials of the whole factory with dump trucks and loaders are stored in the storage yard. According to raw material characteristics, storage time and production requirements, chromium ore should be stored for 6 months, coke and blue charcoal for 3 months, dolomite and silica for 45 days, finished products for 2 months, and slag for 1 year.

To prevent mixing and auxiliary operation equipment, with enough spacing between strip or the storage shed, the rain smoothly discharge, material or storage shed the floor is higher than the floor, and have certain drainage slope, longitudinal length drainage, drainage end with sedimentation tank, the yard catchment area is larger, the rainy season discharge sewage, discharge after precipitation. The storage yard is surrounded by a highway, and each material strip or storage shed is equipped with a channel to ensure the smooth flow of all kinds of vehicles.

The feeding system to the smelting workshop

The batch batching scale system of "vibration feeder + weighing bucket + vibration feeder" is set under the bin, coke, silica and chromium ore stored by the bar valve, motor vibration feeder, weighing bucket, motor vibration feeder are unloaded on the tape machine, according to the ratio of the materials are transferred to the fixed reversible tape machine by the tape machine, and then unloaded into the furnace top bin.

The connection of each production link of the logistics conveying system adopts the conveyor composed of belt conveyor. After determining the loading point and unloading point according to the needs of the user, the belt conveyor is arranged as straight as possible, and the maximum amount of raw materials are arranged to take the shortest route, and the overpass mode is used as far as possible, without detour or detour. Reduce transit frequency and transfer height to reduce raw material damage



and environmental pollution, reduce transfer power and operating cost, and reduce infrastructure investment; use centralized transport and reduce dispersed transport to improve the comprehensive operation rate.

Finish iron chromium block cooled by artificial after pouring coarse, the iron chromium block after coarse grain is not more than 300mm, coarse iron after the loader into the underground bin, by the jaw crusher for fine broken, broken finished grain of about 0–100mm, again after the # tape machine, finished buffer warehouse by car directly outbound or bags into the finished product storage.

The conveyor corridor and the transfer station are semi-closed, the belt corridor is not heating and insulation, not insulation, the duty room of the transfer station takes heating and insulation measures according to the need.

3.2.4 Composition of the main facilities

The raw material yard of high carbon ferrochrome ore furnace in this project is mainly composed of batching system, finished product crushing system and warehouse facilities. Reserve pellet facilities, the process facilities of pellet system include powder shed, bentonite warehouse, powder batching chamber, grinding chamber, ball making chamber, ball screening chamber, vertical furnace, etc.; cold batching system process facilities include block shed, dry material shed, bulk screening chamber, block ore batching chamber, etc.; finished product crushing system is mainly composed of underground bin, crusher and finished product buffer warehouse; warehouse facilities are mainly composed of comprehensive warehouse and finished product warehouse.

3.2.4.1 Supply and batching system

(1) block material shed and dry material shed

Block material shed and dry material shed are used together to store the wet material and dry material for chromium block ore, coke and silica. According to the proportional requirements of material consumption, they meet the use requirements of chromium block mine, coke and silica for 180d, 90d and 45d respectively.



(2) Ingredients room

Block chamber bin feeding through tape machine and mobile unloading truck combination, mainly used for chromium ore, coke and silica ingredients, ingredients under the warehouse using heavy ingredients, ingredients equipment for motor vibration feeder, weighing bucket, motor vibration feeder combination, ingredients process fully enclosed, ingredients motor vibration feeder using frequency conversion speed regulation and automatic control. Environmental dust removal is considered during the unloading and batching process of the warehouse to meet the emission standard requirements.

3.2.4.2 Finished product crushing system

(1) Broken chamber

The iron size of the molten iron after pouring is large, which requires manual or mechanical equipment. The particle size of the material is not greater than 350mm, which is pushed into the underground bin by the loader and into the crusher. The crushing system adopts open circuit primary crushing, and the crusher adopts jaw crusher.

3.2.4.4 Warehouse facilities

Warehouse facilities are a part of the factory, which serves the factory production, storage, storage, acceptance, distribution of raw materials, auxiliary materials and auxiliary parts. The comprehensive warehouse of the project includes refractory materials, spare parts, electrode paste warehouse, finished product warehouse, lime yard, charcoal yard and limestone yard, etc.

Comprehensive warehouse (refractory materials, spare parts, electrode paste warehouse joint construction) consider to store refractory materials, spare parts, electrode paste, etc. There are cars in and out, and forklift is set in the warehouse. An electric single beam bridge crane with lifting weight of $Q=5t$, span 13.5m and rail surface height of 7m is set up to complete the access task. Stpiling height is 3m and storage time is 90 days.



The finished product warehouse is used to store ferrochrome blocks, with cars in and out. The forklift is set in the warehouse for auxiliary operation, and two electric single-beam bridge cranes with lifting weight of Q=5t, span 16.5m and 7m are used to complete the access task. Stiling height is 3m and storage time is 60 days.

3.3 Main process characteristics

- (1) The process process is simple and smooth, and some materials flow in.
- (2) The raw material warehouse is suitable for raw material transportation, procurement and climate characteristics.
- (3) Ingredients use automatic weight ingredients, advanced technology, reliable technology and high accuracy.
- (4) Adopt mature furnace type, high production efficiency, good quality and stable finished products; no agglomeration, convenient operation and control, no high-grade refractory materials and special steel.
- (5) The whole process layout is compact, reasonable, and less occupied.



4 Public and auxiliary facilities

4.1 Water supply and drainage facilities

4.1 summary

Kinetic Development Group Limited South Africa 2×33000 kVA high carbon ferrochrome project new 2×33000 kVA semi-closed mine furnace.

The design scope of water supply and drainage includes: 2×33000 kVA high carbon chromium electric furnaces, living and welfare facilities in the plant and the design of water supply and drainage pipe network in the plant.

The project uses the same water source for producing new water, fire fighting and domestic water, and the supply amount of producing new water is 17m³/h, the domestic water supply is 5m³/h, water supply pressure not lower than 0.15MPa.

The water source comes from the well water near the plant, and the source water is diverted to the newly built production and fire storage pool (the fire pool is shared with the new production and water storage pool), and then pressurized by the production water supply pump through the newly built production and fire water supply pipe for users. In case of fire, the starting fire pump group can supply fire water through the new production and fire water supply pipes, and the domestic water is directly supplied by the deep well pump in the well.

The drainage in the plant adopts the diversion system.

The production drainage in the plant is reused, and the production wastewater is zero discharge.

Domestic drainage is treated by septic tank and discharged into local municipal drainage network or reused.

The rainwater in the plant is collected by the pipeline, and the initial rainwater is collected and discharged to the initial stage of the



plant for rainwater collection and precipitation treatment, and discharged into the river near the plant in the middle and late period.

The water supply and drainage pipe network of the new plant is connected to 1 meter outside the plant.

According to the water technical requirements provided by relevant process specialty, the total water consumption is $1456\text{m}^3/\text{h}$, where the soft ring water is $1439\text{m}^3/\text{h}$, the production of new water supplement $17\text{m}^3/\text{h}$, $4\text{m}^3/\text{h}$. Production water reuse rate was 98.8%.

The domestic water volume is $5\text{m}^3/\text{h}$, living displacement of $4\text{m}^3/\text{h}$.

The fire water is 20 L/s, and the outdoor fire water is 20 L/s.

4.1.2 Basic data

(To be supplemented)

4.1.3 Design principles

- (1) Ensure the water use requirements of each user in the factory;
- (2) Implement the mode of water resources recycling economy, adopt comprehensive water-saving measures, and use water resources efficiently, and minimize water consumption to the maximum extent;
- (3) design an economical and reasonable, advanced and reliable water supply and drainage system, and strengthen the comprehensive management of the circulating water system;
- (4) adopt safe water supply measures to ensure the safe production of equipment;
- (5) The recycling of by-products is in line with the national circular economy policy;

4.1.4 Quality quality of new water

The water supply for producing new water and fire fighting adopts the same water source, and the designed water quantity is $17\text{m}^3/\text{h}$, the water quality is shown in the following table, and the water supply pressure is not less than 0.15MPa.

Production of new water, fire-fighting water quality table



Water quality project	unit	source water
pH		7.41
total hardness	Mg/L (In CaCO ₃ count)	642
total alkalinity	Mg/L (In CaCO ₃ count)	705
conductivity	μ s/cm	1333
K ⁺	mg/L	0.06
Na ⁺	mg/L	2.52
Ca ²⁺	mg/L	1.94
Mg ²⁺	mg/L	154.8
Cu	mg/L	<LOD
Zn	mg/L	<LOD
Ni	mg/L	<LOD
Fe	mg/L	0.03
Cl ⁻	mg/L	5.96
SO ₄ ²⁺	mg/L	<LOD
TN	mg/L	4.24
PO ₃ ³⁻	mg/L	0.87
NO ₃ ⁻	mg/L	6.39

The water quality of domestic water supply should meet the index requirements of domestic water quality in South Africa, and the water supply pressure should not be less than 0.15MPa.

4.1.5 Production water use and water quality requirements

Water quality requirements parameter list

order number	Water quality project	unit	Net ring water	Soft ring water
1	pH		7-9	7-9



2	conductivity	μs/cm	600-1000	600-1000
3	suspended	mg/l	20	≤3
4	total	°dH	<14	8
5	CL ⁻	mg/l	100	<50
6	SO ₄ ²⁻	mg/l	200	150
7	oil	mg/l	≤5	0

4.1.6, water supply and drainage system

According to the process and technical requirements, the water supply and drainage system are:

- Soft-water closed-circuit circulating water system
- Net ring water system
- Production, fire fighting and living water supply system
- Soft water supply system
- drainage system

4.1.6.1 Soft-water closed-circuit circulating water system

The system supplies the furnace cooling water, the total water amount is 1439m³/h, the water supply pressure at the water distributor should be 0.35MPa, the water supply temperature is 35°C, and the return water temperature is 43°C. The return water enters the evaporative air cooler for cooling, and then circulates after pressurization by the circulating pump. In the whole operation process, the system is semi-closed circulation, and the water quality is not polluted by the outside world.

To ensure the stable water quality of the system, a dosing device is provided.

In order to stabilize the system pressure and control the water and the discharge system, there is a pressure regulator tank.

In order to ensure the flow of the system, the water supply system is set up in the pump station. The soft water supplied by the soft water preparation device is pressurized into the regulating tank by the pump



and supplied to the soft water system according to the liquid level change in the regulating tank. The specific location is in the pump suction pipe. The average systematic water supplement was $4\text{m}^3/\text{h}$.

4.1.6.2 Production, living and fire-fighting water supply system

The new water quantity required for floor sprinkling, clean ring water replenishment and soft water preparation is $17\text{m}^3/\text{h}$, pressurized by the new production pump set through the pipeline.

Referring to China Code for Fire Prevention Design of Buildings (GB50016-2014) (2018 edition), Technical Specification for Fire Water Supply and Fire Hydrant System (GB 50974-2014), Fire Prevention Standard for Design of Iron and Steel Metallurgical Enterprises (GB50414-2018) and relevant fire regulations in South Africa, the factory outdoor fire is calculated at the same time, the outdoor water consumption is $20\text{L}/\text{s}$, without indoor fire hydrant, the fire duration is 2 hours, and the total water demand is 144m^3 . By the factory production, fire water supply pipe network supply.

The living water consumption in the plant area is $5\text{m}^3/\text{h}$, Domestic water is directly supplied by the deep well pump in the well. Drinking water is supplied after treatment of direct drinking water equipment.

4.1.6.3 Soft water supply system

The softened water is prepared by the automatic water softening device in the new circulating pump station, with an output capacity of $50\text{m}^3/\text{h}$, store in the soft pool and supply the soft loop closed circuit system and clean ring water through the pump group. H-Na parallel process is adopted in the soft water preparation process.

4.1.6.4 Drainage system

(1) Domestic sewage drainage system

According to the local environmental requirements in South Africa, the domestic sewage is only treated with septic tank, no relevant



discharge standards. The living displacement was 4m³/h, after septic tank treatment to the local municipal sewage pipe network or reuse.

(2) Rainwater drainage system

The rainwater is collected through the pipeline and then discharged into the rainwater drainage pipe network of the plant. The initial rainwater collection pool is set up at the low part of the plant, and the accident pool of the whole plant is also used. The initial rainwater collection is designed according to the initial rainfall of 15mm, and the effective volume is: 2000m³.

Since there is no rainstorm intensity formula in South Africa, this project intends to design rainwater drainage according to the rainstorm intensity formula in Guangzhou. The rain intensity formula in Guangzhou:

I-Design Rainstorm intensity (mm / min)

T-rainfall duration (min)

The design rainfall return period of the project shall be 2 years.

Rainwater flow formula: $Q = F \cdot q \cdot \psi$ (L/s)

Where: F- catchment area (ha);

ψ - Average runoff coefficient;

(3) Production wastewater drainage system

The waste water from the production and the preparation of soft water in the plant is collected from the pipe network to the production wastewater pool, and after pump lifting, all used for dry slag spraying of electric furnace, and the water consumption of serial cascade is 5m³/h. Production waste water is discharged at a zero point.

4.1.7 Water quality stabilization measures

In order to ensure the long-term stable operation of the circulating water system, the pump station is equipped with a dosing device, and the quantity and type of agent are added into the circulating water system. After the operation of the system, the owner shall entrust the relevant units to conduct water quality test.



4.1.8 Safe water supply measures

1. Each pump group is equipped with a standby pump, and the working pump and the standby pump are automatically switched. When the working pump fails, the standby pump will be automatically put into operation.

Electric furnace and vertical furnace water system are equipped with accident diesel engine pump to ensure water supply in the case of accident.

(3) Electric furnace adopts single pump to single furnace.

4.1.9 Water-saving and energy-saving measures

- Improve the production process and equipment, adopt the process of no or less water consumption, to achieve the purpose of water saving, energy saving and pollution prevention;

- Reasonable allocation of water system, using cascade water mode to reduce the amount of sewage discharge;

- Set up pipe network reasonably and set up water metering control equipment in pipe network, strengthen leakage detection and management, and reduce water loss;

- Add water stabilizer to the circulating water to stabilize the circulating water quality, improve the concentration ratio and reduce the supplementary water.

- All the water supply and drainage equipment adopts water-saving equipment.

a) Operation control and management of water supply and drainage facilities

The water treatment facilities are equipped with centralized operation and a nearby operating system, and the centralized operation is located in the operation room. The operation, display, record and alarm of the main production equipment are displayed on the computer in the operation room.

At ordinary times, the inspection personnel conduct maintenance and maintenance, and the inspection personnel are uniformly dispatched and



directed by the main control room, and are equipped with special maintenance tools, vehicles and communication equipment. The operation management adopts the computer centralized automatic (or centralized manual) operation in the water treatment main control room.

In addition, in order to facilitate maintenance and debugging, each equipment is equipped with organic operation box, using the principle of priority.

The working pump and standby pump of the main water treatment facilities are automatically switched, each pump outlet is set up with local pressure gauge, the main outlet pipe is equipped with pressure, flow and temperature measurement instruments, and the measurement data are displayed on the display screen in the operation room.

The suction well and water pool of each water treatment structure are equipped with liquid level detection instrument, and the water level of each collecting pit is interlocking with the drainage pump.

b) Comprehensive circulating water pump

There is a circulating water pump station, the pump station is ground type, composed of water pump room, suction well, soft water preparation room, transformer room, power distribution room, operation room, etc.

4.1.10 Initial rainwater collection pool

Set up an initial rainwater collection pool.

1 set of rainwater lifting pump, 2 pumps, 1 working, 1 standby;

4.1.11 Waste water collection tank

1 waste water collection pool.

1 set of wastewater lifting pump, 2 pumps, 1 working, 1 standby;

4.1.12 Laying and pipe materials

1. Pipeline laying

Indoor water supply and drainage pipes shall be laid in overhead and pipe trenches, and outdoor pipes shall be directly buried.



2 The pipe

- Production of new water, living and fire water supply pipes

Indoor and outdoor welded steel pipe, polyethylene (PE) water supply pipe (DN25~DN50);

- Soft water supply pipe

Indoor and outdoor seamless welded steel pipe.

- Circulating water pipeline

All spiral seam welded steel pipe (DN200~DN1000) and straight seam welded steel pipe (DN25~DN150) are used indoors and outdoors.

- Addressing pipeline

PE plastic pipes are used both indoors and outdoors.

- drain line

Indoor drainage plastic pipe, straight seam welded steel pipe; outdoor high density polyethylene double wall winding drainage pipe.

4.1.13 Main technical and economic indicators

Total water consumption for production: 1,456 m³/h

Among Circulating water quantity: 1,439 m³/h

Production water supplement amount: 17m³/ h (including new amount of water for preparation of soft water)

Strading water consumption 4m³/h

Production water reuse rate: 98.8%

Domestic water consumption: 5m³/h

Living displacement: 4m³/h



4.2 Ventilation and dust removal facilities

4.2.1 Design Basis

Code for Design of Heating, Ventilation and Air Regulation for Civil Buildings GB50736-2012;

Emission Standard for Pollutants in Ferroalloy Industry GB28666-2012;

Emission Standard of Air Pollutants of Iron and Steel sintering and Pellet Industry GB28662-2012;

Code for Acceptance of Ventilation and Air Conditioning Engineering GB50243-2002;

Design and Health Standards for Industrial Enterprises GBZ 1-2010;

Environmental Noise Emission Standard for Industrial Enterprises GB12348-2008;

Code for Fire Protection in Design of Iron and Steel Metallurgy Enterprises GB50414-2007;

National Environmental Management: Article 39 of the Air Quality Act of 2004

Other existing relevant regulations, norms and standards promulgated by the state.

4.2.2 Design scope

The flue gas and dust generated in the newly built plant shall be treated; two electric furnaces shall be arranged in the electric furnace workshop, including one set of electric furnace; one set of dust removal system (for each electric furnace and total of two sets); dust removal facilities shall be provided for the feeding and ingredients system of the ground raw material field; and heating, ventilation and air conditioning design of public and auxiliary facilities of the whole plant.

4.2.3 Furnace gas purification system

Two electric furnaces, each one is equipped with a set of electric furnace flue gas purification system. Follow a set of purification system



instructions below.

4.2.3.1 Design parameters

(1) Furnace gas parameters:

Furnace gas capacity: 200000 Nm³/h

Furnace gas temperature: 450–600℃;

Dust content of furnace gas: 100–150g / Nm³

(2) smoke compositions:

ingredient	H ₂ O	CO ₂	O ₂	N ₂
%	1.0	3.0	19.0	77.0

(3) Composition of soot:

ingredient	SiO ₂	FeO	Al ₂ O ₃	CaO	S	C	Mn
%	15-30	~5	1-5	5-10		~10	~30

(4) Dust particle size (μ m):

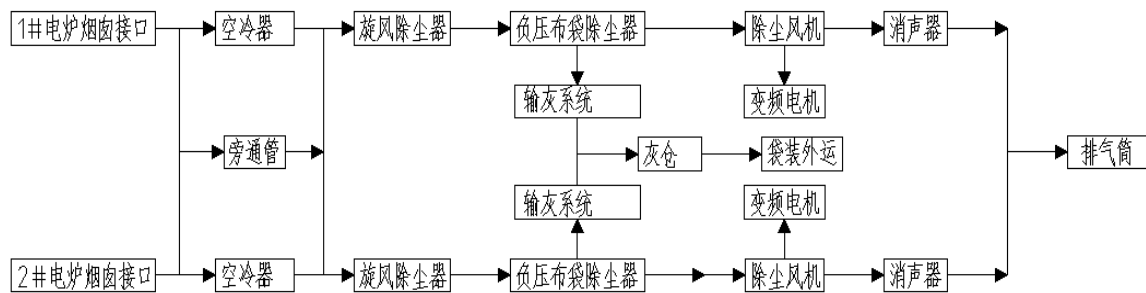
fineness	<1	1-10	10-40
%	50-70	20-30	0-10

4.2.3.2 Flow of the flue gas purification system

Each electric furnace flue gas is set up with a flue gas purification system, and the dust-containing flue gas is discharged to the standard after negative pressure large bag filter.

4.2.3.3 Brief system description

At the interface of the electric furnace, the exhaust cylinder has three flanges on the main workshop. The two flue gas pipes are horizontally connected out and connected with the aggregate smoke pipe. In order to ensure the pressure of-100Pa in the smoke hood and the most economical system air volume, the fan motor is equipped with frequency converter to adjust the system air volume and fan speed. The dust-containing flue gas is reduced to 230℃ by the air cooler, filtered by the front cyclone and the negative pressure large bag filter. The flue gas is discharged up to the standard. Every two sets of dust removal systems share one exhaust cylinder.



4.2.4 Smoke exhaust system and dust removal system of furnace top

A set of dust removal system is set at the roof of each electric furnace, a total of two sets.

