

Chapter 9 Environmental Risk Analysis

9.1 Analysis of environmental risk factor and its quantity

According to the introduction of the construction project and the analysis of the engineering, the major environmental risks of this project come from the liquid gas storage tank in the plant site. Liquid gas is colorless and transparent, with C_3H_8 and C_4H_{10} as its main components. When the enterprise reaches its normal production capacity, the demand of liquid gas and the model of transport is shown as table 9.1-1.

Table 9.1-1 Demand of Dangerous Goods and its Model of Transport

Serial Number	Goods	Size and Form	Demand (t/a)	Model of Transport	Model of Storage
1	Liquefied petroleum gas	Liquid State	7820	Truck	Storage Tank of 50 m ³

9.2 Traits and Harm of Environmental Risk Factors

Main traits of liquid petroleum gas:

First, low boiling point. As the boiling point of propane is $-42^{\circ}C$ and that of butane is $-10^{\circ}C$, slight increase of temperature in the storage tank will lead to the increase of saturation vapor pressure.

Second, high volatility. With normal temperature and pressure, liquefied petroleum gas which is in liquid state is highly volatile. When meeting air, it will instantly expand by 250-300 times. That is to say, if there is leakage of liquefied petroleum gas which is in liquid state, it will become large amount of gas and resort in the atmosphere.

Third, heavier than air. Liquefied petroleum gas is 1.5 to 2.0 times as heavy as air. When it is in liquid state, it is lighter than water, with its specific weight half of that of water. In stable atmosphere, it does not easily diffuse. It usually flows like water from high place to lower place and collects at low-lying land such as underground air-gaps, cable ducts and drains.

Fourth, low ignition temperature, which is about $430^{\circ}C$ - $500^{\circ}C$. Sparkles from match, flame, cigarette lighter, electric light switch and automobile vent-pipe can easily ignite liquefied petroleum gas.

Fifth, high risk of explosion. The mixture of liquefied petroleum gas and air forms highly explosive mixture. The explosion limit of liquefied petroleum gas is 2-9%, which means when 2 quotient of liquefied petroleum gas and 98 quotient of air meets open flame, it will burn and explode, at the speed of 2000-3000m/s and the temperature of flames reaching $2000^{\circ}C$.

Sixth, high coefficient of volume expansion. The coefficient of volume expansion of liquefied petroleum gas reaches 0.003 at the temperature of 15℃. Therefore, when injecting liquefied petroleum gas into the storage tank, the tank should not be full-filled, with certain gas phase space left.

9.3 Analysis of Traits of Environmental Risks

Liquefied petroleum gas storage tank is designed, manufactured, installed, managed and employed according to the standard of the third category of pressure container, thus the quality usually can be guaranteed. However, in the process of usage, leakage of gas, split of welding line on the tank, the split of pipeline from the tank may occur now and then for certain causes. Once such cases occur, large amount of liquefied petroleum gas will spurt out of the tank from the split and instantly diffuse, forming combustible vapor clouds or explosive gas mixture. Once meeting open fire, it will instantly burn and explode, causing inestimable danger and destruction to the surroundings.

Take a 50 m³C₃H₈ liquefied petroleum gas storage tank as an example, if the welding line of the tank breaks unexpectedly, the whole tank of C₃H₈ leak out, then the pollution to the surrounding environment can be estimated in the following way.

9.3.1 Diffusion Range of Explosive Mixture

- (1) Suppose the discharging coefficient of a 50 m³ storage tank is 0.8, the specific weight of liquid propane is 0.5, then the weight of propane is :

$$50 \times 0.8 \times 0.5 (\text{t/m}^3) = 20 (\text{t})$$

- (2) Volume of 20t gasified propane

According to our experience, the volume of 20t of liquefied propane is 40m³, under normal temperature and pressure, the volume will instantly expand by 250-300 times. If it expands by 300 times:

$$40 \text{m}^3 \times 300 = 12000 \text{m}^3 \text{ (gasified propane)}$$

- (3) Mixing with air and forming upper explosive limit mixed gas

If the explosive limit is 9.5%, the air needed is $V_{1 \text{ upper}}$, then

$$V_{1 \text{ upper}} = 12000 \times (1 - 0.095) \div 0.095 = 114315.8 \text{ m}^3 \text{ (air)}$$

Volume of upper explosive limit mixed gas is $V_{2 \text{ upper}}$

$$V_{2 \text{ upper}} = 12000 + 114315.8 = 126315.8 (\text{m}^3)$$

If propane diffuses from the split, the radius of extent is :

$$R_{\pm} = \sqrt[3]{V_2 / \frac{2}{3} \pi} = \sqrt[3]{\frac{126315.8}{0.66 \times 3.14}} \approx 39 (\text{m})$$

- (4) Mixing with air and forming lower explosive limit mixed gas:

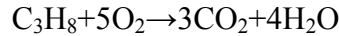
If lower explosive limit is 2.4%, the air needed is $V_{1 \text{ lower}} : 4.8 \times 10^5 \text{ m}^3$, the volume of lower explosive limit mixed gas is $V_{2 \text{ lower}} : 236000 \text{ m}^3$. If the gas diffuses like a hemisphere, its radius of extent is $R_{\text{lower}} : 62 (\text{m})$.

Take the split as the center, the area within the radius of 39-62m is where explosion will occur once explosive mixed gas meets open fire.

9.3.2 Range Affected by the High Temperature

Once meets open fire, burning and explosion will occur in the area where mixed C_3H_8 gas exists, high temperature produced by burning will expand the gas. The area of high temperature can be calculated by common computing method.

Equation of Burning propane is



The oxygen needed for burning 1Kg propane is

$$\frac{5O_2}{C_3H_8} = \frac{5 \times 32}{44} = \frac{160}{44} = 3.64(kg_{\text{氧}})$$

Converting it into air, then the air needed is $3.64/0.21=17.3(kg \text{ air})$

When 1Kg propane is burning, the weight of high temperature burning gas produced should be equal to that of 1Kg propane before it is burnt, which is $17.3+1=18.3(kg)$

When propane is burnt, the temperature can reach 2120° . In normal state, the density of mixed gas is $1.25kg/m^3$. In normal state, the volume of mixed gas produced by 1Kg propane is:

$$\frac{18.3}{1.25} = 14.64(m^3)$$

The volume of the mixed gas produced by 20t of propane is :

$$20 \times 1000 \times 14.64 = 292800 m^3$$

The adiabatic compression equation is:

$$\frac{V_2}{V_1} = \frac{T_2}{T_1}$$

In the equation, V_2 ---- volume of the gas at the temperature of 2120°

V_1 ---- volume of the gas at the temperature of 0°

T_2 ---- temperature of the gas at 2120°

T_1 ---- temperature of the gas in normal state

$$V_2 = \frac{2120 + 273}{273} \times 292800 = 2.57 \times 10^6 (m^3)$$

If the gas diffuses

$$r = \sqrt[3]{V_2 / \frac{2}{3}\pi} = \sqrt[3]{\frac{2.57 \times 10^6}{0.66 \times 3.14}} \approx 108(m)$$

When 20t of propane totally diffuses, mixed gas will explode once it meets open fire, combustion temperature can reaches 2120° . Take the falloff point as the center,

living beings in the area within the radius of 108m will be burnt and flammable things will be ignited.

9.3.3 Estimation of Explosive Energy

According to the experimental study of the effective fuel value of combustible mixture and the combustion heat value of TNT, propane's TNT equivalence factor is 3.36, which means that the explosive force of 1Kg propane is equal to that of 3.36Kg TNT explosive. Thus the explosive force of 20t propane is:

$$W_{\text{TNT}}=20\text{t}\times 3.36=67.2\text{t}$$

9.4 Analysis of Countermeasures against Environment Risks

9.4.1 Keeping the Ground of Storage Field at a Certain Gradient

When fire happens in the liquefied petroleum gas storage field, shell of storage tank may break, once large amount of liquefied gas flows out of the tank into the storage field and if not be removed in time, it will collect and burn at the bottom of the storage tank, which will worsen the destruction of fire.