4.2.4.1 Design parameters

1) Flue gas parameters:

Flue gas temperature: $<100^{\circ}\text{C}$

Flue gas volume: $100000\text{ m}^3/\text{h}$

Dust content of flue gas: $100\text{mg} / \text{m}^3$

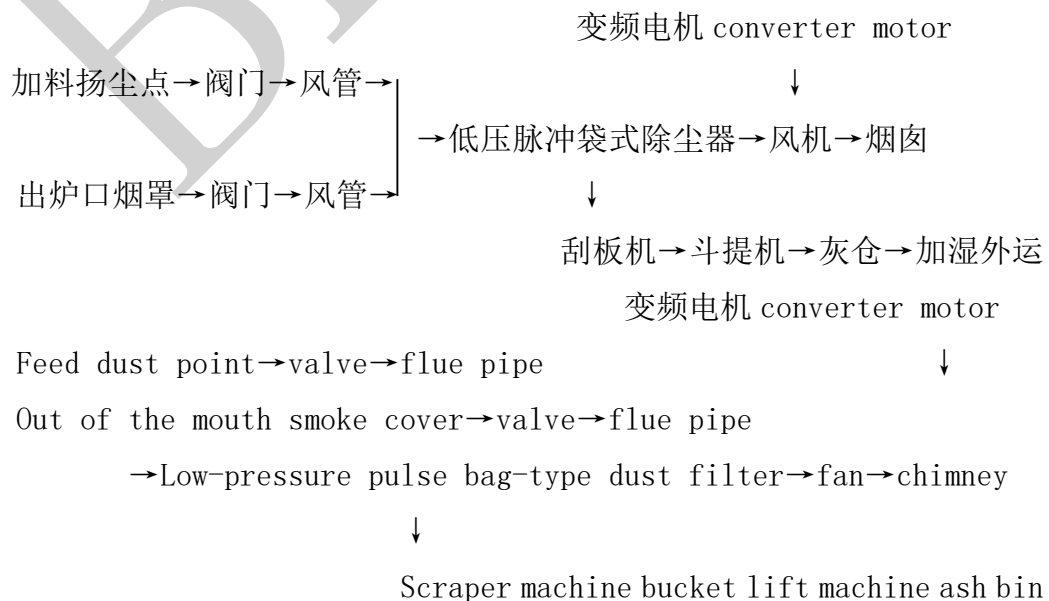
2) Top feeding setting parameters:

Air volume: $20,000\text{ m}^3/\text{h}$

Temperature: Normal temperature

Dust content of flue gas: $5\text{g} / \text{m}^3$

4.2.4 System process. 2





wet external transport

4.2.4 Brief system description.3

During the operation of the system, the flue gas from the oven and the dust-containing gas from the furnace top are collected through their respective hoods, led by the air duct to the pulse bag dust filter for filtration, and then discharged by the induced draft fan. After filtration, the dust and smoke concentration is less than 30mg / Nm³ Meet national emission standards. The ash on the cloth bag is sprayed into the ash bucket after low pressure pulse gas. It is collected by the horizontal scraper and bucket elevator and sent into the ash storage bin. The dust dust is transported after humidification. In order to prevent the flue gas temperature fluctuation from burning out the bag, the mixed air valve is set on the inlet pipe of the bag dust collector. The mixed air valve is linked with the temperature measurement point on the inlet pipe of the bag dust collector. When the temperature is 250℃, the mixed air valve is automatically opened, and when the temperature is <230℃, it is automatically closed.

.54.2 Raw material feeding and dust removal at each scatter point

.5.1 4.2 Division of the dust removal system

According to the operation schedule of each dust point, the distance of each dust point, and the operation energy consumption, all dust removal points are divided into two sets of dust removal systems:

Dust removal system (1 set in total)

Dry material stack dust removal system (1 set in total)

The above dust removal system adopts pulsed bag dust collector; the dust-containing gas generated by the dust source point enters the dust collector through the pipe through the fan, and the filtered gas is discharged into the chimney by the fan. The ash on the cloth bag falls into the ash bucket after spraying by low pressure pulse gas. It is collected by the horizontal scraper and bucket elevator and sent to the ash storage warehouse and transported out by car.



Each dust source point in the dust removal system has manual air volume regulating valve and electric valve according to the production conditions. The electric valve is at the corresponding point, open when the valve is produced, and the valve is closed when the dust is not produced. The control of valve and corresponding production equipment (for example, electric feeder, conveyor belt, discharge valve, etc.) are set as interlocking control.

4.2.5.2 Raw material ingredients and dust removal system

The raw material batching conveying facility has a set of dust removal system to collect the dust generated in the process of transporting materials such as belt conveyor.

(1) System process:

any power-generating or power-driven machine



Each dust point dust cover valve duct low pressure pulse bag dust collector fan chimney



Scraper machine bucket lift machine ash bin wet external transport

(2) System brief description

In the process of the dust removal system operation, the dust-containing gas is collected by the vacuum hood and led through the air duct to the pulse bag dust collector for filtration, and then discharged into the discharge chimney by the induced draft fan. After filtering the dust-containing smoke gas, the dust concentration of the gas is less than 30mg/m³ meet national emission standards. The ash on the cloth bag is sprayed into the ash bucket after low pressure pulse gas. It is collected by the horizontal scraper and bucket elevator and sent into the ash storage bin. The dust dust is transported after humidification.

4.2.5.3 Dry material pile dust removal system

The dry material storage conveying facility has a set of dust removal



system to collect the dust generated during the transportation of materials by the belt conveyor.

(1) System process:

any power-generating or power-driven machine



Pulse bag valve of each dust collector fan chimney



Scraper machine bucket lift machine ash bin wet external transport

(2) System brief description

In the process of the dust removal system operation, the dust-containing gas is collected by the vacuum hood and led through the air duct to the pulse bag dust collector for filtration, and then discharged into the discharge chimney by the induced draft fan. After filtering the dust-containing smoke gas, the dust concentration of the gas is less than 30mg / m³ Meet national emission standards. The ash on the cloth bag is sprayed into the ash bucket after low pressure pulse gas. It is collected by the horizontal scraper and bucket elevator and sent into the ash storage bin. The dust dust is transported after humidification.

4.2.6 Ventilation and cooling facilities of electric furnace bottom

A fan is set at the bottom of each electric furnace for ventilation cooling, and the fan and the furnace bottom thermocouple are connected. When the temperature of the furnace bottom is higher than 180℃, the fan is started for ventilation cooling. When the furnace bottom temperature is lower than 80℃, the fan is closed. The fan air volume is 40,000 m³/h short for Taizhou.

4.2.7 Ventilation and air-conditioning facilities

4.2.7.1 Ventilation

In order to meet the requirements of production process, eliminate indoor waste heat and harmful gas, ensure the operating environment of operators, on the basis of making full use of natural ventilation, the relevant station room, electrical room, water pump room, etc.



4.2.7.2 Air-conditioning

In order to meet the requirements of human body comfort and the temperature requirements of equipment operation, air conditioning facilities are set up in the main control room and operation room to ensure the normal working environment and personnel working environment of indoor electrical equipment.

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4.3 Thermal facilities

The supporting thermal facilities of this project include the centralized air compressor station and the thermal pipe network in the engineering area.

4.3.1 Air pressure station of the whole plant

According to the process requirements and the gas consumption situation of the whole plant, a new air compressor station is built in this project.

The compressed air of the air pressure station is used by all users in all areas of the plant.

4.3.1.1 Consumption of compressed air

Statistics of compressed air consumption in each area of the plant are as follows:

Whole-factory compressed air user consumption scale

order number	project	dosage (Nm ³ /min)	pressure (MPa)	Use the system	remarks
one	ferroalloy				
1	Process gas	2	0.65	be disconnected	
2	Blow and use gas	1	0.65	be disconnected	
3	Maintenance gas	1	0.65	be disconnected	
4	Iron water bag repair bag	1	0.65	be disconnected	
	subtotal	5			
two	dust elimination				
1	Electric furnace flue gas purification system	43	0.6	be disconnected	
2	Iron mouth, casting, smoke exhaust and dust removal system	13	0.6	be disconnected	



3	Top-feeding and dust removal system	3	0.6	be disconnected	
4	Feed dust removal system	2	0.6	be disconnected	
	subtotal	61			
	amount to	66			
	Air correction factor is 1.208				
	Use a coefficient of 0.7 simultaneously				
	Gas consumption of the dryer is 1.07				
	Not user 1.05				
	Pipe network leakage: 1.05				
	Design consumption	66			



4.3.1.2 Scale of air compressor station

According to the compressed air consumption scale, the total amount of compressed air required is 66m³/min. Most of the users require oil-free and water-free compressed air. Meanwhile, considering that the external network compressed air pipeline if only one pipeline is easy to manage, save land space and reduce investment, the compressed air in the air compressor station of the whole plant is designed according to all oil-free and water-free. Select 333 m³/ min, 0.85Mpa Oil injection screw air compressor, 2 with 1 standby. At the same time, supporting 1 set of 70m³/ Min pre-filter, 170m³/ Min oil removal filter, 2 sets of 70m³/ Min Microheat regeneration drying, machine, 170m³/ Min rear placement filter.

4.3.1.3 Process flow of compressed air

After the air is boosted through the oil injection screw air compressor, the compressed air with a temperature of about 40°C enters the gas storage tank, 70m³/ Min pre-filter, 70m³/ Min oil removal filter, 70m³/ min micro-heat regeneration dryer, 70m³/ min rear filter is used for each user.

4.3.2 Compressed air external network of the whole plant

The compressed air of the air pressure station is used by the whole factory users. The compressed air quality is oil-free and water-free compressed air, the main pipe diameter: Φ 2196, gas supply pressure: 0.85MPa, connected by the air compressor station to each user, the pipeline adopts seamless steel pipe. Thermal compensation uses the direction of the pipeline as natural compensation as far as possible. For the thermal pipeline that cannot be compensated naturally, the square compensator is used for compensation. The pipeline laying method is overhead laying, and the pipeline is not insulated.

4.4 Power supply and distribution facilities

Kinetic Development Group Limited South Africa 2×33000 kVA, high carbon ferrochrome project, the project includes a workshop of two high carbon ferrochrome smelting furnace, raw material system, flue gas purification system, circulating water system and other public and auxiliary facilities. The project has a high carbon iron chrome design production capacity of 125,300 tons / year.

4.4.1 Electricity voltage level and load condition

The primary voltage of smelting furnace transformer is 35kV, the primary voltage of other power transformers and the end voltage of high voltage motor are 10 kV, and the voltage level of low voltage power load is 380 / 220V.

The power load capacity and voltage grade of the substation are shown in the following table:

load calculation table

order number	Name of the electrical equipment group	Equipment installation capacity (kW)	calculated load		
			Pjs(kW)	Qjs (kVar)	Sjs (kVA)
one	Mineral furnace (35kV)				
	33000 kVA thermal furnace (single)	33000	22440	24196	33000
	Two sets of total	66000	44880	48392	66000
	35kV for compensation		54120	37776	
two	10kV, electrical equipment				
1	Power change part				
	Main workshop substation	733	355	153	387
	Dust removal substation	1741	844	363	919
	Raw material feeding substation	515	250	107	272

	Integrated circulating water pump station and substation	410	199	86	216
	New pump station	65	31	14	34
	Air pressure station pump station	38	19	8	20
2	High voltage motor part	0	0	0	0
	Cooling water pump set of ore supply furnace body	630	290	125	315
	Dust removal fan motor	4595	2367	1018	2577
	Dust removal fan of the batching station	140	90	39	98
	Feed dust removal fan	56	38	16	41
	Air pressure station air compressor	453	250	107	272
3	1~2 Small plan	2344	1183	509	1288
	1. Two total	66000kW+ 2344kVA	55303		

According to the above load calculation table, the total calculated load of the electrical equipment in the project is 55,303 kW, and the annual power consumption is about 4.38×10^8 kWh, the compensated combined power factor is greater than 0.95.

Among the above loads, most of the loads are secondary loads, containing only a small amount of primary loads (mainly for the smelting furnace workshop crane, and part of the feed pump of the water system) and three types of loads.

The project plans to build a 132 / 35kV substation in the plant area. Since the local power grid can only provide primary power supply for the project, in order to meet the needs of safe production, the following security measures are taken: the diesel generator is provided in the smelting workshop to provide security power supply for the primary load in the

workshop; and the diesel generator pump in the circulating water pump station.

4.4.2 Power supply and distribution facilities in the plant

According to the load distribution and power supply, a new 35kV substation shall be built in the plant to supply power to six single-phase transformers of two 33 MVA smelting furnaces at 35kV, and two 12 MVA and 35 / 10kV step-down transformers shall be installed in the substation to supply power to the power load of each system at 10kV voltage level.

4.4.2.1 Electrical primary system

(1) 35kV substation

- **The choice of the main change**

According to the power load capacity and load voltage grade (see Table 7-1), two 35 / 10kV capacity of 12 MVA on-load voltage regulating transformers are used for the smelting workshop, raw material system, furnace gas purification system, circulating water system and other facilities. The two transformers are mutually on standby.

- **Determination of the main electrical wiring**

The 35kV system adopts the wiring mode of single bus section, and mainly feeds to 2 smelting furnaces, 212MVA 35KV / 10kV distribution transformers and 2 sets of capacitor compensation devices; including PT cabinet and used cabinets, see the main electrical wiring diagram for details

The 10kV system in 35kV substation adopts the form of single bus segment wiring, and the power supply is respectively drawn from the 10kV side of two transformers in 35kV substation, both of which are connected by bus row. In normal operation, each transformer has half of the working load. When one transformer is repaired or faulty, it can provide power for all working loads by another transformer. There is no capacitor compensation for the 10kV system in the substation.

- **Reactive power compensation device**

Due to the low power factor of the electric furnace load, the power factor is about 0.80 after the low-voltage side compensation is adopted in the smelting workshop. In order to improve the power factor of 35kV bus, the centralized reactive power

compensation of 35kV bus section of 35kV substation is adopted. The power factor is above 0.95 after compensation.

(2) The 35kV power distribution room in the smelting workshop

The furnace transformers used for each smelting furnace in the workshop are three single-phase transformers, and the primary voltage of the transformer is 35kV. According to the requirements of the smelting process, the primary side wiring form of the transformer can be star or angular, and the star and angular wiring can be realized by the circuit breaker installed in the 35kV switch cabinet in the smelting workshop. Each electric furnace is equipped with a 35kV bus section, including one incoming cabinet, one outlet cabinet, one PT cabinet, one star cabinet and one corner cabinet.

4.4.2.2 Secondary system

(1) Relay protection

In order to combine with the microcomputer monitoring system, both the 35kV system and the 10kV system adopt the unit microcomputer integrated protection device. The microcomputer protection device has the advantages of high flexibility, high reliability and simple wiring. Each protection measurement and control device is installed on the local switch cabinet panel, and can communicate with the monitoring system. The specific protection settings are provided as follows:

For the 35kV system protection:

- **35kV incoming line protection:**

The 35kV incoming line protection is the backup protection of the 132kV / 35kV main transformer.

The incoming line of 35kV switching station in smelting workshop is limited for switching rate protection and overcurrent protection

- **35kV bus bar protection:**

Charging protection, over-current protection.

- **35 / 10kV transformer protection:**

The transformer is equipped with main and backup protection, heavy gas protection and zero sequence current protection; the backup protection is composite voltage locking overcurrent protection; in addition, light gas,

temperature limit and overload protection action in the signal.

- Electric furnace transformer protection:

The main protection is electric current break, composite voltage locking overcurrent, heavy gas protection (transformer body, voltage regulating switch), pressure release and cooler full stop protection; the backup protection is light gas (transformer body, voltage regulating switch), and the oil surface temperature limit, and the backup protection is on the signal.

- 35kV capacitor compensation protection:

Current rate break, overcurrent, overvoltage, low voltage, voltage imbalance, single-phase ground protection.

10kV System protection:

- The 10kV incoming line protection in the 35kV substation is the backup protection of the 35kV / 10kV main transformer.
- 10kV subsection protection: bus charging protection.
- Power transformer protection: electric current rate break, overcurrent, heavy gas, light gas, single-phase ground.
- High voltage motor: electric current rate break, overcurrent, low voltage, single-phase ground protection.

(2) Control and signaling system

The control system of the substation adopts the distributed microcomputer monitoring / protection two-in-one device, and the circuit breaker control mode adopts the local and centralized control mode. Under normal working conditions, all switching equipment is monitored and controlled through the microcomputer monitoring system in the main control room. The main functions of the control system are as follows:

- Display the electrical main wiring, switch running status, relevant measurement data, daily load curve and other pictures through the monitor.
- Alarm of accident signal and warning signal and picture display and printing.
- Print reports at any time or regularly.
- Communicate with the microcomputer protection and management

machine.

- Local control of the circuit breaker is achieved by a transfer switch or push button set on the 10kV, switchgear and 35kV switchgear.
- When the microcomputer monitoring system works with abnormal equipment, it can automatically conduct sound or voice alarm, and introduce the flash alarm screen on the monitor to store and print the type and position of the fault.

(3) Measurement and measurement

All electrical measuring meters are set up in accordance with the relevant national standards, and each measurement amount is displayed by the local instrument and the microcomputer monitoring system monitors respectively. The monitoring system can print out the current, active power, reactive power, power factor, bus voltage and active and reactive power quantity of each line regularly and at any time.

Each measurement and measurement are set as follows:

- 35kV incoming line: three-phase current, with / reactive power, power factor, with / reactive power degree;
- 35kV side of electric furnace transformer: three-phase current, with / reactive power, power factor, with / reactive power degree
- 35kV side of the main transformer: three-phase current, active / reactive power, power factor
- Main transformer 10kV side: three-phase current, active / reactive power.
- 10kV outgoing line: three-phase current, active / reactive power.
- 10kV bus: each section of the bus has phase voltage and line voltmeter and insulation monitoring.

Among them, the measurement amount of the three-phase current on the 35kV side of the two electric furnace transformers shall be transferred and input to the PLC system in the smelting workshop and displayed on the display device. The meters of the 35kV system and 10kV system are installed on the switch cabinet panel.

(4) The AC power consumption system

In 35kV, a 200 kVA and 35/0.4kV dry transformer of 35kV bus is set as the low-voltage power supply in the station, and the low-voltage distribution system adopts single bus section wiring. The transformer and the low-voltage distribution panel are arranged in the distribution room. The AC power supply system of the 35kV substation is shared with the 132kV substation.

(5) The DC system

The 35kV substation has a set of DC power supply device with a capacity of 200Ah. The DC system adopts single bus segment wiring, and the contact switch should be set between the two groups of buses. The output voltage of the DC screen is 110V, which is used for circuit breaker control, signal, protection, automatic device and other equipment of 35kV, substation and 132kV substation. The accident lighting of the substation adopts battery lamps, without additional lighting DC system. The 35kV substation and the 132kV substation share this DC system.

The switch control, signal and protection in the 35kV distribution room of the smelting workshop are powered by a set of DC power supply devices with a capacity of 65Ah. The AC power supply of the DC screen is derived from the low-voltage AC system in the smelting workshop substation.

The DC system adopts high-frequency switching power supply, with N-1 configuration

4.4.2.3 Selection of main electrical primary equipment

The 35kV substation is equipped with 35kV distribution room, main transformer room, 10kV distribution room, relay room and auxiliary room. See the attached figure for layout.

35kV high voltage switch cabinet adopts KYN 61-40.5 metal closed shift switchgear, equipped with vacuum circuit breaker, spring operating mechanism and operating power supply of DC110V. 10KV power distribution device adopts KYN28A-12 medium-operated vehicle armored metal closed switch cabinet, equipped with vacuum circuit breaker and spring operating mechanism. The open current of 35kV circuit breaker is 25 kA, and the open current of 10kV circuit breaker is 25 kA.

8MVA 35 / 10KV main transformer adopts SF11 series on-load forced oil circulation air-cooled power transformer, using YN / d11 wiring group.

The parallel compensation capacitor adopts the full film capacitor, and the reactor uses the aluminum conductor reactor insulated by epoxy resin.

Both the 35kV and 10kV switchgear are selected as well-known domestic brands.

4.4.3 Grounding

Both 35kV and 10kV systems are indirect grounding systems, and 380 / 220V low-voltage distribution system adopts neutral point direct grounding system.

All non-live metal parts of electrical equipment shall be reliably grounded, with grounding resistance not greater than 4 ohm and switchyard computer system grounding resistance not greater than 1 ohm.

4.4.4 Lightning protection

Buildings and structures above 15m shall be provided with lightning protection. For columns and beams that are steel structures or buildings covered by metal plates, steel structure and metal plates are used as flash connector, and the steel structure and metal plates should be reliably grounded. Its impact grounding resistance shall not be greater than 30 ohms.

4.4.5 Fire prevention and fire protection

Smoke alarm and detection components are installed in all electrical rooms and transformer rooms of this project. Cable laying should be avoided as far as possible through high temperature, explosion, flammable and other areas, otherwise the corresponding fire prevention measures should be taken

Set up the alarm device in the main control room.

All cable inlet and exit holes are blocked with fireproof material.

Fire separator between cable bridges.

Halogen trolley fire extinguisher in main transformer and distribution room, and foam fire extinguisher in other rooms.

Set up automatic fire alarm device and fire extinguishing device in the high and low voltage distribution room, electrical room, operation room,



cable trench, cable bridge, etc.

4.4.6 Power pipe network

The incoming line of 35kV switch station in smelting workshop shall be considered according to cable incoming mode. The 10kV cable lines from 35kV substation to all facilities shall be laid by overhead cable bridge, and a small amount of local cables shall be directly buried. 35kV cable adopts flame retardant XLPE XLPE insulated single-core cable, and 10kV power cable adopts XLPE XLPE insulated cable three-core cable.

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4.5 Electrical transmission and control

4.5.1 Overview:

4.5.1.1 Design content and scope

The electrical design scope is two high carbon iron chromium ore furnace workshop and its raw material system, circulation pump station, ventilation and dust removal facilities and other low-voltage power supply and distribution, electrical control, electrical equipment installation, line laying, grounding protection, lighting and lightning protection factory design.

4.5.1.2 Design Basis

Prepare in accordance with relevant laws, regulations, mandatory standards, specifications and task letter of attorney provided by ferroalloy, mechanization, waterway, ventilation and other specialties.

4.5.2 Voltage grade and load classification of main electrical equipment:

4.5.2.1 Current type and voltage level of electrical equipment

Transformer receiving voltage: 10kV

High-voltage motor power supply voltage: 10kV

Low-voltage power voltage: AC380V $\pm$ 7%

Control circuit voltage, : AC220V $\pm$ 7%, DC24V

Electrical lighting voltage: AC380V / 220V / 24V

PLC input and output voltage: DC24V

Solenoid valve: DC 24 V/AC220V

Frequency: 50 HZ $\pm$ 0.5Hz

4.5.2.2 Load classification

Most of the load of this project is second II load, and the casting span crane and circulating pump station are class I load. According to the actual situation of the workshop, the second class load is powered by two power supplies, with two power supplies respectively from different transformers and bus sections of the substation. Additional diesel generator shall be provided in the first load; diesel engine pump set to ensure the safety of electricity consumption. The raw material system is considered according to the three types of loads, and the low-voltage power supply and distribution system adopts the power supply and distribution

mode of single bus power supply.

4.5.3 Low-voltage power supply and distribution system

4.5.3.1 Low-voltage load calculation table and substation setting

According to the characteristics of process equipment and general drawing layout, the low-voltage load of the project is set in the table as follows:

Substation of thermal furnace workshop

The substation is located in the thermal furnace workshop, the electrical room is equipped with load control center (PCC) and motor control center (MCC), which supplies the low-voltage electrical equipment in the workshop, workshop crane, finished product crushing system, electric furnace gas purification, smoke exhaust system at the outlet of the furnace and the dust removal system on the roof. The low-voltage power supply and distribution PCC system adopts the power supply and distribution mode of single bus section. The 10kV power supply is derived from different bus segments of 10kV switchstation.

- **Raw material batching substation**

The substation is located near the raw material batching system, and the electrical room is equipped with load control center (PCC) and motor control center (MCC), which provides low-voltage load power for raw material drying system, raw material batching system, raw material batching dust removal system, dry material stacking dust removal system, gas pressure station and canteen bathroom in the production area. The low-voltage power supply and distribution PCC system adopts the power supply and distribution mode of single bus power supply. 10kV power supply is derived from 10kV switchstation.

- **Substation of the circulating water pump station**

The substation is located in the partial span of circulating water pump station. The electrical room is equipped with load control center (PCC) and motor control center (MCC), which supplies low-voltage load power for circulating water pump station, air pressure station and machine repair workshop. The low-voltage power supply and distribution PCC system adopts

the power supply and distribution mode of single bus section. The 10kV power supply is derived from different bus segments of 10kV switchstation.

- Living area box change

The living area box is set near the bathroom of the living area canteen, providing the low voltage load electricity of the bathroom, office building, dormitory building and the nearby central laboratory and warehouse. 10kV power supply is derived from 10kV switchstation.

4.5.3.2 Setting of electrical room

According to the layout drawing and load distribution of each process specialty and general drawing, the locations of substation, electrical room and operation room are determined as follows:

- Substation of thermal furnace workshop

The substation is located in the mine thermal furnace workshop, and the electrical room is equipped with a load control center (PCC) and a motor control center (MCC).

- Raw material batching substation

The substation is located near the raw material batching system, and the electrical room is equipped with a load control center (PCC) and a motor control center (MCC).

- Substation of the circulating water pump station

The electrical room is located in the partial span of the circulating water pump station, and the electrical room is equipped with a load control center (PCC) and a motor control center (MCC).

- Air pressure station electrical room

The electrical room is located in the partial span of the air compressor station. The electrical room is equipped with a motor control center (MCC), which is responsible for the power supply and distribution of the low-voltage load in the air compressor station. The electric room is supplied from the circulating water pump station substation.

- Each dust removal electrical room

Each dust removal electric room is set under each dust collector,

and the electric room is equipped with a motor control center (MCC) for each dust removal system.

4.5.3.3 Operating room setting

According to each process control requirements, determine the location of the operation room as follows:

1) Operation room of hot furnace workshop

The operation room is located in the +8.5m layer of the furnace workshop, which is mainly used for monitoring all electrical equipment of the furnace workshop and its related dust removal system.

2) Raw material batching control room

The control room is located in the raw material batching electrical room, which is mainly used to monitor the operation of all electrical equipment in the raw material batching system.

3) Control room of the circulating pump station

The control room is located in the electrical partial span of the circulating pump station, mainly used for monitoring the electrical equipment incoming line of the circulating water system and its nearby air compressor station.

4.5.4 Performance of the main electrical equipment:

4.5.4.1 Electrical transmission and control

The LV AC motors are controlled by the motor control center (MCC). Low-voltage motors of 75kW and above are started by soft starter, and those less than 75kW are directly started. When the motor adopts the soft start mode, the bypass design is considered. The soft starter is connected with the PLC system through the hard wire for data transmission.

The c feeder, star ash discharge valve, the production of new water supply pump and other motors and the process equipment according to the process requirements of the frequency conversion speed control ac motor transmission mode. For the motor requiring frequency conversion and speed regulation, upload the state and alarm signal of the motor and frequency converter to the corresponding PLC through the Profibus DP interface on the frequency converter, and receive the start / stop and frequency given signal of the motor from the PLC.

4.5.4.2 Operation mode

The system operates in three types: manual operation; centralized manual operation and automatic operation of the operation station

Manual operation (for maintenance and emergency treatment of on-site accidents): the manual operation is not implemented by PLC.

Centralized manual operation: for some equipment that does not participate in the interlock or some equipment that need to be started before or in the operation of the system, manual operation on the main control room operation station.

Automatic operation of the operation station: this is the main operation mode of normal production. Operation, control, monitoring and troubleshooting of each production system on the production line through PLC.

4.5.5 Computer control system

4.5.5.1 PLC Settings

To implement the data acquisition and sequential and logical control of the equipment, the PLC system is set as follows:

1 # thermal furnace PLC A set

2 # ore furnace PLC A set

Circulating water pump station PLC A set

Raw material system PLC A set

4.5.5.2 Control functions of each PLC

The PLC of the heating furnace mainly controls under the bin, the iron control system, the gas purification system of the electric furnace and the smoke exhaust system of the electric furnace, including the closing operation of the electric furnace transformer, the gear adjustment of the transformer, the control electrode lifting, pressing and hydraulic system, cooling system, distribution system, opening and blocking eye machine, etc

The PLC of the circulating water pump station mainly controls the equipment start / stop and working status display of the circulating water system and the air compressor station system.

Raw material system PLC mainly controls the start / stop and working status

display of the workshop material receiving, batching and feeding system and the raw material dust removal system equipment.

4.5.5.3, Computer system power supply

In order to improve the reliability of the system operation, the power supply of the computer system adopts the UPS device to meet the power supply to the computer system through the UPS power supply in an emergency, complete the necessary operation, and quickly restore the normal operation after the fault. The UPS power supply operates lasts 30 minutes.

UPS setting: one set of UPS for each furnace has two sets; two electrical rooms of raw material system have one set of UPS and one set of UPS.

4.5.6 Equipment type selection

Power transformer adopts energy-saving oil-immersed double winding without excitation voltage regulating transformer, and low voltage reactive power compensation device adopts dynamic low voltage reactive power compensation device.

Low-voltage load center cabinet (PCC) and motor control center (MCC) adopt GGD low-voltage fixed complete switchgear, and the protection grade is IP 31. Other auxiliary facilities for nearby power supply choose low voltage power distribution box to supply power for nearby low voltage load. The protection level of outdoor machine side box, maintenance box, power supply box and so on is IP 54. Select the corresponding grade of explosion-proof equipment in the explosion-proof area according to the regulations.

The above various electrical equipment, components and frequency converter, soft starter are using domestic quality brands.

PLC can use SIEMENS, AB, QUANTUM and other series of products, intelligent field equipment and remote I / O using Turk, Wanke and other products, HMI using ordinary PC machine. The system software shall be supplied with the equipment, and the application software shall be prepared by the Contractor.

4.5.7 Selection and laying methods of wire and cable

The power pipe network in the factory mainly adopts the laying mode of cable trench and cable bridge, supplemented by direct burial and pipe piercing.

Low voltage power cable adopts XLPE xLPinsulated cable or PVC PVC

insulated cable, control cable PVC PVC insulated cable, computer system control cable PVC PVC insulated insulated cable and computer shield cable.

In the area with high temperature, the high temperature resistant cable is used to improve the reliability and safety of the electrical system and prolong the service life of the whole system. Flexible cables shall be used for vibration and mobile equipment situations.

4.5.8 Lightning protection and overvoltage protection and grounding

Lightning protection is considered for buildings higher than 15 meters high. The pillars and beams are buildings of steel structure or buildings covered with metal plate, using the steel structure and metal plate as the flash connector, using the steel structure column as the lead line, and reliably connected with the steel structure and metal plate. Its grounding resistance shall not be greater than 30 ohms.

For the roof of explosion-proof buildings such as gas pressure station, the grounding resistance shall not be greater than 10 ohms. Outdoor oxygen and gas pipelines shall be provided with anti-static grounding, and the grounding resistance shall not be greater than 10 ohms.

The low-voltage power network adopts the three-phase five-line system of transformer neutral direct grounding. According to the regulations, the working grounding of electrical equipment and protection grounding are integrated, and the grounding resistance is less than 4 ohms. Make repeated grounding at the house of the MCC cabinet without transformer, and the grounding resistance is not greater than 10 ohms.

The normal and uncharged metal housing of all equipment shall be reliably grounded.

The computer system is separately equipped with a grounding resistance of less than 1 ohm.

4.5.9 Fire prevention measures

When cable laying, should avoid through high temperature, explosion, flammable and other areas. Otherwise, the corresponding fire prevention measures should be taken.

Electrical room, operation room, cable interlayer and other entrances

are exits with fire door (partition) and fire blocking material.

Automatic fire alarm device is installed in the high and low voltage distribution room, electrical room, operation room, cable trench, cable bridge and other places.

4.5.10 Electrical lighting:

Workshop lighting power supply system power supply from the low-voltage power system.

- The voltage of the lighting lamps is generally ~220V.
- Mobile lighting fixtures and accident maintenance lighting use 24V safety lighting.
- High and low voltage distribution room and control room, computer room in addition to using energy-saving fluorescent lamp normal working lighting, but also equipped with accident lighting.
- Explosion-proof lamps shall be installed in places with explosion risk.
- Factory area road is equipped with road lighting.
- Emergency lighting shall be provided in the main control room, computer room, important production places and main evacuation channels of each electrical room.
- The workshop adopts high efficiency sodium lamp or metal halide lamp lighting, with illumination not less than 50 lx.
- Water pump room, dust removal facilities system and other workshops with waterproof and dust-proof factory lamp lighting. The illumination is not less than 100 lx.
- Substation, high and low voltage distribution room and control room, operation room, computer room in addition to the normal working lighting, with accident lighting. The illumination of transformer room shall be no less than 100 lx; high and low voltage distribution room and computer room shall not be less than 200 lx; control room and operation room shall be no less than 300 lx.

4.6 Automation instrumentation

4.6.1 Overview of the process

Kinetic Development Group Limited, 2 × 33000 kVA high carbon ferrochrome project in South Africa, one high carbon ferrochrome production workshop with two 33000KVA high carbon ferrochrome furnaces and one set of original / batching system, dust removal system, one air pressure station and one circulating water pump station; each electric furnace has flue gas dust removal system.

4.6.2 Selection of main equipment

Instrument selection adopts high precision, stable, reliable and cost-effective products.

The pressure / differential pressure detection adopts intelligent pressure / differential pressure transmitter with HART cometer;

Electric furnace cooling water backwater temperature detection using the temperature switch;

Return flow detection of electric furnace cooling water adopts flow switch;

Electromagnetic flow meter is used for pump room water flow detection and differential pressure flow meter with differential pressure transmitter;

Weighing bucket weighing and furnace top bin weighing using resistance strain weighing sensor with intelligent weight display transmission controller;

Radar material level meter is used for the bin level detection of electric furnace original / batching system;

The water level detection of suction well adopts capacitor or wave type liquid level meter;

Automatic control valve with electric valve.

The rest of the tests were performed by conventional instruments.

4.6.3 Main test and control items:

Electric furnace raw material / batching system

- Sieving warehouse material position detection;
- Weigh the lump mine weighing bucket;
- Quantitative feeding control of fine powder ore;
- The transfer station weighs the weighing bucket.

33000 kVA furnace (2 total)

- Furnace gas temperature and pressure detection;
- Furnace bottom temperature detection, alarm, interlock;
- Temperature detection and alarm of cooling water return pipe;
- Flow rate detection and alarm of cooling water return pipe;
- Temperature and pressure detection of cooling water inlet pipe main pipe;
- Detection of cooling water return pipe;
- Furnace top feed bin weighing test;

Electric furnace flue gas dust removal system (2 sets)

- Temperature and pressure detection of flue gas outlet pipe of thermal furnace;
- Temperature and pressure detection of metal filter filter;
- Temperature and pressure detection of outlet pipe of metal filter bag;

Dust removal system (including iron port smoke exhaust and dust removal, original ingredient dust removal, etc.)

- Import and outlet pressure detection of dust collector;
- Fan bearing, temperature detection;
- Motor bearing, temperature detection;
- Motor stator temperature detection;
- Temperature, temperature, pressure and flow of fan bearing cooling water;

- Detection of the backwater temperature and pressure of the fan bearing cooling water.

air compression station

- No oil without water compressed air, temperature, pressure, flow, dew point detection;
- Nitrogen temperature, pressure and flow detection;
- Temperature and pressure of the outlet pipe of each air compressor;
- Detection of temperature, pressure and flow of water supply main of air compressor;
- Temperature and pressure test of cooling water of air compressor.

Cycle pump station

- Detection of temperature, pressure and flow rate of outlet header of electric furnace cooling soft water closed circulation pump group;
- Detection of the temperature, pressure and flow rate of the outlet header of the spray water supply pump group;
- Production of new water, water supply pump group outlet main pipe pressure, flow detection;
- Pressure and flow detection of outlet header of soft water replenishment pump set;
- Pressure and flow detection of outlet header of soft water system;
- Detection of water supplement flow of new water in production;
- Local indication of the pump outlet pressure;
- Water level detection of suction Wells;
- Catchment pit water level interlocking;
- Interlocking of rainwater collection pool;
- Interlock of waste water collection tank.

4.6.4 Control room, power supply and grounding

The control room (operation room) of each subsystem is all used together with the electrical specialty, and its location and area are shown in the attached drawings of the corresponding process specialty.

Instrument power supply: AC 220V± 10% 50Hz ± 1% single-phase.

Control system power supply: AC220V 50Hz and DC24V, using uninterrupted power supply UPS power supply.

Working grounding: grounding the common line of the control system or equipment, and the protection system equipment works accurately and reliably, and the grounding resistance is not more than 1 Ω ;

Protection grounding: protect the safety of people and equipment, the grounding resistance is not greater than 4 Ω .

4.6.5 Design and laying of cables and bridges

Automatic signal and control cables with cable bridge or pipe protection laying.

Consider more than 50% of the bridge cable space.

When the analog weak signal cable and the control cable share the same bridge frames, the partition is designed between the bridge frames.

The cable cable protection pipe adopts galvanized steel pipe, considering the space allowance in the protection pipe.

Instrument cable bridge should be separated from the power cable bridge.

4.6.6 Instrument maintenance and maintenance personnel

For the instrument selected by the project, equipped with more than 10 professional and technical personnel, maintenance, repair of the normal operation of the instrument, and regular calibration, with college degree or above.

4.6.7 Control system

There are 5 sets of PLC control systems in this project, one set of control system for each electric furnace body (one set of electric furnace, a total of 2 sets), and one set of control system for electric furnace raw material / ingredients, circulating water and dust removal process.



All PLC control systems are used, and communication between PLC systems is realized through industrial Ethernet.

PLC cabinet and operation station are set in the control room (operation room) of each process facility.

The measurement and control of the air compressor station passes through I / O, and the remote station is connected to the circulating water PLC control system.

BERIS

4.7 Telecommunications facilities

4.7.1 Overview

(1) Design basis

- ✧ Design mission letter of attorney provided by the relevant profession
- ✧ Code for Design of Industrial TV System Engineering GB 50115-2009
- ✧ Design Code for Automatic Fire Alarm GB 50116-2013
- ✧ Design Fire Protection Standard for Iron and Steel Metallurgy Enterprises GB 50414-2018
- ✧ Code for Fire Protection Design of Buildings GB 50016-2014 (2018)
- ✧ Other relevant design specifications

(2) Design scope

The scope of this design is the telecommunications facilities within the 2×33000 kVA high carbon Cr project of Kinetic Development Group Limited South Africa.

(3) Design content

- ✧ automatic telephone system
- ✧ dispatching telephone system
- ✧ Industrial TV system
- ✧ Computer network system
- ✧ automatic fire alarm system
- ✧ One-card system
- ✧ ground system
- ✧ telecommunication lines

4.7.2 Telecommunications facilities

(1) Automatic telephone system

In order to meet the daily official communication of management, production and auxiliary production departments, 46 automatic telephone units are set up in the operation room, offices and dormitories in front

of the factory. For details, see Schedule 1 Telephone User Table for the setting location. The source of automatic telephone, the owner shall apply to the local telecommunication bureau according to the relevant local regulations.

(2) Dispatching the telephone system

In order to meet the daily official service and dispatching communication contact of the production management department and important production positions, one set of 40-door dispatching main engine is set up in the main control room, and the dispatching telephone extension is set up in each office and operation room in the factory.

(3) Production of sound amplification and communication system

➤ Production of broadcast amplification communication system

In order to facilitate the production notice in the noisy production workshop, and in case of fire, the system can be used as a fire broadcasting system. The system terminal equipment is set in the main control room.

A total of 2025W horn speakers are set up on the platform of the workshop and around the material shed.

(4) Industrial TV system

In order to facilitate the production dispatching command personnel and site operators to intuitively observe the important production parts that are not easy to see on the work site and the important production links in the harsh production environment, the industrial TV monitoring system is set up.

A total of 70 sets of high-definition cameras are set up in the electric furnace workshop, batching system, pressurization station and other process facilities. The cameras are equipped with protective covers under the corresponding environment according to different monitoring environment, and the monitoring signals are sent to each process operation

room respectively.

For the specific layout, see Attached Table 2 industrial TV User table.

(5) Computer network system

In order to realize the production and office automation, intelligence and information, the project configuration of computer information network. The information points are set up in the main operation room and the office, the factory front area office building and the dormitory building.

(6) Automatic fire alarm and linkage fire control system

In order to ensure safe production, timely detect the fire situation, control the fire spread as soon as possible, and reduce the fire loss, the automatic fire alarm system and linkage control system are set up. The project is equipped with a fire control room, which is located in the circulating water pump station.

➤automatic fire alarm system

Composition of the system: various fire detectors, various modules, manual alarm button, sound and light alarm and other equipment. The system adopts the bus system.

Fire detection in this project adopts two methods: manual manual alarm and automatic detector detection. The manual alarm button is selected for manual alarm. Automatic detection selects different system protection objects, different places and different requirements for fire detection. For electrical room, duty room and operation room, photoelectric smoke detector is set, and cable-type temperature detector is used in cable interlayer, transformer room, cable corridor and cable bridge.

At least one manual fire alarm button and sound and optical alarm are installed in each fire zone; mainly, the bottom edge of manual alarm button is 1.5 m from the ground; the sound and optical alarm is installed 0.3 m from the door or the bottom edge is 2.5 m from the ground. There are obvious

signs.

➤ Linkage control system

The main equipment of the linkage control system is the bus controller and the multi-line controller. The main object of the system linkage control is the fan, air conditioning system, fire valve, acoustic and optical alarm in the protection area. In case of fire, close the fire door, ventilation fan, air conditioning system and fire valve in the corresponding area, open the smoke exhaust fan and sound and light alarm, and open the fire hydrant pump in the fire extinguishing area. All linkage objects should be sent to the fire control room, and the system adopts bus and multi-line hybrid system.

➤ Fire fighting telephone and fire fighting broadcasting system

Fire telephone jack and fire broadcast speakers are set up in the main area of the factory.

In each control room, duty room automatic telephone as fire alarm telephone use.

(7) One-one card system

In order to realize the diversion management of staff and outside the factory, improve the scientific level of enterprise management and decision-making, and realize the scientific and automatic office business, this project has set up the whole factory one-card system.

The most fundamental requirement of the one-card system is "information sharing and centralized control", and realizes the intelligent management of a variety of different functions through one card. Through the one-card center management platform, employees can complete the attendance query, permission setting, online payment and other requirements.

One-card module includes: center management module, attendance

management module, access control management module, charge management module, visitor management module, etc. The attendance management subsystem, access control management subsystem and consumption management subsystem in the enterprise one-card management system are integrated into an IC card, and an employee can realize the functions such as attendance, access control and internal consumption with one employee card.

4.7.3 Earthing system

Telecommunication equipment shares grounding with power PLC equipment when conditions permit, and the grounding resistance is not greater than 1 ohm.

4.7.4 Telecommunication lines

The telecommunication lines are laid openly in the workshop and secretly in the building room; the external network is laid along the cable trench and directly buried underground.

4.7.5 Fire prevention plugging

All telecommunication lines through the wall perforation are blocked with fire blocking material.

4.8 Machine repair and testing facilities

4.8.1 Electrode shell machining and machine repair room

According to the construction content and scale of the project and the mechanical processing cooperation conditions in the surrounding areas, the repair facilities of the project are as follows: motor shell processing and repair room;

4.8.1.1 Production tasks

The main tasks of the electrode shell machining room and the machine repair room are as follows:

1) Manufacturing task of electrode shell in the thermal furnace production workshop;

Electrode case specifications and production are shown in the following below:

Electrode shell specifications and production table Table 13.1.1-1

or der nu mb er	Electric furnace name	Electrode shell specifications (mm)	Steel plate thickness (mm)	weigh t (kg)	output	
					(t)	(jié)
1	High carbon ferrochrome ore hot furnace	Φ 1250mm×1250	2.5	278	226	810

2) The production of spare parts for daily maintenance, minor repair and emergency repair shall be completed by the repair section. Large cast iron, cast steel, cast copper, large riveting welding parts outsourcing.

4.8.1.2 Working system

The electrode shell processing and machine repair room work for 251 days, the annual equipment base of 1930 hours.

4.8.1.3 Main equipment selection

According to the process requirements and the electrode shell consumption

Main equipment selection for motor shell production:

Selection of electrode shell machining equipment: 1 Q11-8X2500 shear, 1 WD67Y-100 / 2500 bending, 1 Y L 32-315 four-column hydraulic press, 1 J C 23-63 open tilt press, and 2 portable sand turbine.