Experiments show that with open fire, steel tank wall of the storage tank which is 25mm thick can reach the temperature of 690℃ in 16 minutes and steel tank wall which is 13mm thick can reach the temperature of 690℃ in only 8 minutes, at which time the tank is possible to break because all storage tanks of liquefied petroleum gas are pressure vessels. Once broken, the consequence will be inconceivable. The wreckage of the tank can fly out of 300ms, which is disastrous. If the tank breaks, the liquefied petroleum gas spurting out of the tank mixes with air, reaching explosion limit, once meets open fire, it will explode again, which easily leads to the chain explosion in the storage field.

To remove the liquefied petroleum gas collecting in the storage area, the slope of the field should be kept at 1:40, usually not lower than 1:60. With such gradient, the liquefied petroleum gas collecting in the storage field can quickly be drained into the emergency system that is equipped with safety apparatus so as to guarantee the safety of the storage field.

9.4.2 Sprinkler system

The sprinkler system is an effective measure to prevent storage tank of liquefied petroleum gas from fire because when fire occurs to storage tanks, if the burning storage tank and neighboring tanks can be cooled by sprinkler system, continuous water curtain forming out side of the tank, then the fire can be effectively restrained, the temperature of the tank be lowered, the pressure inside the tank be checked. When the tank is 1/2~3/4 full, it is most possible to explode. Practice shows that without water cooling the tanks, tanks of 4.5~13.6m³ explode within 8~30 minutes, among which 58% explode at 15th minute, which shows the necessity of cooling the tanks with water.

Total quantity of heat absorbed by the tank is : $Q=K \cdot F \cdot A^{0.82}$

In the equation, Q---- total quantity of heat absorbed by the tank

K ----heat flux of effectively wetted area

F---- environment coefficient

A ---- effectively wetted area

When the tank trapped in the fire is heated, the heat flux of wet tank wall is approximately 345000~369000kJ/m²h. If the intensity of cooling water supply is 10L/m²·min, the efficiency of sprinkling cooling water can be as high as 80%. The heat flux of wet tank wall drops to 20% that of heat flux without sprinkling cooling water. Standards of the intensity of cooling water supply vary from country to country. But domestic studies prove that the intensity of cooling water 10L/m²·min has met the standard. When the diameter of water drop is 0.1~1mm, the cooling effect is best. Continuous water curtain forming on the outer tank wall, if the temperature of outer tank wall is put under 100℃, safety can be guaranteed.

9.4.3 Lowering the Pressure

As the storage tank of liquefied petroleum gas is pressure vessel, it is more dangerous than other storage tanks with normal pressure. When the tank is on fire, instant measures should be taken to lower the pressure, which can lower the danger of explosion. When the tank is on fire and if the pressure inside the tank is higher than 0.3Mpa, the pressure should be half down within 10~15 minutes so as to make it safe. Pressure lowering can be achieved through distant operation by automatic control system.

9.4.4 Improving Flange Seal Structure

High-necked symmetrical welding, binding combination of metal wrapped shim and high-strength bolt should be adopted on the first flange of the storage tank but not combination of asbestos rubber shim, plane or convex flange and mild steel bolt. While fastening the bolts, force should be evenly and symmetrically exerted, airproofing the tank but not overexerting the force.

9.4.5 Establishing Independent Fire Screen

Impervious fire screens should be established for each tank. If a tank breaks or collapses, burning liquefied petroleum gas will not be able to diffuse outwards owing to the fire screen, which can prevent the diffusion of fire and make it easier to put out the fire.

9.4.6 Bettering Safety Equipment and Enhancing Fire-prevention Ability

- (1) Storage tanks should be equipped with leakage stoppage appliance and tools according to the first layer of flange structure and size. Specific personnel should be assigned to the storage house, guaranteeing the safety of the storage tanks.

Specific personnel should be assigned to be responsible for sealing leakage and drill regularly.