Electrode shell welding equipment selection: DC electric welding machine, AC electric welding machine, special welding frame.

Machining equipment: CA6140B ordinary lathe 1, 1 XA6132 universal lift table milling machine, 1 GB4240 horizontal belt saw machine, 1 B6050 planer, 1 Z3040 * 16 rocker drill machine, supporting the selection of dust removal sand turbine 2, 1 marking platform.

One LD type 5t electric single-beam crane is selected for the lifting equipment.

See the equipment table for the specific equipment parameters.

4.8.1.4 Workshop area and composition

Electrode shell processing and machine repair room consists of processing and production area, welding production area and storage area. At one end of the workshop is a small house with auxiliary facilities, including tool room, lounge, electrical room, etc.

4.8.1.5 Labor quota

12 personnel.

4.8.2 Laboratory testing facilities

According to the construction content, production scale and process requirements of the project, build a new central laboratory. The specific design contents are as follows:

4.8.2.1 Task

The central laboratory mainly undertakes the physical performance and chemical composition analysis of incoming raw materials (chromium ore, coke, etc.), the furnace analysis of ferrochrome, the composition analysis of finished ferrochrome alloy and slag; the routine water quality analysis of whole water system; the inspection of electrode paste shall be considered externally. Details are shown in the following table:

Inspection requirements, items and times of raw materials

name	Analyze and test items	The number of analysis	remarks
Dinas	total analysis:SiO ₂ 、CaO、Al ₂ O ₃ 、FeO、MgO、	The first	Each

rock	P ₂ O ₅ 、 MnO、	batch of use and find problems	producing area
	Feed the silica: SiO ₂	o.d	Take the average sample
chrome ore	total analysis:Cr ₂ O ₃ 、 Fe O 、 Al ₂ O ₃ 、 CaO、 MgO 、 SiO ₂ 、 P、 S	The first batch of use and find problems	Each producing area
	incoming chromium ore: Cr ₂ O ₃	Each batch	Points of origin
	Feed the chromium ore: Cr ₂ O ₃ 、 H ₂ O	Each class once	Take the average sample
coke	Full analysis: fixed carbon, volatile, ash and SiO ₂ 、 Al ₂ O ₃ , CaO, MgO, FeO, P, S, and moisture	once every month	Each producing area
	Factory incoming coke: fixed carbon, volatile, ash, moisture	Each batch	
	Feed the coke: H ₂ O	Each class once	Take the average sample
dolomite	Full analysis: valid CaO, SiO ₂ 、 Al ₂ O ₃ 、 MgO、 FeO、 C、 P、 S	once every month	Each producing area
	Feed lime: effective CaO	o.d	

Inspection requirements, items and times of finished products and slag

name	Analyze the project	number of times
high carbon ferro-chrome	Full analysis: Cr, C, Si, P, S, and Fe	once every month
	Pre-furnace analysis: Cr, C, Si, P, S	Each furnace once
bira nest	total analysis:Cr ₂ O ₃ 、 SiO ₂ 、 CaO、 MgO、 Al ₂ O ₃ 、 P ₂ O ₅ 、 FeO、 S	Once every ten days or once every half a month



	Published analysis: Cr_2O_3 、 SiO_2	Each furnace once Each class once
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Inspection requirements, items and times of water quality

name	Analyze the project	number of times
Water quality index of the circulating water system	PH value, electrical conductivity, turbidity, total hardness, calcium hardness, total alkalinity, chloride ion, total iron, free chlorine, agent concentration	o.d

4.8.2.2 Area and composition

The central laboratory is a single-storey building, located close to the electric furnace workshop. It is mainly composed of raw material sample making room, finished product sample making room, drying and burning room, infrared carbon and sulfur room, chemical analysis room, balance color comparison room and warehouse, power distribution room, toilet, sample mail room and data processing room and other auxiliary rooms.

4.8.2.3 Work system and labor quota

The main working system of the central laboratory is three shifts and two shifts, with a total of 13 people.

4.9 General drawing layout and transportation

4.9.1 Project Overview

The project is located in Muscina-Makadu, Limpopo Province, South Africa, covering an area of 60 square kilometers, which is adjacent to Zimbabwe, Mozambique and Botswana. The reserves of open-pit coke mines around the SAR are more than 10 billion tons. South Africa has more than 83% of the world, manganese resources for more than 81%, and the high-grade vanadium reserves rank first in the world. There are other rich stainless steel raw material mining resources in the region: iron ore, silicon ore, nickel ore, limestone, etc. The national railway, highway and power supply network run through the zone, 500 kilometers away from the large port terminal of Maputo, Mozambique. The Limpopo River is 30 kilometers away from the zone and is an important source of water for the zone.

4.9.2 General plane layout

4.9.2.1 Basis and principles of plant general plane layout

(1) The main design basis of the general layout of the plant is the Code for General Plane Design of Industrial Enterprises GB50187-2012 and the current Code for Fire Prevention of Building Design GB 50016-2014;

(2) According to the production nature and construction scale of the project, and combined with the natural conditions and current situation of the site for the general layout. On the premise of meeting the industrial production land, the land needs of material transportation, pipeline laying, environmental protection, safety and health, and fire fighting are comprehensively considered. Strive to the general map layout is reasonable, the transport line is short, smooth.

(3) On the premise of meeting the process production process, operation requirements, reasonable functional zoning. The appearance of the building structure is coordinated and orderly, and the width of the passageway is moderate, creating conditions for natural ventilation, lighting, drainage,

sanitation and greening layout.

4.9.2.2 General layout and general situation of the plant area

According to the site situation, the whole factory area is divided into 5 functional areas. They are: raw material storage area, public and auxiliary facilities area, main plant area, office area, 132kV substation area.

Raw material storage area mainly has: dry material shed, block material shed, etc.

The public and auxiliary facilities mainly include: vertical furnace (reserved), production area canteen bathroom, block batching room, comprehensive circulating water pump room, air pressing nitrogen room, motor shell processing and machine repair room, etc.

The main plant area mainly has the main workshop, hot furnace flue gas purification system, dry slag pit, etc.

The office area mainly includes the office building, the living area canteen, the dormitory building, the comprehensive warehouse and so on.

4.9.3 Vertical arrangement

Vertical layout principles:

(1) Reasonably determine the elevation of each production process facilities in the site, and minimize the amount of moving earthwork in the site.

(2) Reasonably determine the slope and catchment area of the site to ensure smooth drainage of the site.

4.9.4 Transportation

4.9.4.1 Tape transportation

Coke, silica and ferrochrome block ore are transported from the block material shed to the main workshop, with an annual transportation capacity of 330,116 t.

4.9.4.2 Road transport:

The width of the new road is 7m and 4m respectively, the pavement adopts cement concrete pavement structure, the pavement structure layer is: 240mm thick C30 concrete + 150mm thick cement stability layer + 180mm thick natural graded gravel. The turning radius is 12m, 9m and 6m respectively.

1. Road transportation outside the factory

Silstone, chromium block ore and coke were transported from the factory into the block shed, with an annual transportation capacity of 330116t.

Electrode paste, electrode shell, refractory materials, steel bars, spare parts from the factory into the comprehensive warehouse, the annual transportation volume is about 6800t;

The annual total transportation volume of the road in the factory is 336,916 t.

2. Road transportation in the factory

Electrode paste and refractory materials are transported from the comprehensive warehouse to the main workshop, with an annual transportation capacity of about 5100t.

High-carbon ferrochrome is transported from the main workshop to the finished product warehouse, with an annual transportation volume of 125,000 t.

The rebar is transported from the comprehensive warehouse to the electrode shell processing and machine repair room, with an annual transportation capacity of 680t.

The electrode shell is transported from the electrode shell processing and machine repair room to the main workshop, with an annual transportation volume of 310t.

The annual total amount of road transportation in the factory is: 131,090 t.

4.9.5 Pipe network integration

4.9.5.1 External energy media

External energy media mainly include: electricity.

4.9.5.2 Internal pipelines

The contents include: production and living water supply pipeline; drainage pipe; ventilation pipe; power cable; heating pipeline; road lighting, etc.

4.9.5.3 Laying requirements

When the pipeline and the trench cross the road, the vertical clear distance between the top of the pipe and the bottom of the road pavement structure should not be less than 0.70m, and shall be strengthened when it does not meet the requirements.

The length of the end of the embankment, and the kerb shall not be less than 1.0m.

When the overhead pipeline crosses the road, the clearance shall meet the requirement of 6.0m.

The buried pipelines are arranged according to the buried depth of the pipelines, and they are arranged in the ground from shallow to deep from the building foundation.

4.9.6 Greening and fire-fighting design

4.9.6.1 Greening

In order to beautify and purify the surrounding environment of the factory and create a beautiful, quiet and pleasant production and living environment for employees, plant some flowers and trees suitable for local growth around the building, on both sides of the road and in the idle areas.

The green area occupying rate is not less than 20%.

4.9.6.2 Fire fighting

There are circular roads or passageways around the building to meet the passage of fire-fighting vehicles. There are fire water supply pipes and fire hydrants along the road to meet the requirements of fire water use.



The fire protection of the whole factory area shall be uniformly considered uniformly by Party A. This design does not consider the provision of fire engine and fire garage.

4.9.6.3 Guard

Build a 2.5m physical wall around the factory area. In the southeast side of the factory, there are three gates, one logistics gate and two personnel gates. In the southeast corner of the factory, a logistics gate is set at each gate. The personnel on duty use four shifts three pour, labor fixed 10 people.

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4.10 Civil works

4.10.1 Design Basis

Code for Fire Protection in Design of Buildings GB50016-2014 (2018 edition)

Code for Fire Protection in Design of Iron and Steel Metallurgy Enterprises GB 50414-2018

Code for Seismic Design of Buildings GB50011-2010 (2016 Edition)

GBZ 1-2010

Code for Design of Industrial Buildings GB50046-2008

Code for Design of Concrete Structures GB 50017-2017

Code for Design of Steel Structure GB50017-2003

Unified Standard for Reliability Design of Building Structure GB50068-2001

Code for Design of Building Ground, GB50037-2013

Code for Loading of Building Structure GB50009-2012

Technical Code for Roofing Engineering GB50345-2012

Code for Design of Building Foundation Foundation GB50007-2011

Technical Specification for Waterproofing of Underground Engineering GB50108-2008

Code for Design of Masonry Structures GB50003-2011

The Unified Technical Specification for the Application of Wall Materials, GB50574-2010

Technical Specification for Structure of Cold-formed Thin Steel GB50018-2002

Code for Design of Pipe Support for Iron and Steel Enterprises GB50709-2011

"Metallurgical Enterprise Safety and health Design Regulations" Ye Sheng: 1996] no. 204

4.10.2 Design and content

4.10.2.1 High-carbon ferrochrome production workshop

It is planned to build 2×33000 kVA high carbon ferrochrome furnace, a high carbon ferrochrome production workshop, and two furnaces in the main workshop.

(1) Architectural design

1) The fire risk produced in the main workshop of the thermal furnace is classified as grade D, the fire resistance grade of the building is grade 2, and the roof waterproof

grade is grade.

2). The aboveground part of the workshop adopts the steel structure.

.53) The basic pillar spacing of the workshop is 9m, 6m and 6m; the plant foundation and underground structures are cast-in-place reinforced concrete structures.

4). The production nature of this workshop is smelting workshop, the workshop is not heating workshop. The roof and wall of the workshop are enclosed with single-layer color pressed steel plate.

5) Composition of furnace workshop: composed of furnace span, casting span, finished product finishing span and finished product span. The total span of the ore thermal furnace is 5 layers, and the other span is a single layer.

6) envelope structure: the roof adopts hidden single-layer color pressing steel plate. All roofing uses long ruler plates. The hot furnace span adopts the form of double slope roof, and the other spans are single slope roof. The roof drainage adopts the organized drainage (using the drainage mode outside the steel gutter). Wall: use 240mm brick wall for elevation below 1.2m, and use rain screen for elevation above 1.2m.

7) Daylighting and ventilation: the rain-blocking wall block, roof lighting belt and ventilation building of the workshop can meet the requirements of natural lighting and ventilation in the workshop.

8). Floor: according to the load of the process, concrete floor or reinforced concrete floor, etc. The concrete floor is divided between 4m-6m in grid joints.

9). Safety walkways and steel ladder: bilateral safety walkways are set on each span, and the crane maintenance platform is set at both ends of each span to connect with the safety walkways on both sides of each span to facilitate safety and convenient maintenance.

10). Outdoor works: outdoor water, gate ramp are all concrete.

11). Small houses in the workshop: small houses in the workshop have low voltage power distribution room, thermal furnace control room, hydraulic station, high pressure switch station, etc.; small houses in the workshop are adopted according to different building fire risk classification: small houses on the ground all adopt reinforced concrete frame structure or brick structure, the roof adopts cast-in-place reinforced concrete slab. The small houses located on the platform are made of steel structure or brick concrete structure, and the roof and wall are made of color pressed steel plate. Windows and

Windows use aluminum alloy doors and Windows or fire doors and Windows.

(2) Structural design

The main workshop is of steel frame with frame support system; the casting span is lattice steel column, solid crane beam, brake plate and brake edge beam system; the roof is welded H-type steel beam, C-type purlin and roof support; the column support is double sheet steel structure; C-type purlin sealing wall.

Workshop column foundation: adopts reinforced concrete independent foundation; wall foundation adopts foundation beam or strip foundation.

Equipment foundation: the equipment foundation in the workshop adopts reinforced concrete foundation. The underground pipe trench adopts the waterproof reinforced concrete structure.

4.10.2.2 Raw material field system

- 1) Ingredients feeding system.
- 2) Final product warehouse and finished product processing system.
- 3) Comprehensive warehouse.
- 4) slag disposal pit

Basic requirements for buildings and structures:

- 1) The raw material site is built on the ground, and the structure type is semi-closed, open around, and equipped with protective railings;
- 2) The buildings under the raw material site are concrete structures; all above-ground parts are steel structures;
- 3) All raw material yard is fortified with canopy, open around; slag yard is stored in open air, considering seepage prevention and drainage around.
- 4) Underground receiving bin and batching bin are steel structures with wear-resistant lining plates.
- 5) All corridor corridor boards 12° steps, <12° non-slip strip;

4.10.2.3 Public and auxiliary facilities

The main contents include: machine repair facilities, ventilation and dust removal facilities, power supply and distribution facilities, automatic instrument facilities, water supply and drainage facilities, etc. Welfare facilities include office area canteen, dormitory, office building; production area canteen and bathroom office complex building.

(1) Main construction (structure) engineering scheme

According to different use properties, respectively: steel structure, reinforced concrete frame structure, reinforced concrete frame structure and underground reinforced concrete structure, brick and concrete structure.

The roof and envelope structure of steel structure building adopts single-layer color pressed steel plate, doors and Windows choose flat open steel doors, pressed steel plate doors, electric rolling shutter doors, steel anti-theft doors, PVC plastic doors and Windows, wooden doors, toughened glass doors, etc.

The roof of reinforced concrete frame structure adopts extrusion board insulation layer and high polymer modified asphalt roll waterproof; the envelope structure adopts brick wall or aerated concrete block wall; steel fire doors, steel anti-theft doors, PVC plastic doors and Windows, transformer room doors and Windows, etc.; and the underground buildings and structures adopt reinforced concrete structure.

The roof of reinforced concrete frame structure adopts insulation color steel plate or single-layer color pressed steel plate; the envelope structure adopts brick wall or insulation color steel plate and single-layer color pressed steel plate; open steel door, pressed steel plate and sandwich plate door, electric rolling steel curtain door, steel anti-theft door, PVC plastic doors and Windows, etc.; underground buildings and structures adopt reinforced concrete structure.

For the floor, cement mortar floor, floor tile floor, electrical room with special requirements, etc.

The outer wall adopts paint wall, face brick wall surface, etc.

The inner wall adopts cement mortar wall, coating wall, face brick wall surface, etc.

The ceiling adopts cement mortar, plastering, and the ceiling adopts fireproof paper surface gypsum board ceiling, aluminum alloy hole plate, light steel keel fixation, etc.



5 Energy assessment

5.1 Design Basis

(1) Energy Conservation Law of the People's Republic of China (Order of the President [2007] No.77)

(2) Outline of China Energy Conservation Technology Policy (Development [2006] No.609)

(3) General Rules for Comprehensive Energy Consumption Calculation (GB / T2598-2008)

(4) Code for Energy Saving Design of Iron and Steel Enterprises (GB50632-2010)

(5) Energy Consumption Limit for Unit Product of FerroAlloy (GB / 21341-2017)

5.2 Project Overview

2×33000 kVA high carbon iron chromium ore furnace is built, and a main workshop for high carbon iron chromium production is set up, and the main workshop has two high carbon iron chromium ore furnace, with an annual output of high carbon iron chromium about 125,300 tons.

5.3 Energy utilization

5.3.1 Electricity

The annual power consumption of the whole plant is 4.3810^8 kWh.

5.3.2 Water

The annual consumption of new water in the whole plant is $340560 \text{ m}^3/\text{a}$.

5.3.3 Fuel

Annual consumption of coke in thermal furnace: 57651 t/a .

5.3.4 Compressed air

Compressed air is used by users by the new air compressor station through the regional pipe network, with an annual consumption: $522,720 \text{ Nm}^3/\text{a}$.

5.4 Energy assessment

5.4.1 Process energy consumption

The energy medium consumed by the ore heating furnace is mainly: electric power, coke, new water, compressed air, etc.

The process energy consumption calculated by the equivalent value (0.1229 kgce



/ kWh) is shown in the table below.

Energy consumption of electric furnace process

order number	name	Physical single consumption	unit	Decline coefficient	unit	Fold standard coal
						(kgce/t)
1	coke	460	kg/t	0.9714	kgce/kg	446.84
2	compressed air	2	Nm ³ /t	0.0400	kgce/Nm ³	0.08
3	New water	5	Nm ³ /t	0.2570	kgce/Nm ³	1.29
4	electricity	3050	kWh/t	0.1229	kgce /kWh	374.845
	subtotal					823.055

The energy consumption equivalent value of the thermal furnace smelting process is 823.055kgce/t.

5.4.2 Comprehensive energy consumption

The power conversion coefficient is calculated according to the equivalent value (0.1229 kgce / kWh), and the annual comprehensive energy consumption of the project product is shown in the table below.

Comprehensive energy consumption meter

order number	name	Physical annual consumption	unit	Decline coefficient	unit	Fold standard coal (tce/a)
1	electricity	4.38×10^8	kWh/a	0.1229	kgce/kWh	53830.20
2	coke	57651	t/a	0.9714	kgce/kg	56002.18
3	New water	213840	m ³ /a	0.2570	kgce/m ³	175.05
	amount to					110007.43

The calculated annual comprehensive energy consumption of the project product is: 110007.43tce/a (equivalent value).

5.4.3 Comprehensive energy consumption per unit product

After calculation, the comprehensive energy consumption per unit product of the project is 877 kgce / t, and the smelting power consumption per unit product is 3050 kWh / t.

5.4.4 Analysis of project energy consumption



This project is an emerging industry. From the analysis of the process energy consumption and the comprehensive energy consumption of unit product, the energy consumption of unit product is reasonable.

5.5 Energy-saving measures

(1) Reasonable layout, optimize the connection between the production process and process, adopt advanced energy saving and emission reduction, clean production technology, and minimize energy consumption.

(2) The electric furnace adopts bellows pressure ring, forged copper tile, water-cooled cable and other new technologies, greatly reducing the hot furnace shutdown time, thus reducing the power consumption.

(3) According to the load capacity, power supply distance and distribution, and electrical equipment characteristics, rationally design the power supply and distribution system and select the power supply voltage; the substation shall be as close to the load center as possible to shorten the distribution radius and reduce the line loss.

(4) According to the different requirements of the production process for water quantity, water pressure, water quality and water temperature, design a more reasonable water use process, stabilize the water quality of circulating water, use water-saving equipment as far as possible, reasonably control the concentration ratio of circulating water, and improve the reuse rate.

(5) The use of new water transmission pipe, eliminate the traditional cast iron pipe and galvanized pipe, in order to better achieve the pipeline does not leak, easy to operate and monitoring.

(6) To meet the requirements of process equipment and environmental protection requirements should also do a good job of building energy conservation.



6 Environmental protection

6.1 Environmental protection design basis

The national standards and technical provisions for the design basis are as follows:

- (1) The Emission Standard of Pollutants in the Ferroalloy Industry (GB28666-2012);
- (2) "Comprehensive Sewage Discharge Standard" (GB8978- -2006);
- (3) The National List of Hazardous Waste Products;
- (4) Pollution Control Standard for General Industrial Solid Waste Storage and Disposal Site (GB18599- -2001);
- (5) Pollution Control Standard for Hazardous Waste Storage (GB18597- -2013 revision);
- (6) Environmental Noise Emission Standard for Industrial Enterprises (GB12348- -2008);
- (7) Cleaner Production Standard Steel Industry (ferroalloy) (2009).
- (8) National Environmental Management: Article 39 of the Air Quality Act of 2004

6.2 Project Overview

Kinetic Development Group Limited, South Africa 2×33000 kVA high carbon ferrochrome project, the project annual output of 125,300 tons.

The construction contents of this project mainly include: electric furnace smelting facilities, raw material system and warehouse, water supply and drainage facilities, ventilation and dust removal facilities, thermal facilities, power supply and distribution and electrical facilities (including 132kV transformer station), machine repair and inspection and testing facilities, etc.

6.3 Main pollution sources, pollutants and their control measures

This project is S0 according to Article 39 of National Environmental



Management: Air Quality Act 2004 in South Africa₂The emission is 500mg / Nm³, NO_xThe emission is 400mg / Nm³, The particulate matter emission of the semi-closed furnace is 30mg / Nm³. Please refer to the figure below for the specific emission limits.

(9) Subcategory 4.9: Ferro-alloy₂ Production

Description:		Production of alloys of iron with chromium, manganese, silicon or vanadium, the separation of titanium slag from iron-containing minerals using heat.	
Application:		All installations.	
Substance or mixture of substances		Plant status	mg/Nm³ under normal conditions of 273 Kelvin and 101.3 kPa.
Common name	Chemical symbol		
Sulphur dioxide	SO ₂	New	500
		Existing	500
Oxides of nitrogen	NO _x expressed as NO ₂	New	400
		Existing	750
Particulate matter from primary fume capture system, open and semi-closed furnaces			
Particulate matter	N/A	New	30
		Existing	100
Particulate matter from primary fume capture system, closed furnaces			
Particulate matter	N/A	New	50
		Existing	100
Particulate matter from secondary fume capture system, all furnaces			
Particulate matter	N/A	New	50
		Existing	100

The pollution sources generated by this project are mainly the main works and public auxiliary works of the project, and the main pollutants are waste gas, waste water, solid waste, noise, etc.

Combined with the characteristics of the environmental pollution of the project, the environmental pollution control plan strictly implements the national laws, regulations, standards, norms and relevant industrial policies concerning environmental protection, so as to exchange the maximum environmental benefits with the minimum economic cost.

6.3.1 Major sources of pollution

1) Waste gas (including smoke, dust and industrial waste gas, etc.)

Dust and smoke gas produced in the drying process of chromium ore and



coke;

Dust generated in the production process of raw materials and auxiliary materials system;

Dust-containing gas, smoke and dust particles produced in the process of smelting and production;

Instant dust generated when the alloy bag and middle tank are unpacking and overturned.

2) Wastewater

A small amount of domestic sewage produced by the workshop living facilities.

3) noise

Mechanical noise generated by the raw material processing process;

Smelting electric furnace smelting generation, noise;

Dust removal fan, air compressor and other equipment in the process of operation of the noise.

4) Solid waste

Slag produced during the smelting of the electric furnace;

Waste refractory materials produced during the repair of process equipment;

Dust and dust captured by each dust removal system;

6.3.2 Pollution control measures

The project is equipped with corresponding flue gas dust collection, dust removal and purification facilities, so as to effectively control all kinds of pollution sources and pollutants as far as possible. Considering the characteristics of environmental pollution of the Project, the preliminary plans of pollution control measures are as follows:

According to the production process and equipment configuration, remove dust at each transfer point, dust production equipment and other



dust production links in the production process.

The following technical measures are taken in this design:

The gas produced in the production process of the electric furnace is purified by the flue gas purification system and then transported to the user point for use.

The dust-containing gas at each dust source point in the production process such as raw material processing equipment is collected through the set trap cover and enters the dust collector through the dust removal pipeline for purification.

The dust removal system of loose materials and auxiliary raw materials is usually composed of the dust removal and extraction cover, pipe, regulating valve, fan, bag dust collector, mechanical ash conveying device, ash storage bin, chimney and other equipment. The auxiliary supporting system consists of: instrument detection, electrical automation system, compressed air system, etc.

Natural ventilation and necessary axial flow mechanical ventilation are installed in each production plant.

In order to prevent the pollution of surface water environment caused by the generated wastewater, the project water is divided by quality, divided by pressure and graded, and the technologies of turbidity diversion, recycling and stable water quality are adopted to save water resources. The control measures taken in the project mainly include:

A) The cooling and drainage of the process equipment uses the residual pressure flow to the hot pool, and then it is sent to the evaporative air cooler or cooling tower for cooling, and the cooled water flows to the circulating cold pool for recycling;

B) Domestic sewage and washing wastewater shall be transported to the designated treatment point after treatment by septic tank;



C) The underground water in the workshop shall be directly discharged to the rainwater pipe of the plant with a submersible sewage pump. The rainwater on the ground is collected through the rainwater outlet, and organized to the rainwater pipe through the drainage pipe.

The main wastewater pollution sources, pollutants and their treatment measures of this project are shown in the following table.

Main wastewater pollutants and their treatment measures

systematic name	Facility name	Name of pollution source	Main pollutants	Pollution control measures and effects
Soft-loop water treatment system	electric stove	Electric furnace water cooling system	temperature increment	After the closed-circuit circulating water system is adopted, the residual pressure returns water, cooled by the evaporative air cooler, and then the backwater returns to the pump station, and then pressurized through the pressurized pump, and sent to the user for use.
circulation	Vertical furnace, air pressure station, water pump	Indirect cooling of shaft furnace, air pressure station, water pump and other equipment	temperature increment	The net circulating water depends on the residual pressure return water to the cooling tower, and the water cooled by the cooling tower is treated, and then the water stabilizer is added and sent by the pump to recycling.
domestic installation	Health facilities	Domestic sewage,	S~200mg/L COD ~ 250	Domestic sewage and washing wastewater are



systematic name	Facility name	Name of pollution source	Main pollutants	Pollution control measures and effects
ion	s	washing wastewater	mg/L, BOD ₅ ~150 mg/L	transported out after septic tank treatment

The main equipment to produce noise in this project includes raw material treatment equipment, electric furnace, vertical furnace, dust removal system fan, air compressor, circulating water pump, etc. The following noise control measures are proposed:

- A) Select low noise equipment and low speed fan;
- BY) Take sound insulation and noise reduction measures: put the air compressor, water pump, fan, grinder, etc. indoors;
- C) Take shock absorption measures: absorb the vibration equipment through foundation treatment;

By taking the above measures, the impact of noise on the surrounding environment can be greatly reduced, so that the noise in the workplace is 85dB (A), and the noise at the factory boundary meets the requirements of the three standards in the Environmental Noise Emission Standard for Industrial Enterprises (GB12348-2008), namely, 65dB (A) in the day, 55dB (A) at night. The main noise source and its control measures are shown in the table.

Table of main noise sources and control measures

order number	Name of the major pollution sources	Control the front sound level dBA	Main control measures	Control the post-sound level dBA
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1	electric stove	~115	Building sound insulation, set up a smoke hood	≤85
2	Vertical furnace (reserved)	~100	Foundation shock absorption, set up a large sealing cover	≤80
3	Minder (reserved)	90~95	Foundation shock absorption, building sound insulation	≤75
4	Dryer (Reserved)	80~90	Foundation shock absorption, building sound insulation	≤70
5	air compressor	90~95	Muffler, building sound insulation	≤80
6	Dust removal system fan	95~110	muffler	≤85
7	Pump, cooling tower	90~95	Foundation shock absorption, building sound insulation	≤80

All kinds of solid waste produced in production as far as possible to achieve resources and harmless. The main measures are taken are as follows:

A) The slag produced in smelting is dry slag, and the dry slag yard shall be constructed and finally sold to other units.

B) Collect the chromium dust captured by the dust removal system and send it to the raw material treatment system for use.

C) Waste refractory materials, cast residue and other industrial



wastes, recycled from old refractory bricks and scrap steel, and transported to the slag yard for temporary storage.

Other pollution control measures:

This project is mainly through the use of advanced technology, improve the quality, so as to reduce the generation of pollutants. The main measures are listed as follows:

A) The efficient pulse bag dust collector is adopted to increase the dust capture rate and reduce the dust emission;

B) In terms of process configuration, minimize the drop of each material transfer point, and set a sealing cover at each dust point to minimize dust pollution.

By adopting the above advanced technology and a series of supporting sewage control measures, a good foundation has been laid for protecting the environment.

6.4 Factory greening

Plant greening plays a very important role in preventing pollution, protecting the environment and improving working conditions. The design considers to make full use of both sides of the plant road and the space around the plant to plant trees and grass. When designing the plant greening, fully combine the production process, pay attention to the greening structure and function, such as planting heat-resistant tree species and SO around the main plant. Monitoring plants, other areas are planting broad-leaved forest trees with good sound absorption and dust-proof effect, so that the greening rate of the whole plant reaches 20%.

6.5 Environmental monitoring

After the project is completed and put into operation, the environmental protection management and environmental monitoring work



shall be handled by the environmental protection department of the company.

Environmental monitoring plan: According to the characteristics of the project waste gas treatment facilities and noise sources, combined with the actual situation of the plant, the environmental monitoring of the project shall be considered by the environmental monitoring station of the plant.

6.6 Brief analysis of environmental impact

In the design of this project, the principle of "clean production, total amount control and increased production and pollution reduction" is strictly implemented, and the international advanced environmental protection technology and equipment are adopted. In the engineering design for waste gas, waste water, solid waste and noise and other major environmental pollutants, adopted a series of corresponding prevention and control measures, comprehensive treatment, as far as possible to reduce the impact on the environment of engineering discharge pollutants, pollutant discharge and discharge concentration meet the relevant discharge standards, so the project will not have big influence on the factory environment. From environmental environment, the technology is feasible.

Quantitative environmental impact analysis remains to be determined in environmental impact assessment.



7. Labor safety and health

7.1 Preparation basis and standards adopted

(1) Production Safety Law of the People's Republic of China (revised in 2014);

(2) General Provisions of Safety and Health Requirements of Production Process (GB12801-2008);

(3) General Provisions of Safety and Health Design of Production Equipment (GB5083-2012);

(4) Design Code for Noise Control of Industrial Enterprises (GB / T50087-2013);

(5) Sanitary Standards for the Design of Industrial Enterprises (GBZ 1-2010);

(6) Occupational Contact Limit for Hazardous Factors in the Workplace- -Part 1: Chemical Hazardous Factors (GBZ2.1-2010);

(7) Occupational Contact Limit for Hazardous Factors in the Workplace- -Part 2: Physical Hazardous Factors (GBZ2.2-2010);

(8) Code for Seismic Design of Buildings (GB50011-2010);

(9) Code for Lightning Protection Design of Buildings (GB50057-2010);

(10) Code for Design of Automatic Fire Alarm System (GB50116-2013);

(11) Code for Fire Prevention in Building Design (GB50016-2014);

(12) Code for Design of Building Fire Extinguisher Allocation (GB50140-2014);

(13) Safety Regulations for Lifting Machinery (GB6067);

(14) Safety Regulations for FerroAlloy (AQ2024-2010);

(15) Guidelines for Safety Design of Electrical Equipment (GB / T 25295-2010).

In addition to the above standards and specifications, it also includes GB2893-2008 Safety Color, GB4053-4053.1-4053.2-2009 Safety



Technical Conditions for Fixed Steel Ladder and Steel Ladder, GB4053.3-2009 Safety Technical Conditions for Stationary Industrial Protective Rail, GB4053.4 Fixed Industrial Steel Platform and General Requirements for Design and Manufacturing of Fixed and Active Protective Devices for Mechanical Safety Protective Devices (GB / T8196-2003), etc.

7.2 Project overview

Kinetic Development Group Limited South Africa 2×33000 kVA high carbon ferrochrome project, the project annual output of 125,300 tons.

The construction contents of this project mainly include: electric furnace smelting facilities, raw material system and warehouse, water supply and drainage facilities, ventilation and dust removal facilities, thermal facilities, power supply and distribution and electrical facilities (including 132kV transformer station), machine repair and inspection and testing facilities, etc.

In order to strengthen labor protection, improve working conditions, and implement the policy of "safety first, prevention first", the engineering design must implement the labor safety law and implement the national labor safety and health standards. Labor safety and health will be carried out according to the relevant regulations of the metallurgical industry.

7.3 Analysis of the main dangerous and harmful factors of the construction project

7.3.1 Analysis of natural hazard factors

The adverse effects of natural factors generally include earthquake, bad geology, heat, lightning, flood and other factors, the harm of various harmful factors are different, the possibility of occurrence, the scope of harm and the consequences caused are not the same.

The main natural risk factors existing in the construction area of the



Project are:

- 1) Earthquake: the earthquake occurred in the construction area of the project may damage the construction and structures of the project.
- 2) Lightning: the gas pipeline and chromium alloy production plant of this project are the second type of lightning protection structures, and the other structures belong to the third type of lightning protection structures. Lightning accidents may cause damage to gas pipelines, towering structures and electrical equipment.
- 3) Flood: It may cause flood accumulation accidents.

7.3.2 Analysis of the main hazards and harmful factors in the production process

The main dangerous and harmful factors in the production process include: material transportation and mechanical injury; explosion of liquid metal and slag; explosion of combustible gas; gas poisoning and asphyxiation; electric shock injury of electrical equipment; waste gas, high temperature radiation and noise in the production process.

◆ Analysis of the main risk factors in the production process

1) Fire and explosion accidents

Maintenance of gas equipment, facilities, pipelines, no partition, purging, replacement, and test of gas concentration, explosion; gas leakage, if not found in time and improper control, explosion accident may occur.

Main electric room, transformer room, cable room, cable tunnel and other electrical equipment may cause fire when overflow or failure.

The main parts prone to explosion and fire accidents are: gas transmission pipeline; high voltage distribution room: low voltage distribution room: electrical system, etc.

2) Electric shock injury



The shell of electrical device is damaged and accidentally touched by electric shock; mobile electric equipment without protective grounding measures; electric shock during maintenance; electrical equipment in main electrical room, transformer room, cable room, cable tunnel, overcurrent or fails.

The main parts of electric shock accident are: transformer and distribution devices; live facilities, equipment; transmission lines, etc.

3) Burning accident

Electric furnace and other production equipment is high temperature equipment, and it needs to be operated continuously. Failure during the operation may cause burning accidents.

High temperature operation (including steam operation) process and fault operation process. High-temperature liquid metal in water explosion injury accident.

The main parts of the burning accident are: electric furnace and other production equipment, steam equipment and pipeline, dust removal pipeline of production system, etc.

4) There are risks in the transportation process of lifting equipment

In the production and maintenance process, lifting equipment is used to lift materials and equipment. If the safety device of lifting equipment is defective or the lifting equipment is not operated properly, lifting injury accidents may be caused.

The main parts of lifting injury accident are: equipment installation, maintenance, moving heavy objects and other lifting places.

5) Mechanical injury

This project involves many mechanical equipment. In the production process or equipment maintenance process, when the operator approaches



the dangerous area of the mechanical moving parts, if the protective cover and protective screen baffle of the equipment are lacking, it is easy to cause collision, twisting, grinding and other injuries. Bare transmission equipment, tape transportation protection is not properly prone to mechanical damage.

The main parts of mechanical injury accidents include: fan, dust collector, external leakage parts of various pumps, exposed parts of mechanical equipment, etc.

6) Object strike

Object strike refers to the movement under the action of gravity or external force, hitting the human body and causing human injury accident. In the process of raw material preparation of the facilities and equipment, because the operators do not operate according to the operating procedures, the equipment installation is unqualified and other reasons, the raw material block, tools or equipment fly out or fall off, which may strike the operator and cause the object to strike safety accidents.

The main parts of object strike accidents are: raw material preparation, ingredients; fan; equipment installation; equipment maintenance, etc.

7) Falling from a height

Falling from height refers to the personal injury accident caused by falling due to unconcentration or improper protection when employees are working above 2m (including 2m), but excluding the falling accident of electric shock.

The main parts of high falling accident are: building roof; working platform with 2m higher, inclined ladder and pit; aerial operation, etc.

◆ Analysis of the major occupational harmful factors in the production process



1) Dust

Solid dust formed in the production process that can be suspended in the air of the workplace for a long time is one of the important productive harmful factors that pollute the environment and endanger the health of workers.

During the production process of this project, the electric furnace, raw material treatment equipment and raw material transportation system and other devices will produce and escape dust, causing pollution to the environment and harm to the operators.

2) Noise and vibration

The main equipment pollution sources in the production process of this project include: noise generated in the production process; aerodynamic noise generated during the fan operation, and mechanical noise generated during the operation of various mechanical equipment. The sound level of each noise source is about 85-105dB (A).

Mechanical noise generated by all kinds of mechanical equipment and transportation equipment during construction operation, and noise generated by production system, dust removal system, water treatment system and finished product transportation system.

The main parts of noise and vibration hazards are: each production workshop; dust removal system workplace; air compressor workplace; water treatment system workplace, etc.

3) High temperature hazards

High temperature environment can cause the central department (heat radiation disease, daily radiation disease, heat spasm, heat failure), long-term high temperature operation (several years) can appear hypertension, myocardial damage and digestive dysfunction. The degree of high temperature hazard is related to air temperature, air humidity,



airflow, radiant heat and individual body heat tolerance.

In this project, the electric furnace, raw material treatment equipment and coke drying production equipment belong to the high temperature operation area. According to the requirements of "High Temperature Operation Classification" (GB / T4200-2008), the allowed continuous contact time shall not exceed the relevant regulations under different working site temperature and different labor intensity conditions.

4) Poisoning and suffocation

During the maintenance of the gas system, without partition, purging and replacement, testing the gas concentration and not using protective equipment, gas poisoning accident; the failure of the pressure reducing valve group is prone to gas poisoning accident; the damaged gas leakage of expander, flange, shaft seal and pipe causes gas poisoning.

The main parts of gas poisoning and asphyxiation and dust hazard accidents are: gas transmission pipeline. According to the Gas Safety Regulations for Industrial Enterprises (GB6222- -2005), the maximum allowable concentration of carbon monoxide in the operating environment is 30 mg/m³.

5) Safety management defects

Improper establishment, structure and personnel composition of safety institutions result in improper connection, blank management, incomplete professionalism in safety management, and backward technical level of professionals, resulting in loopholes in safety management.

Safety management plans, emergency plans, methods and measures are not formulated in accordance with relevant laws and regulations, resulting in the ineffective implementation of accident rescue work, thus affecting the safety production.



6) Other factors

Vehicle injury refers to the human falling and object collapse, falling and crushing accident caused by the enterprise motor vehicle, but does not include the accident caused by lifting equipment and pulling vehicles and vehicles.

The site is narrow, the vehicle violation reversing, non-driver driving, driver violation, the car material is stable, command. The main parts of the vehicle injury accident are: the transportation process of finished products.

Electromagnetic radiation is radio frequency electromagnetic wave, which is mainly manifested as radio frequency heating effect and non-thermal effect. The main parts of the electromagnetic radiation accident existence are: transformer.

7.4 Main preventive measures taken in the labor safety and health design

7.4.1 Measures to prevent natural disasters

(1) Shock-proof measures

All the buildings (structures) of the project are fortified according to the local earthquake intensity. The seismic and earthquake protection of all electrical equipment is designed according to the requirements of the relevant specifications. For the mobile electrical equipment are taken shock reinforcement measures.

(2) Lightning protection measures

All structures above 15m shall adopt lightning protection grounding measures, lightning rod or lightning belt; protective grounding and working grounding systems of electrical equipment.

(3) Flood control and water measures

The plant is equipped with a good rainwater drainage pipe network, to prevent the heavy rain impact on production;



The equipment set in the open air is equipped with a rain canopy.

(4) Sand-sand resistance load measures

The structure of the plant considers the wind, rain, ash and other dynamic (static) load and various natural factors. Tall building design considers wind pressure load.

The occurrence of natural hazard factors is basically inevitable, but corresponding preventive measures can be taken to reduce the damage or loss to personnel, equipment, etc.

7.4.2 Hazard measures during production process

◆ Preventive measures for the main risk factors in the production process:

1) Fire prevention and explosion prevention measures

In order to prevent the possible explosion accidents of water leakage of water cooling system of electric furnace and raw material treatment equipment, temperature, flow, pressure monitoring and alarm devices are installed in the cooling water system.

In places with explosion and fire danger, the electrical equipment is explosion-proof. In order to avoid fire, the inspection doors of cable interlayer and shaft are designed as fire doors at the entrance of cable channel, such as fire doors for tunnel and fire prevention materials.

All electrical devices in places with explosion and fire hazards are designed according to the requirements of the relevant design specifications.

2) Anti-electric shock measures

In order to prevent electric shock accident, the electric furnace shell and its components take protective grounding measures.

Relay protection: in order to ensure the safe operation of electrical equipment, the following relay protection measures are adopted,



synchronous motor set longitudinal differential, overload, low voltage and single-phase ground protection.

High-voltage asynchronous motor is equipped with electric current rate break, overload, low voltage and single-phase ground protection. Low voltage motor setting short circuit, overload and low voltage protection. The distribution transformer is equipped with electric current rate break, delay overcurrent, gas and temperature protection.

Electric transmission protection: in order to ensure the stable operation of the power line, the thermal variable resistance or liquid resistance soft start device is designed for the synchronous motor, other high voltage asynchronous motor adopts the direct start mode, the low voltage motor generally adopts the direct start mode, for the equipment requiring speed regulation, AC frequency conversion speed regulation is adopted.

Grounding protection: according to the requirements of Grounding Design Code for Industrial and Civil Power Devices, the grounding resistance of transformer is 4 Ω . Metal enclosure protective ground resistance 10 Ω , ground form TN-C-S system. The PLC ground resistance is 1 Ω . Reground the power inlet away from the transformer with a ground resistance of 10 Ω . Lightning protection and grounding resistance of gas pipeline is 30 Ω . Lightning protection and impact grounding resistance of the building roof is 30 Ω .

Electrical safety: in order to ensure the personal safety of electrical equipment, the normal unelectric part of electrical equipment adopts zero protection, and set up special grounding wire (PE).

3) Prevent burning and lifting injury measures

Heat insulation operation room and control room are set up in the high-temperature operation area such as electric furnace and raw material



treatment equipment. High temperature areas and high temperature pipes for heat insulation, thermal insulation, and hanging warning signs.

The safety distance, road layout, safety signs and safety color of lifting, transportation and loading and unloading shall be carried out according to the relevant regulations.

4) Mechanical injury prevention and human fall measures

The general layout of the workshop has sufficient operation space for each operation equipment, and there is no visiting platform and walkway in the main workshop.

High-speed mechanical equipment are equipped with safety cover, workshop with safety corridor, main equipment, pipes and valves need often operation, maintenance places have enough operation maintenance area, operation platform and stairs with safety protection railing, roof surface of safety railing height of 1050mm, 10 over 8m high platform railing height of 1100mm.

All pits, Wells, ditches, ponds, etc. shall have safety railings or cover plates.

Maintenance platforms and maintenance channels shall be set up in places for frequent inspection and maintenance, and protective measures and safety signs shall be set up in dangerous areas.

5) Vehicle injury prevention measures

The width and turning radius of the railways and roads in the area are set up according to the standard requirements, and the railways and roads are connected between the workshops to ensure the safety and smooth transportation.

The material transportation mode, the storage area and the reasonable layout of the pedestrian passageway shall be fully considered in the workshop. The double-sided crane safety corridor is provided in the



workshop and connected, the clearance size of the crane and the workshop meet the requirements of the specification, the safety corridor of the crane and the safety signs.

6) Other safety production measures

Electric furnace power, electrode lifting and rotation, furnace body tilt, road cover lifting and rotation, to avoid damage to equipment and personnel during misoperation. The hydraulic station is equipped with energy accumulator, which can ensure the safety of equipment in accidents such as power failure.

The design of steel ladder meets the requirements of safety technical conditions of fixed steel ladder and inclined ladder. Each dangerous area shall be marked with eye-catching safety signs according to the provisions of the Safety Sign. All plant buildings are equipped with more than two safety exits.

◆ Industrial hygiene protection measures

Design Starting from the production process, combined with the actual needs of labor protection, the following effective protective measures are taken:

1) Measures to prevent dust and poisoning hazards

In this project, dust removal system is set up for smoke removal and dust removal, and mechanical negative pressure suction hood is set at each dust point to make the concentration of dust and harmful substances in the workplace meet the emission requirements of China. At the same time, individual protection should be strengthened to ensure the health of workers.

2) Prevent noise

The main equipment that produce noise in this project are fan, fan, dust collector, circulating water pump, cooling tower, air compressor,



etc. Take the following measures: selecting low noise equipment and low speed fan for dust removal fan; taking sound insulation and noise reduction measures: placing air compressor, water pump, fan, etc. indoors; taking shock absorption measures: reducing vibration equipment through basic treatment: setting the muffler at the fan outlet and sealing the fan by sealing. Ensure that the sound source intensity at 1m of the high-noise equipment is less than 85dB (A).

At the same time, individual protection should be strengthened. For individual posts with noise greater than 85dB (A), when restricted by working methods and conditions, personal protective equipment, such as earplugs, should be adopted to ensure the health of operators.

3) Prevent high temperature

In order to eliminate the heat emitted by the central control room, control room, main control room, operation room, instrument control room, duty room, ensure the normal operation of the electrical equipment and improve the working environment of operators, the air conditioner is set for air adjustment.

Good natural ventilation is considered in the design of each plant. When the natural ventilation can not meet the requirements, for example, axial flow fan or roof fan is set in chromium alloy production workshop, hydraulic station, high and low voltage distribution room, electrical room, water pump station for ventilation. The fan set in the high voltage distribution room can be used for accident smoke exhaust. Axial flow fan is set up in each high-temperature operating area for human body ventilation.

4) Other measures

Water supply and drainage measures: industrial water is recycled and utilized. This project establishes outdoor rainwater drainage pipes and



uses existing facilities.

The site of the project is determined after several joint studies by relevant local departments and construction units. Consider the design layout with reasonable production process and convenient road transportation, arrange all production units; input iron raw material and fuel, finished product output, connect the internal production process of the workshop well; ensure the workshop layout meets safety and fire prevention regulations.

According to the general drawing layout, the building spacing of this project can meet the requirements of safety and fire prevention spacing. The pits, ditches, holes and the holes, holes for lifting and maintenance on the workshop should be equipped with movable cover plate or guardrail. The width of the main traffic ladder in the design workshop shall not be less than 0.8m. The outdoor high ladder shall be fortified with protective plate or protective net, and safety railings shall be set around the working platform.

The houses in this project adopt natural lighting and the Windows are open. At the same time, according to the requirements of production and related safety and health, ventilation and cooling measures for high temperature operation area in the workshop; air conditioning equipment or ventilation equipment shall be installed in the electrical room and other places with special requirements for air environment to improve the working conditions; design the batching room, workshop duty room and mixture corridor in the factory.

The main wind direction in the area is southeast wind throughout the year, and the overall layout and design of the related facilities have taken into account the influence of the wind direction.

Electric furnace, raw material treatment equipment and other two



power supply, two power supply can be switched to each other, some important equipment such as: electric furnace, water pump station is also equipped with security power supply.

Safety management The safety department of the company is responsible for the unified management, and the safety department is responsible for the specific implementation. The safety officer department is fully responsible for the safety work and conducts a monthly safety inspection. Establish safety education and training system, conduct safety training for all production post personnel, after passing the examination and obtain the certificate before holding the certificate.

Formulate relevant safety rules and regulations such as safety inspection system, production safety accident management system, major hidden danger rectification system, equipment safety management system, safety production file management system, and safety production reward and punishment system.

Formulate various operation safety rules and operation rules of each type of work, each operation to do the rules to follow, operate according to the rules, to ensure production safety and personal safety.

7.5 Expected effect of labor safety and health

In the design of this project, the relevant national policies and regulations are strictly implemented, and the policy of "safety first, prevention first" is implemented to "have rules to follow and operate according to rules". At the same time, the dangerous and harmful factors in the production process are comprehensively analyzed, and corresponding safety preventive measures are taken in each production link.

In conclusion, the project design has taken corresponding preventive measures for the possible natural disaster factors and the possible



dangerous and hazard factors in the production process, which can meet the requirements of relevant standards and specifications, and ensure that the operators can work under the conditions of occupational safety and health. As long as the enterprise strengthens the management, the operators strictly abide by the operating rules, put an end to illegal operations, the personal safety and health of the workers will be guaranteed, can achieve the expected purpose.

BERIS



8 Fire

8.1 Design Basis

- (1) The Fire Control Law of the People's Republic of China (2008);
- (2) Code for Fire Prevention in Building Design (GB50016-2014);
- (3) Code for Design of Building Fire Extinguisher Allocation (GB50140-2010);
- (4) Code for Construction and Acceptance of Automatic Fire Alarm System (GB50166-2016);
- (5) Code for Lightning Protection Design of Buildings (GB50057-2010);
- (6) Code for Design of Automatic Fire Alarm System (GB50116-2013);
- (7) Requirements for Setting up Fire Safety Signs (GB15630-1995);
- (8) Minutes of meetings confirmed with the South African Fire Department.

8.2 Project Overview

8.2.1 8 Tasks and scope of the project

Kinetic Development Group Limited South Africa 2×33000 kVA high carbon ferrochrome project, the project annual output of 125,300 tons.

The construction contents of this project mainly include: electric furnace smelting facilities, raw material system and warehouse, water supply and drainage facilities, ventilation and dust removal facilities, thermal facilities, power supply and distribution and electrical facilities (including 132kV transformer station), machine repair and inspection and testing facilities.

8.2.2 Analysis of engineering fire factors

In the production process, the size of fire risk is directly related to the number of dangerous substances, production properties, operation and management level, and environmental conditions.

This project is not prone to fire under normal production conditions,



and only under operation error, violation of regulations, improper management and other abnormal production conditions or accident conditions, the fire may be caused by various factors. For example, the fan, main electric room, power distribution room and main control room are prone to fire in case of electric spark or lightning strike, and the gas system may explode in the production process of open fire. The leakage of metal liquid from electric furnace, raw material treatment equipment and other production equipment is prone to fire and explosion accidents in case of water on the ground.

The hazardous goods characteristics of this project are as follows:

Distribution room, transformer room and so on belong to class C;

Electric furnace, raw material treatment equipment belongs to the ding class;

Fan room, cooling tower, circulating water pump station, etc., belong to class E.

The main fire and explosion environment in this project is mainly power system and gas system. According to the national "Code for Fire Prevention in Building Design" (GB50016-2006), the classification of the fire and explosion risk of the main production sites or devices is shown in the table.

Classification of fire and explosion risk of the main production sites or devices

order number	Site, device, or system parts	Production of fire hazard categories	fire danger grade	Main fire and Explosion danger
--------------	-------------------------------	--------------------------------------	-------------------	--------------------------------



1	Main control-setting and transformer room	the third of the Ten Heavenly Stems	serious	Live objects
2	Electric furnace, charcoal material drying equipment Such as production equipment	man	In danger	Combustion solid
3	circulation	the fifth of the ten Heavenly Stems	light	Combustion solid

8.3 Fire prevention measures

8.3.1 General drawing layout

According to the requirements of production and transportation and fire prevention, in strict accordance with the "Code for Building Fire Design" and other relevant fire prevention design. There are circular roads or passageways around the building to ensure the smooth flow of fire-fighting vehicles. There is sufficient safety and fire prevention spacing between the buildings and structures to meet the requirements of the fire prevention code.

8.3.2 Building fire protection

The layout of the project is reasonable, the whole factory construction (structure) is tightly beaten, the factory site is flat, and the building is connected by the corridor. There is equipped around the



road, which can meet the needs of product transportation and ensure the fire vehicles unimpeded. The coke storage facilities of this project are Class C buildings, electric furnace, raw material processing equipment and other chromium alloy production workshops, electrical rooms and chimneys belong to Class D buildings, while others are Class E buildings, and the design fire resistance grade is Grade II.

High-rise industrial workshops such as operation room, electric room, electric furnace, raw material treatment equipment are equipped with fire safety channels directly to the ground; the floors of chrome alloy production workshops such as electric furnace and raw material treatment equipment are open or semi-open buildings; fire doors are provided at both ends of the front room of the elevator room and step room.

Design According to the Code for Fire Prevention in Building Design, determine the distance of safe evacuation in the workshop, the number of safe exits and the width of evacuation in the organization, and identify the simple horizontal and vertical traffic flow lines.

Each building (structure) is classified according to the fire risk of production, see "List of structures" for details.

8.3.3 Automatic fire alarm system

In order to prevent fire accidents, automatic fire alarm facilities are set up in important places such as electrical central control room, high voltage distribution room, low voltage distribution room, computer room, communication room equipment room, cable interlayer and various transformer and distribution stations.

1) Allocation of fire alarm facilities

The fire alarm controller is placed in the manned electrical central control room. Smoke detectors and manual alarm buttons are provided in the electrical central control room, high and low voltage distribution



room, computer room, communication equipment room and each substation, and cable fixed temperature detectors are provided in each cable interlayer in the electrical room.

The fire alarm controller can jointly control the fire hydrant system and the elevator in the electrical room. It can be interlocking with the gas fire extinguishing device in the electrical central control room, and the system loop is bus. Design detection points, alarm points and linkage points, all incorporated into the one-step construction category.

Acoustic and optical alarms are provided in the electrical room. When the fire occurs, the sound and light alarm alarms. When the staff on duty in the electrical central control room hear the alarm sound, they can immediately leave the danger scene and reduce casualties.

2) Fire alarm line

When the fire alarm line is laid in the building, the suspended ceiling or the steel pipe of the floor and walls; outdoors, the flame retardant shielding control cable shall be laid along the bridge and corridor.

When the fire alarm line is laid in the cable interlayer of the electric room, the flame retardant thermal control cable is laid on the cable tray.

3) Fire alarm linkage

The fire fighting equipment for fire linkage includes: in the main control room is equipped with a gas fire extinguishing driver and the solenoid valve between the water supply and drainage professional gas fire cylinder. When a fire occurs, the smoke and temperature detectors in the main control room alarm, and the solenoid valve acts to put out the gas fire in the main control room. The direct and external special fire alarm telephone is set up in the main control room, and the administrative



telephone, dispatching telephone, wireless intercom and instruction communication intercom communication facilities in the workshop office, section, control room and duty room can be used as the contact alarm in case of fire.

8.3.4 Electrical fire prevention

(1) All higher than 15m structures shall take lightning protection measures, set up lightning rod or lightning belt.

(2) In order to protect equipment and personal safety, all normal metal facilities shall be grounded reliably grounded, and the grounding resistance shall be not more than 4 Ω . Ground resistance of 10kV switchstation is not greater than 0.5 ohms, and grounding resistance of other facilities is not greater than 4 Ω .

(3) Protective devices or warning signs are provided in the areas with high pressure danger in the factory area. When the sliding touch line of the crane is on the same side as the crane cab in the workshop, an isolation safety net shall be set up close to the sliding touch line. All exposed live equipment is equipped with safety fences and warning signs. Provide local safety lighting in all dangerous places.

(4) The burner is equipped with reliable insulation measures. Connect the long electrode shell and the electrode platform to ensure the insulation between the operator and the ground.

(5) Take necessary fire prevention measures in the transformer room, cable tunnel, basement and other places according to the regulations.

8.3.5 Explosion-proof and fire prevention

The working site near the operating area of the electric furnace should be kept dry, and there should be no water in the pit to prevent molten alloy or slag explosion in water.

8.3.6 Fire extinguisher configuration



Electrical room, operation room, control room and hydraulic room are equipped with portable dry powder fire extinguishers.

8.4 Fire brigade situation

The production plant has a fire brigade and no fire engine. In case of fire, contact the regional fire brigade to provide facilities to assist in fire fighting.

8.5 Fire control management organization

The fire management organization and fire management work of this project shall be considered by the company.

8.6 Fire protection investment

The investment of special fire fighting facilities of this project is mainly: new indoor fire hydrant, mobile fire extinguishers, fire emergency lights and fire warning signs, etc., and the investment cost has been included in the total investment of the project.

8.7 Analysis of the expected effect of preventive measures

This design is designed in accordance with the Code for Fire Prevention of Building Design and other relevant provisions, and a series of perfect and effective fire control measures are taken for the places with fire hazards. Under normal circumstances, the operation is carried out in strict accordance with the operating procedures to avoid the occurrence of fire accidents and ensure safe production and life safety of staff. In case of a fire, the fire fighting facilities can be used to put out the fire in time, control the disaster situation, and minimize the loss.



9 Organization and labor quota

9.1 Organizational structure

This project is affiliated to Kinetic Development Group Limited The organization is considered by the company and incorporated into the existing organization.

9.2 Labor quota

According to the labor quota standard stipulated by the state and the

order number	Name of the post (work station)	fixed number of staff members or passengers					remarks
		the first of the ten Heavenly Stems	the second of the ten Heavenly Stems	the third of the Ten Heavenly Stems	man	amount to	
one	Raw material system						
	direct labor	10	10	10	10	40	
	administrative staff	2				2	
two	Mine heat furnace workshop						
	direct labor	21	21	21	21	84	
	administrative staff	5				5	
three	work shop						
	operating	10				10	

personnel density required by the production equipment, the labor quota required by the project is 235 people.



	personnel						
	administrative staff	2				2	
four	132kV power substation						
	operating personnel	3	3	3	3	12	
	administrative staff	2				2	
five	Inspection and maintenance of electrical equipment						
	Inspection personnel	3	3	3		9	
	administrative staff	2				2	
six	water system						
	operating personnel	3	3	3		9	
	administrative staff	2				2	
seven	Empty nitrogen suppression workshop						
	Operation personnel	2	2	2		6	
	administrative staff	1				1	
eight	dust pelletizing system						



	operating personnel	2	2	2		6	
	administrative staff	1				1	
nine	Inspection and laboratory						
	operating personnel	4	4	4		12	
	administrative staff	1				1	
ten	truck scale	2	2	2		6	
eleven	entrance guard	3	3	3		9	
twelve	administration staff	12				12	
amount to	operating personnel					203	
	administrative staff					32	

Note: The administrative personnel in the form are Chinese personnel, and the system management personnel are technical engineers with relevant system expertise. They can be decided by the local personnel or for domestic employment according to the technical level of the local personnel.

9.3 Source of employees

The source of employees has the following ways:

- (1) Internal adjustment of the company.
- (2) Middle and senior personnel are recruited for the society.
- (3) Production personnel and general workers in South Africa, with personnel with working experience.

9.4 Personnel training

The process equipment of this project has a relatively high degree



of automation, which requires the technical personnel and production workers to have a relatively high cultural quality and professional quality, and the training work is extremely important. During the preparation period, the training of the enterprise employees should be arranged, so that the trainees can be put into the equipment installation and debugging and trial production in time.

The main contents of technical training include production management training, application training of key technologies, operation and maintenance training of key equipment, quality control training, safety training, etc. The training objects include production workers, technicians and management personnel. Specific training measures:

(1) Organize theoretical knowledge learning to improve the level of cultural knowledge of the staff.

(2) Organize all kinds of new personnel for local training before the project is put into operation, and organize the assessment before taking up the post, and select the best ones.

(3) Invite experts with practical experience to teach technology on site. Arrange technical personnel with practical experience to give lessons to cadres and workers in different positions to improve the professional quality of all staff.

(4) Equipment providers need to be responsible for the training for key positions.



10 Investment estimate

10.1 Overview

The project mainly includes 2 × 33000 kVA thermal furnaces and the construction of raw material unloading, storage and transportation, raw material treatment (reserved for pellet facilities), finished product processing, scattered dust removal system and public auxiliary facilities, etc.

10.2 preparation basis

22.3.1 Construction Investment Budget Index of the Ministry of Metallurgical Industry.

22.3.2 Measures for Preliminary Design Estimation of Metallurgical Industry Construction.

22.3.3 Investment budget index of completed projects or similar projects.

22.3.4 The quantities shall be provided by each specialty.

10.3 relevant instructions

22.4.1 The price comprehensively takes into account the current price level;

22.4.2 Other project expenses shall be calculated according to the Preparation Method of Design Budget of Metallurgical Industry;

22.4.3 Transportation and miscellaneous expenses of engineering equipment shall be calculated at 9.5%;

22.4.4 The project reserve fund shall be calculated at 5%;

10.4 Investment Overview

order number	Name of the project and the costs	Estimated value (ten dollars)				
		construction engineering	installation cost	erection work	miscellaneous expenses	amount to
1	2	3	4	5	6	7
one	construction cost					
1	Electric furnace main workshop	832.57	829.11	176.79		1838.46
2	Raw materials for ingredients	296.20	268.12	146.15		710.48
3	dust removal by ventilation	87.04	356.16	46.30		489.50
4	Public auxiliary	216.22	486.66	264.68		967.56



	facilities					
5	Living welfare facilities	88.67	0.00	0.00		88.67
6	Total map and external network	219.71	7.39	55.59		282.69
	subtotal	1740.41	1947.44	689.51		4377.37
7	Equipment and instruments: 1%		1.95			
	amount to	1740.41	1949.39	689.51		4379.31
two	Other costs for the construction project				218.87	218.87
	amount to	1740.41	1949.39	689.51	218.87	4598.18
three	The reserve fee is 5%				229.91	229.91
	amount to	1740.41	1949.39	689.51	448.78	4828.09



11. Analysis of the economic benefits

11.1 and the preparation basis

(1) This economic evaluation is prepared according to the Economic Evaluation Methods and Parameters of Construction Projects (Version III) jointly issued by the National Development and Reform Commission and the Ministry of Construction in 2006, and the current domestic fiscal and tax policies, accounting systems and relevant regulations.

(2) Take the project as an independent system, calculate and evaluate the overall economic benefit of the project in accordance with the principle of consistent cost and benefit.

(3) The market price excluding tax is used.

11.2, production scale

After the completion of the project, the annual output of high carbon ferrochrome is 125,300 tons. See the process section for the product outline.

11.3 Project calculation period and production load

The calculation period of the project is 21 years, including 2 years; the first year is 80% of the production capacity and 100% in the second year.

11.4 Investment estimation and fund-raising

11.4.1 Total investment estimation

The total investment of project I is 405,0160 million, of which:

- (1) The construction investment is RMB 347,511,400 yuan;
- (2) Interest during the construction period of RMB 10,709,900 yuan;
- (3) The bottom working capital is 46.794,700 yuan.

The total investment of the construction project is RMB 514,203,600 yuan, of which:

- (1) The construction investment is RMB 347,511,400 yuan;
- (2) Interest during the construction period of RMB 10,709,900 yuan;
- (3) Working capital is RMB 155,982,400 yuan.

11.4.2 Financing

The total fund raised was 514.2036 million yuan, of which:

- (1) Applying for a long-term loan of 283,497,300 yuan, with an annual interest



rate of 4.65%;

(2) Apply for a working capital loan of 109,187,700 yuan, with an annual interest rate of 4.35%;

(3) The self-raised funds (capital) of the enterprise is 121,518,700 yuan, accounting for 30.0% of the total investment approved.

See Schedule 1 for working capital estimation, and Table 2 for the total investment use plan and fund raising.

11.5 Total costs and expenses

11.5.1 Calculation basis

(1) Raw and auxiliary materials and power consumption are determined according to the production process. The price of raw and auxiliary materials and power is determined by referring to the current market price provided by the owner. The electricity fee shall be 0.5283 yuan / kW. H. (excluding tax) calculation.

(2) For 235 employees, the salary is 90,000 yuan / person. Year calculation.

(3) The residual value rate of depreciation of fixed assets is 5%, and the comprehensive depreciation life is 12 years.

(4) Amortization of other assets for 12 years.

11.5.2 Total costs and expenses

According to the calculation, the average annual total cost and cost after the completion of the project is 806,627,400 yuan.

Annual manufacturing costs are shown in Table 7-1, and total costs are shown in Supplementary Table 3.

Table 11-1 Annual manufacturing cost

order number	project	unit	unit consumption	Unit Price (excluding tax price)	cost per unit	Annual consumption capacity	total cost	remarks
			(/t)	(first /t)	(first)		(Wan Yuan)	
one	cost of manufacture				6437.57		80662.74	
1	Raw and auxiliary materials				3552.39		44511.47	
1.1	chrome ore	t	2	1438.54	2877.0	25.06	3604	



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					8		9.81	
1.2	Coke / orchid charcoal	t	0.50	1158.57	579.29	6.27	7258.44	
1.3	Silicite / dolomite	t	0.17	95.55	16.63	2.18	208.32	
1.4	carbon paste	t	0.025	3176.04	79.40	0.31	994.89	
2	motive power				1853.06		2331.203	
2.1	power consumption	kWh	3504	0.5283	1851.16	43905	2319.501	
2.2	Water consumption	m ³	1.07	1.78	1.90	65.74	117.02	
3	Workers' wages and benefits	fi rs t					1880.00	
4	cost of production	fi rs t			423.75		5309.63	All are normal years
4.1	maintenance and repair cost	fi rs t			98.88		1238.91	
4.2	depreciation-changing percent age of cost less scrap method	fi rs t			197.75		2477.83	
4.3	other	fi rs t			127.13		1592.89	
5	general expenses	fi rs t			60.09		752.94	
6	cost of financing	fi rs t			162.83		2040.28	
7	selling expenses	fi rs t			227.96		2856.40	



project

8	Total cost	fi rs t			6437.5 7		8066 2.74	
	amortization charge	fi rs t			4.62		57.9 2	
9	handling cost	fi rs t			6072.3 6		7608 6.72	

Note: sold to China, the freight should increase 719.76 yuan / ton.

11.6, operating income

According to the average market price and the future market price trend in recent March, the average sales price of the high-carbon ferrochrome (55 base tons) is 8141.59 yuan / ton (excluding tax), and the annual sales revenue is 1020.141,200 yuan (excluding tax).

11.7 Tax and profit calculation

The VAT rate is 13%, and the urban maintenance and construction tax and education surcharge are 5%, 3% and 2% respectively.

The income tax rate is 25%, and the statutory surplus reserve fund is 10% of the net profit. The calculated average annual profit is RMB 121,724,600 yuan; the average annual net profit is RMB 91,293,500 yuan.

The profit and profit distribution table is shown in attached Table 4.

11.8 and a financial analysis

11.8.1 Profitability analysis

11.8.1.1 Pre-financing analysis

The financial internal rate of return of project investment before income tax is 31.65%; the financial internal rate of return of project investment after income tax is 26.05%, greater than the set benchmark rate of return (12%).

The cash flow statement of the project investment is shown in attached Table 5.

11.8.1.2 Post-financing analysis

Financial internal rate of return of project capital is 30.80%.

The cash flow statement of the target capital is shown in attached Table 6.

11.8.2 solvency analysis



In the solvency analysis, the equal repayment of principal and interest is used, and the current period of equal repayment is 5.02 years. The balance sheet is shown in Supplementary Table 7.

11.8.3 Analysis of financial viability

Funding source and application table are shown in attached Table 8.

11.8.4 break-even analysis

As long as the production capacity utilization rate of the project exceeds 37.73%, it can be profitable.

11.9 Evaluation conclusion

After the income tax of this project, the financial internal rate of return of the project investment is 26.05%, which is 12% higher than the set benchmark rate of return. The debt repayment analysis index is good, and it has the financial survival ability.

The evaluation indicators are summarized in Table 11-2.



order number	name of index	unit	quantity	remarks
1	Products and Output			
1.1	High carbon ferrochrome (55 base t)	ten thousand t/a	12.53	
2	Consumption of the main raw and auxiliary materials			
2.1	chrome ore	ten thousand t/a	25.06	
2.2	Coke / orchid charcoal	ten thousand t/a	6.27	
2.3	Silicite / dolomite	ten thousand t/a	2.18	
2.4	carbon paste	ten thousand t/a	0.31	
3	power consumption			
3.1	power consumption	ten thousand kW·h	43905	
3.2	Water consumption	ten thousand m ³	65.74	
4	Labor quota and productivity			
4.1	manpower quota	human being	235	
4.2	all-personnel labour productivity	ten thousand t/a	0.05	
5	Main economic indicators			
5.1	total investment	Wan Yuan	40501.60	
5.1.1	Including: construction investment	Wan Yuan	34751.14	
5.1.2	Construction period interest	Wan Yuan	1070.99	
5.1.3	Shop bottom working capital	Wan Yuan	4679.47	
5.2	sales income	Wan Yuan	10201	



			4.12	
5.3	total cost	Wan Yuan	80662.74	normal year
5.4	total profit	Wan Yuan	12172.46	normal year
5.5	income tax	Wan Yuan	3043.12	
5.6	after-tax profits	Wan Yuan	9129.35	normal year
5.7	Sales taxes and surcharges	Wan Yuan	160.33	normal year
5.8	Full investment of the financial internal rate of return	%	26.05	after tax
5.9	All investment payback period (including the construction period)	a	5.92	after tax
5.10	Loan repayment period	a	5.02	
5.11	Net profit ratio of project capital	%	22.54	normal year
5.12	Total investment yield	%	30.05	normal year
5.13	breakeven point	%	37.73	
5.14	Economic added value of EVA	Wan Yuan	7716.85	normal year



Schedule 1: Working Capital Estimate Table

Unit: ten thousand yuan

order number	project	Turnover times	1	2	3	4	5	6	7	8	9	10
1	circulating assets		-	-	20649.22	24076.17	24076.17	24076.17	24076.17	24076.17	24076.17	24076.17
1.1	receivables	8	-	-	7743.84	9510.84	9510.84	9510.84	9510.84	9510.84	9510.84	9510.84
1.2	stock		-	-	12526.48	14186.43	14186.43	14186.43	14186.43	14186.43	14186.43	14186.43
1.2.1	Raw and auxiliary materials	8	-	-	4451.15	5563.93	5563.93	5563.93	5563.93	5563.93	5563.93	5563.93
1.2.2	fuels and energy	10	-	-	1864.96	2331.20	2331.20	2331.20	2331.20	2331.20	2331.20	2331.20
1.2.3	goods in process	110	-	-	578.48	659.41	659.41	659.41	659.41	659.41	659.41	659.41
1.2.4	finished product	11	-	-	5631.89	5631.89	5631.89	5631.89	5631.89	5631.89	5631.89	5631.89
1.3	ready money	11	-	-	378.90	378.90	378.90	378.90	378.90	378.90	378.90	378.90
2	cash liabilities		-	-	6782.35	8477.94	8477.94	8477.94	8477.94	8477.94	8477.94	8477.94
2.1	account payable	8	-	-	6782.35	8477.94	8477.94	8477.94	8477.94	8477.94	8477.94	8477.94



3	floating capital		-	-	13866.87	15598.24	15598.24	15598.24	15598.24	15598.24	15598.24	15598.24
4	Working capital has increased in the current period		-	-	13866.87	1731.37	-	-	-	-	-	-

Continuation table 1

order number	project	Turnover times	11	12	13	14	15	16	17	18	19	20	21
1	circulating assets		24076.17	24076.17	24076.17	24076.17	24076.17	24076.17	24076.17	24076.17	24076.17	24076.17	24076.17
1.1	receivables	8	9510.84	9510.84	9510.84	9510.84	9510.84	9510.84	9510.84	9510.84	9510.84	9510.84	9510.84
1.2	stock		14186.43	14186.43	14186.43	14186.43	14186.43	14186.43	14186.43	14186.43	14186.43	14186.43	14186.43
1.2.1	Raw and auxiliary materials	8	5563.93	5563.93	5563.93	5563.93	5563.93	5563.93	5563.93	5563.93	5563.93	5563.93	5563.93
1.2.2	fuels and energy	10	2331.20	2331.20	2331.20	2331.20	2331.20	2331.20	2331.20	2331.20	2331.20	2331.20	2331.20
1.2.3	goods in process	110	659.41	659.41	659.41	659.41	659.41	659.41	659.41	659.41	659.41	659.41	659.41
1.2.4	finished product	11	5631.89	5631.89	5631.89	5631.89	5631.89	5631.89	5631.89	5631.89	5631.89	5631.89	5631.89
1.3	ready money	11	378.90	378.90	378.90	378.90	378.90	378.90	378.90	378.90	378.90	378.90	378.90



2	cash liabilities		8477.9 4	8477.9 4	8477.9 4	8477.9 4	8477.9 4	8477.9 4	8477.9 4	8477.9 4	8477.9 4	8477.9 4	8477.9 4
2.1	account payable	8	8477.9 4	8477.9 4	8477.9 4	8477.9 4	8477.9 4	8477.9 4	8477.9 4	8477.9 4	8477.9 4	8477.9 4	8477.9 4
3	floating capital		15598. 24	15598. 24	15598. 24	15598. 24	15598. 24	15598. 24	15598. 24	15598. 24	15598. 24	15598. 24	15598. 24
4	Working capital has increased in the current period		-	-	-	-	-	-	-	-	-	-	-

Schedule 2. Project total investment and use plan and fund raising table

Unit: ten thousand yuan

order number	project	amount to	1	2	3	4
	Production load		0%	0%	80%	100%
1	Total funds	51420.36	10624.42	25197.71	13866.87	1731.37
1.1	Construction investment	34751.14	10425.34	24325.80	-	-
1.2	Construction period interest	1070.99	199.07	871.91	-	-
1.3	floating capital	15598.24	-	-	13866.87	1731.37
2	financing	51420.36	10624.42	25197.71	13866.87	1731.37
2.1	funds in the hands of the localities	12151.87	2097.66	5374.74	4160.06	519.41



	Including: used for working capital	4679.47	-	-	4160.06	519.41
2.2	borrow money	39268.49	8526.76	19822.97	9706.81	1211.96
2.2.1	short term bank loan	10918.77	-	-	9706.81	1211.96
2.2.2	money borrowed for long term	28349.73	8526.76	19822.97	-	-

Schedule 3 Total cost table

Unit: ten thousand yuan

order number	project	amount to	1	2	3	4	5	6	7	8	9	10
0	Production load		0 %	0 %	80%	100%	100%	100%	100%	100%	100%	100%
1	cost of production	1310802	-	-	61448.4 2	75013.1 2	75013.1 2	75013.1 2	75013.1 2	75013.1 2	75013.1 2	75013.1 2
1.1	Direct material fee	836816	-	-	35609.1 7	44511.4 7	44511.4 7	44511.4 7	44511.4 7	44511.4 7	44511.4 7	44511.4 7
1.2	Power fee	438266	-	-	18649.6 2	23312.0 3	23312.0 3	23312.0 3	23312.0 3	23312.0 3	23312.0 3	23312.0 3
1.3	Direct wages and welfare funds	35720	-	-	1880.00	1880.00	1880.00	1880.00	1880.00	1880.00	1880.00	1880.00
1.4	cost of production	67432	-	-	5309.63	5309.63	5309.63	5309.63	5309.63	5309.63	5309.63	5309.63
1.4.1	repair cost	12389	-	-	1238.91	1238.91	1238.91	1238.91	1238.91	1238.91	1238.91	1238.91
1.4.2	depreciation cost	24778	-	-	2477.83	2477.83	2477.83	2477.83	2477.83	2477.83	2477.83	2477.83
1.4.3	other manufacturing overhead	30265	-	-	1592.89	1592.89	1592.89	1592.89	1592.89	1592.89	1592.89	1592.89



2	general expenses	13785	-	-	752.94	752.94	752.94	752.94	752.94	752.94	752.94	752.94
2.1	Invisible amortization fee	290	-	-	28.96	28.96	28.96	28.96	28.96	28.96	28.96	28.96
2.2	Other asset amortization fees	290	-	-	28.96	28.96	28.96	28.96	28.96	28.96	28.96	28.96
2.3	Other administrative expenses	13205	-	-	695.02	695.02	695.02	695.02	695.02	695.02	695.02	695.02
3	selling expenses	53700	-	-	2285.12	2856.40	2856.40	2856.40	2856.40	2856.40	2856.40	2856.40
4	cost of financing	38357	-	-	1632.23	2040.28	2040.28	2040.28	2040.28	2040.28	2040.28	2040.28
5	Total cost	1484076	-	-	66118.7 1	80662.7 4	80662.7 4	80662.7 4	80662.7 4	80662.7 4	80662.7 4	80662.7 4
5.1	Including: fixed cost	208994	-	-	11859.9 1	12839.2 5	12839.2 5	12839.2 5	12839.2 5	12839.2 5	12839.2 5	12839.2 5
5.2	controllable cost	1275082	-	-	54258.8 0	67823.5 0	67823.5 0	67823.5 0	67823.5 0	67823.5 0	67823.5 0	67823.5 0
6	handling cost	1420361	-	-	61950.7 4	76086.7 2	76086.7 2	76086.7 2	76086.7 2	76086.7 2	76086.7 2	76086.7 2

Continuation

table 3

order number	project	amount to	11	12	13	14	15	16	17	18	19	20	21
0	Production load		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
1	cost of production	1310802	75013. 12	75013. 12	71296. 38	71296. 38	71296. 38	71296. 38	71296. 38	71296. 38	71296. 38	71296. 38	71296. 38
1.1	Direct material fee	836816	44511. 47	44511. 47	44511. 47	44511. 47	44511. 47	44511. 47	44511. 47	44511. 47	44511. 47	44511. 47	44511. 47
1.2	Power fee	438266	23312.	23312.	23312.	23312.	23312.	23312.	23312.	23312.	23312.	23312.	23312.



			03	03	03	03	03	03	03	03	03	03	03
1.3	Direct wages and welfare funds	35720	1880.0 0	1880.0 0	1880.0 0	1880.0 0	1880.0 0	1880.0 0	1880.0 0	1880.0 0	1880.0 0	1880.0 0	1880.0 0
1.4	cost of production	67432	5309.6 3	5309.6 3	1592.8 9	1592.8 9	1592.8 9	1592.8 9	1592.8 9	1592.8 9	1592.8 9	1592.8 9	1592.8 9
1.4.1	repair cost	12389	1238.9 1	1238.9 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.4.2	depreciation cost	24778	2477.8 3	2477.8 3	0.00	-	-	-	-	-	-	-	-
1.4.3	other manufacturing overhead	30265	1592.8 9	1592.8 9	1592.8 9	1592.8 9	1592.8 9	1592.8 9	1592.8 9	1592.8 9	1592.8 9	1592.8 9	1592.8 9
2	general expenses	13785	752.94	752.94	695.02	695.02	695.02	695.02	695.02	695.02	695.02	695.02	695.02
2.1	Invisible amortization fee	290	28.96	28.96	0.00	-	-	-	-	-	-	-	-
2.2	Other asset amortization fees	290	28.96	28.96	0.00	-	-	-	-	-	-	-	-
2.3	Other administrative expenses	13205	695.02	695.02	695.02	695.02	695.02	695.02	695.02	695.02	695.02	695.02	695.02
3	selling expenses	53700	2856.4 0	2856.4 0	2856.4 0	2856.4 0	2856.4 0	2856.4 0	2856.4 0	2856.4 0	2856.4 0	2856.4 0	2856.4 0
4	cost of financing	38357	2040.2 8	2040.2 8	2040.2 8	2040.2 8	2040.2 8	2040.2 8	2040.2 8	2040.2 8	2040.2 8	2040.2 8	2040.2 8
5	Total cost	1484076	80662. 74	80662. 74	76888. 09	76888. 09	76888. 09	76888. 09	76888. 09	76888. 09	76888. 09	76888. 09	76888. 09
5.1	Including: fixed cost	208994	12839. 25	12839. 25	9064.5 9	9064.5 9	9064.5 9	9064.5 9	9064.5 9	9064.5 9	9064.5 9	9064.5 9	9064.5 9



5.2	controllable cost	1275082	67823. 50	67823. 50	67823. 50	67823. 50	67823. 50	67823. 50	67823. 50	67823. 50	67823. 50	67823. 50	67823. 50
6	handling cost	1420361	76086. 72	76086. 72	74847. 80	74847. 80	74847. 80	74847. 80	74847. 80	74847. 80	74847. 80	74847. 80	74847. 80

Schedule 4: Profit distribution table

Unit: ten thousand yuan

order number	project	amount to	1	2	3	4	5	6	7	8	9	10
0	Production load		0 %	0 %	80%	100%	100%	100%	100%	100%	100%	100%
1	sales revenue	191786 6	-	-	81611. 30	102014. 12	102014. 12	102014. 12	102014. 12	102014. 12	102014. 12	102014. 12
2	Sales taxes and surcharges	3014	-	-	128.26	160.33	160.33	160.33	160.33	160.33	160.33	160.33
3	Total cost	148407 6	-	-	66118. 71	80662.7 4	80662.7 4	80662.7 4	80662.7 4	80662.7 4	80662.7 4	80662.7 4
4	transportation expenses	169550	-	-	7214.8 7	9018.59	9018.59	9018.59	9018.59	9018.59	9018.59	9018.59
5	total profit	261226	-	-	8149.4 6	12172.4 6	12172.4 6	12172.4 6	12172.4 6	12172.4 6	12172.4 6	12172.4 6
6	taxable income	261226	-	-	8149.4 6	12172.4 6	12172.4 6	12172.4 6	12172.4 6	12172.4 6	12172.4 6	12172.4 6
7	income tax	65306	-	-	2037.3 6	3043.12	3043.12	3043.12	3043.12	3043.12	3043.12	3043.12
8	after-tax profits	195919	-	-	6112.0	9129.35	9129.35	9129.35	9129.35	9129.35	9129.35	9129.35



					9							
9	Profits available for distribution	195919	-	-	6112.0 9	9129.35	9129.35	9129.35	9129.35	9129.35	9129.35	9129.35
9.1	Withdraw from the legal surplus reserve fund	19592	-	-	611.21	912.93	912.93	912.93	912.93	912.93	912.93	912.93
9.2	Profits available for distribution by investors	176327	-	-	5500.8 8	8216.41	8216.41	8216.41	8216.41	8216.41	8216.41	8216.41
9.3	undistributed profit	176327	-	-	5500.8 8	8216.41	8216.41	8216.41	8216.41	8216.41	8216.41	8216.41
10	Profit before interest and tax	261226	-	-	8149.4 6	12172.4 6	12172.4 6	12172.4 6	12172.4 6	12172.4 6	12172.4 6	12172.4 6
11	Profit before interest, tax, DeTTDA	286294	-	-	10656. 24	14679.2 5	14679.2 5	14679.2 5	14679.2 5	14679.2 5	14679.2 5	14679.2 5

Continuation

table 4

order number	project	amount to	11	12	13	14	15	16	17	18	19	20	21
0	Production load		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
1	sales revenue	1917866	102014. 12	102014. 12	102014. 12	102014. 12	102014. 12	102014. 12	102014. 12	102014. 12	102014. 12	102014. 12	102014. 12
2	Sales taxes and surcharges	3014	160.33	160.33	160.33	160.33	160.33	160.33	160.33	160.33	160.33	160.33	160.33
3	Total cost	1484076	80662.7 4	80662.7 4	76888.0 9	76888.0 9	76888.0 9	76888.0 9	76888.0 9	76888.0 9	76888.0 9	76888.0 9	76888.0 9



4	transportation expenses	169550	9018.59	9018.59	9018.59	9018.59	9018.59	9018.59	9018.59	9018.59	9018.59	9018.59	9018.59
5	total profit	261226	12172.4 6	12172.4 6	15947.1 2	15947.1 2	15947.1 2	15947.1 2	15947.1 2	15947.1 2	15947.1 2	15947.1 2	15947.1 2
6	taxable income	261226	12172.4 6	12172.4 6	15947.1 2	15947.1 2	15947.1 2	15947.1 2	15947.1 2	15947.1 2	15947.1 2	15947.1 2	15947.1 2
7	income tax	65306	3043.12	3043.12	3986.78	3986.78	3986.78	3986.78	3986.78	3986.78	3986.78	3986.78	3986.78
8	after-tax profits	195919	9129.35	9129.35	11960.3 4	11960.3 4	11960.3 4	11960.3 4	11960.3 4	11960.3 4	11960.3 4	11960.3 4	11960.3 4
9	Profits available for distribution	195919	9129.35	9129.35	11960.3 4	11960.3 4	11960.3 4	11960.3 4	11960.3 4	11960.3 4	11960.3 4	11960.3 4	11960.3 4
9.1	Withdraw from the legal surplus reserve fund	19592	912.93	912.93	1196.03	1196.03	1196.03	1196.03	1196.03	1196.03	1196.03	1196.03	1196.03
9.2	Profits available for distribution by investors	176327	8216.41	8216.41	10764.3 0	10764.3 0	10764.3 0	10764.3 0	10764.3 0	10764.3 0	10764.3 0	10764.3 0	10764.3 0
9.3	undistributed profit	176327	8216.41	8216.41	10764.3 0	10764.3 0	10764.3 0	10764.3 0	10764.3 0	10764.3 0	10764.3 0	10764.3 0	10764.3 0
10	Profit before interest and tax	261226	12172.4 6	12172.4 6	15947.1 2	15947.1 2	15947.1 2	15947.1 2	15947.1 2	15947.1 2	15947.1 2	15947.1 2	15947.1 2
11	Profit before interest, tax, DeTTDA	286294	14679.2 5	14679.2 5	15947.1 2	15947.1 2	15947.1 2	15947.1 2	15947.1 2	15947.1 2	15947.1 2	15947.1 2	15947.1 2

Schedule 5. Statement of investment cash flow / ten thousand yuan

order number	project	amount to	1	2	3	4	5	6	7	8	9	10
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1	inward cash-flow	1935201.30	-	-	81611.30	102014.12	102014.12	102014.12	102014.12	102014.12	102014.12	102014.12
1.1	operating receipt	1917865.51	-	-	81611.30	102014.12	102014.12	102014.12	102014.12	102014.12	102014.12	102014.12
1.2	Recovery of the fixed assets surplus value	1737.56	-	-	-	-	-	-	-	-	-	-
1.3	Recycling working capital	15598.24	-	-	-	-	-	-	-	-	-	-
2	cash drain	1708580.88	10425.34	24325.80	85198.11	90040.12	88308.75	88308.75	88308.75	88308.75	88308.75	88308.75
2.1	investment in the fixed assets	34751.14	10425.34	24325.80	-	-	-	-	-	-	-	-
2.2	floating capital	15598.24	-	-	13866.87	1731.37	-	-	-	-	-	-
2.3	handling cost	1420361.40	-	-	61950.74	76086.72	76086.72	76086.72	76086.72	76086.72	76086.72	76086.72
2.4	Sales taxes and surcharges	3014.13	-	-	128.26	160.33	160.33	160.33	160.33	160.33	160.33	160.33
2.5	transportation expenses	169549.54	-	-	7214.87	9018.59	9018.59	9018.59	9018.59	9018.59	9018.59	9018.59
2.6	income tax	65306.42	-	-	2037.36	3043.12	3043.12	3043.12	3043.12	3043.12	3043.12	3043.12
3	net cash flow	226620.42	-10425.34	-24325.80	-3586.81	11974.01	13705.37	13705.37	13705.37	13705.37	13705.37	13705.37
4	accumulative total of net cash flow	1569478.61	-10425.34	-34751.14	-38337.95	-26363.94	-12658.57	1046.80	14752.18	28457.55	42162.92	55868.29
	Current value of accumulated net cash flow	183198.41	-10425.34	-33341.78	-36525.01	-26513.96	-15719.26	-5549.96	4030.16	13055.23	21557.42	16511.79



5	Net cash flow before income tax	291926. 84	-10425 .34	-24325 .80	-1549.44	15017. 12	16748. 49	16748. 49	16748. 49	16748.49	16748. 49	16748. 49
6	Accumulated net cash flow before income tax	2171026 .14	-10425 .34	-34751 .14	-36300.58	-21283. 46	-4534.9 7	12213. 51	28962. 00	45710.49	62458. 98	79207. 47
	Present value of net cash flow before income tax	132576. 56	-10425 .34	-22916 .44	-1375.10	12555. 29	13191. 54	12427. 27	11707. 27	11028.99	10390. 00	9788.0 4
	Present value of accumulated net cash flow before income tax	314097. 40	-10425 .34	-33341 .78	-34716.88	-22161. 60	-8970.0 5	3457.2 1	15164. 48	26193.47	36583. 47	20178. 04
	financial internal rate of return:				26.05% (after-tax)					31.65% (before tax)		
	Financial net present value (Ic = 12%):				22832.74					36737.71		
	Static investment payback period (including the construction period):				5.92					5.27		
	Dynamic investment payback period (including the construction period):				6.58					5.72		

Continuation

Table 5

order number	project	amount to	11	12	13	14	15	16	17	18	19	20	21
1	inward cash-flow	1935201 .30	102014 .12	102014 .12	102014 .12	102014 .12	102014 .12	102014 .12	102014 .12	102014 .12	102014 .12	102014 .12	119349 .92
1.1	operating receipt	1917865 .51	102014 .12	102014 .12	102014 .12	102014 .12	102014 .12	102014 .12	102014 .12	102014 .12	102014 .12	102014 .12	102014 .12
1.2	Recovery of the fixed assets surplus value	1737.56	-	-	-	-	-	-	-	-	-	-	1737.5 57



1.3	Recycling working capital	15598.2 4	-	-	-	-	-	-	-	-	-	-	15598. 24
2	cash drain	1708580 .88	88308. 75	88308. 75	88013. 50	88013. 50	88013. 50	88013. 50	88013. 50	88013. 50	88013. 50	88013. 50	88013. 50
2.1	investment in the fixed assets	34751.1 4	-	-	-	-	-	-	-	-	-	-	-
2.2	floating capital	15598.2 4	-	-	-	-	-	-	-	-	-	-	-
2.3	handling cost	1420361 .40	76086. 72	76086. 72	74847. 80	74847. 80	74847. 80	74847. 80	74847. 80	74847. 80	74847. 80	74847. 80	74847. 80
2.4	Sales taxes and surcharges	3014.13	160.33	160.33	160.33	160.33	160.33	160.33	160.33	160.33	160.33	160.33	160.33
2.5	transportation expenses	169549. 54	9018.5 9	9018.5 9	9018.5 9	9018.5 9	9018.5 9	9018.5 9	9018.5 9	9018.5 9	9018.5 9	9018.5 9	9018.5 9
2.6	income tax	65306.4 2	3043.1 2	3043.1 2	3986.7 8	3986.7 8	3986.7 8	3986.7 8	3986.7 8	3986.7 8	3986.7 8	3986.7 8	3986.7 8
3	net cash flow	226620. 42	13705. 37	13705. 37	14000. 62	14000. 62	14000. 62	14000. 62	14000. 62	14000. 62	14000. 62	14000. 62	31336. 41
4	accumulative total of net cash flow	1569478 .61	69573. 67	83279. 04	97279. 66	111280 .28	125280 .90	139281 .52	153282 .15	167282 .77	181283 .39	195284 .01	226620 .42
	Current value of accumulated net cash flow	183198. 41	24057. 34	31165. 72	38006. 53	13285. 28	19356. 38	25075. 74	30463. 73	10463. 83	15245. 59	19750. 30	29248. 68
5	Net cash flow before income tax	291926. 84	16748. 49	16748. 49	17987. 40	17987. 40	17987. 40	17987. 40	17987. 40	17987. 40	17987. 40	17987. 40	35323. 19
6	Accumulated net cash flow before income tax	2171026 .14	95955. 95	112704 .44	130691 .84	148679 .24	166666 .64	184654 .04	202641 .45	220628 .85	238616 .25	256603 .65	291926 .84
	Present value of net cash flow before income tax	132576.	9220.9	8686.7	8788.7	8279.5	7799.8	7347.9	6922.2	6521.2	6143.3	5787.4	10706.



		56	5	2	8	8	9	9	7	1	9	7	81
	Present value of accumulated net cash flow before income tax	314097.40	29398.99	38085.70	46874.48	17068.36	24868.25	32216.24	39138.50	13443.48	19586.88	25374.34	36081.15
	financial internal rate of return:												
	Financial net present value (Ic = 12%):												
	Static investment payback period (including the construction period):												
	Dynamic investment payback period (including the construction period):												

Schedule 6. Statement of capital cash flow

Unit: ten thousand yuan

order number	project	amount to	1	2	3	4	5	6	7	8	9	10
0	Production load of (%)		0%	0%	80%	100%	100%	100%	100%	100%	100%	100%
1	inward cash-flow	1935201.30	-	-	81611.30	102014.12	102014.12	102014.12	102014.12	102014.12	102014.12	102014.12
1.1	operating receipt	1917865.51	-	-	81611.30	102014.12	102014.12	102014.12	102014.12	102014.12	102014.12	102014.12
1.2	Recovery of the fixed assets surplus value	1737.56	-	-	-	-	-	-	-	-	-	-
1.3	Recycling working capital	15598.24	-	-	-	-	-	-	-	-	-	-
2	cash drain	1735341.02	2296.73	6246.65	87955.10	103334.70	98718.42	98240.99	98233.63	88783.72	88783.72	88783.72



2.1	capital in cash	17007.20	2097.6 6	5374.74	5374.7 4	4160.06	-	-	-	-	-	-
2.2	Repayment of loan principal	47249.54	-	-	9449.9 1	9449.91	9449.91	9449.91	9449.91	-	-	-
2.3	Loan interest payment	12852.77	199.07	871.91	1799.2 1	1415.98	959.76	482.33	474.97	474.97	474.97	474.97
2.4	handling cost	1420361. 40	-	-	61950. 74	76086.7 2	76086.7 2	76086.7 2	76086.7 2	76086.7 2	76086.7 2	76086.7 2
2.5	Sales taxes and surcharges	3014.13	-	-	128.26	160.33	160.33	160.33	160.33	160.33	160.33	160.33
2.6	transportation expenses	169549.5 4	-	-	7214.8 7	9018.59	9018.59	9018.59	9018.59	9018.59	9018.59	9018.59
2.7	income tax	65306.42	-	-	2037.3 6	3043.12	3043.12	3043.12	3043.12	3043.12	3043.12	3043.12
3	net cash flow	199860.2 8	-2296.7 3	-6246.6 5	-6343.8 0	-1320.58	3295.70	3773.13	3780.50	13230.4 1	13230.4 1	13230.4 1
	parameter:											
	financial internal rate of return:		30.80%									
	Financial net present value (Ic = 12%):		17780. 13	Wan Yuan								

Continuation

Table 6

order number	project	amount to	11	12	13	14	15	16	17	18	19	20	21
0	Production load of (%)		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%



1	inward cash-flow	1935201.30	102014.12	102014.12	102014.12	102014.12	102014.12	102014.12	102014.12	102014.12	102014.12	102014.12	119349.92
1.1	operating receipt	1917865.51	102014.12	102014.12	102014.12	102014.12	102014.12	102014.12	102014.12	102014.12	102014.12	102014.12	102014.12
1.2	Recovery of the fixed assets surplus value	1737.56	-	-	-	-	-	-	-	-	-	-	1737.56
1.3	Recycling working capital	15598.24	-	-	-	-	-	-	-	-	-	-	15598.24
2	cash drain	1735341.02	88783.72	88783.72	88488.47	88488.47	88488.47	88488.47	88488.47	88488.47	88488.47	88488.47	88488.47
2.1	capital in cash	17007.20	-	-	-	-	-	-	-	-	-	-	-
2.2	Repayment of loan principal	47249.54	-	-	-	-	-	-	-	-	-	-	-
2.3	Loan interest payment	12852.77	474.97	474.97	474.97	474.97	474.97	474.97	474.97	474.97	474.97	474.97	474.97
2.4	handling cost	1420361.40	76086.72	76086.72	74847.80	74847.80	74847.80	74847.80	74847.80	74847.80	74847.80	74847.80	74847.80
2.5	Sales taxes and surcharges	3014.13	160.33	160.33	160.33	160.33	160.33	160.33	160.33	160.33	160.33	160.33	160.33
2.6	transportation expenses	169549.54	9018.59	9018.59	9018.59	9018.59	9018.59	9018.59	9018.59	9018.59	9018.59	9018.59	9018.59
2.7	income tax	65306.42	3043.12	3043.12	3986.78	3986.78	3986.78	3986.78	3986.78	3986.78	3986.78	3986.78	3986.78
3	net cash flow	199860.28	13230.41	13230.41	13525.65	13525.65	13525.65	13525.65	13525.65	13525.65	13525.65	13525.65	30861.45
	parameter:												
	financial internal rate of return:												
	Financial net present value (Ic = 12%):												



Schedule 7: Balance Sheet / ten thousand yuan

order number	project	1	2	3	4	5	6	7	8	9	10
0	Production load	0%	0%	80%	100%	100%	100%	100%	100%	100%	100%
1	property	10624.4 2	25197.7 1	53227.0 2	56391.3 3	56128.6 9	55866.0 4	55603.4 0	64790.6 6	73977.9 3	83165.1 9
1.1	Total current assets	-	-	19882.7 2	25524.8 6	27740.0 4	29955.2 2	32170.4 0	43835.4 9	55500.5 8	67165.6 7
1.1.1	receivables	-	-	7743.84	9510.84	9510.84	9510.84	9510.84	9510.84	9510.84	9510.84
1.1.2	stock	-	-	12526.4 8	14186.4 3	14186.4 3	14186.4 3	14186.4 3	14186.4 3	14186.4 3	14186.4 3
1.1.3	ready money	-	-	378.90	378.90	378.90	378.90	378.90	378.90	378.90	378.90
1.1.4	Accumulated surplus funds	-	-	-766.50	1448.68	3663.86	5879.05	8094.23	19759.3 2	31424.4 1	43089.5 0
1.2	construction in process	10624.4 2	25197.7 1	-	-	-	-	-	-	-	-
1.3	fixed assets-net value			33344.3 0	30866.4 8	28388.6 5	25910.8 2	23433.0 0	20955.1 7	18477.3 5	15999.5 2
2	Liabilities and owners' equity	10624.4 2	34114.9 3	60236.6 6	56879.0 6	42907.8 6	32640.5 1	32482.1 0	32482.1 0	32482.1 0	32482.1 0
2.1	Total current liabilities	-	-	6782.35	8477.94	8477.94	8477.94	8477.94	8477.94	8477.94	8477.94
2.1.1	debit balance in suppliers' account	-	-	6782.35	8477.94	8477.94	8477.94	8477.94	8477.94	8477.94	8477.94
2.1.2	money borrowed for short time	-	-	-	-	-	-	-	-	-	-
2.2	Construction investment loan	8526.76	28740.1	29612.1	20236.9	10425.7	158.41	-	-	-	-



			9	0	0	6						
2.3	short term bank loan	-	-	9706.81	10918.77	10918.77	10918.77	10918.77	10918.77	10918.77	10918.77	10918.77
2.4	Debt a small amount	8526.76	28740.19	46101.26	39633.61	29822.47	19555.11	19396.70	19396.70	19396.70	19396.70	19396.70
2.5	owner's equity	2097.66	5374.74	14135.41	17245.46	13085.40	13085.40	13085.40	13085.40	13085.40	13085.40	13085.40
2.5.1	capital in cash	2097.66	5374.74	5374.74	4160.06	-	-	-	-	-	-	-
2.5.2	Accumulated surplus accumulation fund			611.21	912.93	912.93	912.93	912.93	912.93	912.93	912.93	912.93
2.5.3	Accumulated undistributed profits			8149.46	12172.46	12172.46	12172.46	12172.46	12172.46	12172.46	12172.46	12172.46
	parameter											
	asset-liability ratio	80.26%	114.06%	86.61%	70.28%	53.13%	35.00%	34.88%	29.94%	26.22%	23.32%	

Continuation

table 7

order number	project	11	12	13	14	15	16	17	18	19	20	21
0	Production load	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
1	property	92352.46	101539.72	113500.06	125460.40	137420.74	149381.08	161341.42	173301.76	185262.09	197222.43	215599.80
1.1	Total current assets	78830.76	90495.85	102456.19	114416.53	126376.87	138337.21	150297.55	162257.89	174218.22	186178.56	204555.93
1.1.1	receivables	9510.8	9510.84	9510.84	9510.84	9510.84	9510.84	9510.84	9510.84	9510.84	9510.84	9510.84



		4										
1.1.2	stock	14186.43	14186.43	14186.43	14186.43	14186.43	14186.43	14186.43	14186.43	14186.43	14186.43	14186.43
1.1.3	ready money	378.90	378.90	378.90	378.90	378.90	378.90	378.90	378.90	378.90	378.90	378.90
1.1.4	Accumulated surplus funds	54754.59	66419.68	78380.02	90340.36	102300.70	114261.03	126221.37	138181.71	150142.05	162102.39	180479.76
1.2	construction in process	-	-	-	-	-	-	-	-	-	-	-
1.3	fixed assets-net value	13521.70	11043.87	11043.87	11043.87	11043.87	11043.87	11043.87	11043.87	11043.87	11043.87	11043.87
2	Liabilities and owners' equity	32482.10	32482.10	36539.86	36539.86	36539.86	36539.86	36539.86	36539.86	36539.86	36539.86	36539.86
2.1	Total current liabilities	8477.94	8477.94	8477.94	8477.94	8477.94	8477.94	8477.94	8477.94	8477.94	8477.94	8477.94
2.1.1	debit balance in suppliers' account	8477.94	8477.94	8477.94	8477.94	8477.94	8477.94	8477.94	8477.94	8477.94	8477.94	8477.94
2.1.2	money borrowed for short time	-	-	-	-	-	-	-	-	-	-	-
2.2	Construction investment loan	-	-	-	-	-	-	-	-	-	-	-
2.3	short term bank loan	10918.77	10918.77	10918.77	10918.77	10918.77	10918.77	10918.77	10918.77	10918.77	10918.77	10918.77
2.4	Debt a small amount	19396.70	19396.70	19396.70	19396.70	19396.70	19396.70	19396.70	19396.70	19396.70	19396.70	19396.70
2.5	owner's equity	13085.40	13085.40	17143.15	17143.15	17143.15	17143.15	17143.15	17143.15	17143.15	17143.15	17143.15
2.5.1	capital in cash	-	-	-	-	-	-	-	-	-	-	-
2.5.2	Accumulated surplus accumulation fund	912.93	912.93	1196.03	1196.03	1196.03	1196.03	1196.03	1196.03	1196.03	1196.03	1196.03



2.5.3	Accumulated undistributed profits	12172.46	12172.46	15947.12	15947.12	15947.12	15947.12	15947.12	15947.12	15947.12	15947.12	15947.12
	parameter											
	asset-liability ratio	21.00%	19.10%	17.09%	15.46%	14.11%	12.98%	12.02%	11.19%	10.47%	9.83%	9.00%

Attached Table 8 Fund Source and Application Table / ten thousand yuan

order number	project	amount to	1	2	3	4	5	6	7	8	9	10
0	Production load of (%)		0%	0%	80%	100%	100%	100%	100%	100%	100%	100%
1	funds provided	635439.46	10659.99	26225.43	24552.07	30306.44	30306.44	30306.44	30306.44	30306.44	30306.44	30306.44
1.1	total profit	261225.67	-	-	8149.46	12172.46	12172.46	12172.46	12172.46	12172.46	12172.46	12172.46
1.2	depreciation cost	24778.26	-	-	2477.83	2477.83	2477.83	2477.83	2477.83	2477.83	2477.83	2477.83
1.3	amortization charge	579.19	-	-	57.92	57.92	57.92	57.92	57.92	57.92	57.92	57.92
1.4	money borrowed for long term	29413.02	8562.33	20850.69	-	-	-	-	-	-	-	-
1.5	short term bank loan	206244.59	-	-	9706.81	10918.77	10918.77	10918.77	10918.77	10918.77	10918.77	10918.77
1.6	Other funds	-	-	-	-	-	-	-	-	-	-	-
1.7	funds in the hands of the localities	95862.94	2097.66	5374.74	4160.06	4679.47	4679.47	4679.47	4679.47	4679.47	4679.47	4679.47
1.8	Recovery of the fixed assets surplus	1737.56	-	-	-	-	-	-	-	-	-	-



	value											
1.9	Recycling working capital	15598.24	-	-	-	-	-	-	-	-	-	-
2	application of funds	453931.98	10624.42	25197.71	25354.14	28091.26	28091.26	28091.26	28091.26	18641.35	18641.35	18641.35
2.1	Construction investment	34751.14	10425.34	24325.80	-	-	-	-	-	-	-	-
2.2	Construction period interest	1070.99	199.07	871.91	-	-	-	-	-	-	-	-
2.3	floating capital	294635.13	-	-	13866.87	15598.24	15598.24	15598.24	15598.24	15598.24	15598.24	15598.24
2.4	income tax	65306.42	-	-	2037.36	3043.12	3043.12	3043.12	3043.12	3043.12	3043.12	3043.12
2.5	Repayment of the long-term loan principal	28349.73	-	-	9449.91	9449.91	9449.91	9449.91	9449.91	-	-	-
2.6	Repayment of the working capital loan principal											
2.7	Principal repayment of other short-term loans											
3	surplus fund	181507.48	35.57	1027.72	-802.07	2215.18	2215.18	2215.18	2215.18	11665.09	11665.09	11665.09
4	Accumulated surplus funds	1377239.50	35.57	1027.72	-766.50	1448.68	3663.86	5879.05	8094.23	19759.32	31424.41	43089.50

Continuation

table 8

order	project	amount	11	12	13	14	15	16	17	18	19	20	21
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number		to											
0	Production load of (%)		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
1	funds provided	635439. 46	30306. 44	30306. 44	31545. 36	31545. 36	31545.3 6	31545.3 6	31545.3 6	31545.3 6	31545.3 6	31545.3 6	48881.1 5
1.1	total profit	261225. 67	12172. 46	12172. 46	15947. 12	15947. 12	15947.1 2	15947.1 2	15947.1 2	15947.1 2	15947.1 2	15947.1 2	15947.1 2
1.2	depreciation cost	24778.2 6	2477.8 3	2477.8 3	-	-	-	-	-	-	-	-	-
1.3	amortization charge	579.19	57.92	57.92	-	-	-	-	-	-	-	-	-
1.4	money borrowed for long term	29413.0 2	-	-	-	-	-	-	-	-	-	-	-
1.5	short term bank loan	206244. 59	10918. 77	10918. 77	10918. 77	10918. 77	10918.7 7	10918.7 7	10918.7 7	10918.7 7	10918.7 7	10918.7 7	10918.7 7
1.6	Other funds	-	-	-	-	-	-	-	-	-	-	-	-
1.7	funds in the hands of the localities	95862.9 4	4679.4 7	4679.4 7	4679.4 7	4679.4 7	4679.47	4679.47	4679.47	4679.47	4679.47	4679.47	4679.47
1.8	Recovery of the fixed assets surplus value	1737.56	-	-	-	-	-	-	-	-	-	-	1737.56
1.9	Recycling working capital	15598.2 4	-	-	-	-	-	-	-	-	-	-	15598.2 4
2	application of funds	453931. 98	18641. 35	18641. 35	19585. 02	19585. 02	19585.0 2	19585.0 2	19585.0 2	19585.0 2	19585.0 2	19585.0 2	30503.7 8
2.1	Construction investment	34751.1 4	-	-	-	-	-	-	-	-	-	-	-
2.2	Construction period interest	1070.99	-	-	-	-	-	-	-	-	-	-	-
2.3	floating capital	294635.	15598.	15598.	15598.	15598.	15598.2	15598.2	15598.2	15598.2	15598.2	15598.2	15598.2



		13	24	24	24	24	4	4	4	4	4	4	4
2.4	income tax	65306.4 2	3043.1 2	3043.1 2	3986.7 8	3986.7 8	3986.78	3986.78	3986.78	3986.78	3986.78	3986.78	3986.78
2.5	Repayment of the long-term loan principal	28349.7 3	-	-	-	-	-	-	-	-	-	-	-
2.6	Repayment of the working capital loan principal												10918.7 7
2.7	Principal repayment of other short-term loans												
3	surplus fund	181507. 48	11665. 09	11665. 09	11960. 34	11960. 34	11960.3 4	11960.3 4	11960.3 4	11960.3 4	11960.3 4	11960.3 4	18377.3 7
4	Accumulated surplus funds	1377239 .50	54754. 59	66419. 68	78380. 02	90340. 36	102300. 70	114261. 03	126221. 37	138181. 71	150142. 05	162102. 39	180479. 76