- (2) Fixed automatic squirt gun should be put up in the storage field. Owing to the characteristics of large flow quantity, far range, wide area of cooling, being able to move up and down, to rotate side to side, easy to deal with dead angles, squirt gun can play a very critical role in fire disaster. In summer, when it is very high temperature, squirt gun can also be used to cool PLG tank, preventing the occurrence of fire disaster.
- (3) Foam fire hydrant should be set up, which can not only remedy the ground and indoor fire caused by oil crystal but also put out the fire occurring in storage tank.
- (4) TV monitoring facility, leakage alarm device and excessive pressure warning facility should be equipped in storage field. In the meanwhile, storage tanks should be installed with emergency isolation valve.
- (5) Personnel dealing with the emergency should be equipped with protective articles, generally no fewer than two sets, which should include protective clothing, protective helmet, protective gloves, air respirator and so on. The material and design of protective clothing should be applied, convenient and reassuring, not producing electrostatic sparks.
- (6) Pipelines and valves at the root part of the PLG storage tank should be fixed with heat-insulated device. The bottom part of blow-down pipes should be fixed by pipelines, not be let hang in the air.

Chapter 10 Analysis of the Rationality of General Arrangement and Site Selection for the Company

10.1 Overall planning of Nanchang National Economic and Technological Development Zone

Nanchang National Economic and Technological Development Zone is a national-level developing zone approved by the State Council, neighboring the newly developed area—Hong Gu Tang, where Nanchang municipal Party committee and municipal government are located, together with Hong Gu Tan, forming the two important parts in the city on either side of Gan River. Located on either side of Gan River, the development zone and the flourishing old town are striding, in accordance with the policy put forward by the State Council “stressing the three characteristics, working with unanimous strength”, towards the goal of modernized, ecology-friendly, export-oriented new industrial city.

Baishui Lake Industrial Park is projected by Nanchang National Economic and Technological Development Zone within the north-east of the zone, consisting of papermaking park, electronic park and logistic park.

Baishui Lake Industrial Park which is under planning and construction, is in the upper drift of the leading wind direction of Nanchang city. In terms of protecting urban environmental quality and promoting the sustainable development of enterprises in the industrial park, it is quite irrational to let pulping and paper making industry enter the industrial park, which will surely exert negative influence upon the air quality of the city in the future, harming the reputation and grade of the city as well as the city's sustainable development.

10.2 Analysis of the Merits and Demerits of the Selected Site

10.2.1 Merits Analysis

The merits of Jiangxi Chenming Paper Making Company Limited selecting its site in Nanchang National Economic and Technological Development Zone are as follow:

- (1) The region is rich in transport resources, with all kind of extraordinary facilities such as railway, highway, waterway and air transport, which has laid a very good foundation for the enterprises to expand and lower production cost.
- (2) In terms of environmental factors, sewage discharge pole of the company is located 4000m downriver of the water intake point of Nanchang City Shuanggan Water Supply Plant, which is most downriver among all the water intake points of the five water supply plants in the city, thus sewage discharged by the company does not pollute the water intake of the city.

10.2.2 Demerits analysis

- (1) The impact on environmental quality of urban air

The communiqué released by China Environment Monitoring Center in 2002 reflecting the environmental quality of 47 key cities national wide shows that Nanchang city ranked from 14 in 2001 down to 30 in 2002. As the site of the company is in the upper drift of the leading wind direction of Nanchang city, the regions affected are Nanchang Railway Mechanical School, South Metallurgical Institute, Jiangxi Branch, North East Jiaotong University and some other universities and schools. Boilers in the heat power station of Jiangxi Chenming Paper Making Company Limited will exert a bad influence on the environmental quality of the air in the region, hindering the normal life of the teachers and students in the universities and schools, which will bring about negative effect to the improving urban grade and reputation.

- (2) Huge amount of environmental cost will reduce the enterprises' profit space

To reduce the influence of environmental pollution on surrounding residents' life, to control surface flying pollution and disordered discharge, the enterprise will increase expenses on the construction and operation of facilities for harnessing environmental pollution and the overhead expenses, it also has to assume a series of civil disputes caused by accidental discharge, which not only hinders the enterprise's normal

production and operation, but also affect the enterprise' social image. The enterprise's profit space will be reduced because of too high environmental cost.

On the whole, this site brings about both merits and demerits to the enterprise. Taking both economic development and environmental protection into consideration, we hold the opinion that whether the site is suitable for the enterprise or not depends on the fact whether the enterprise can stand the test of the input in environmental protection and means of environmental management. If the enterprise does guarantee its input in environmental protection and regulate its means of environmental management, then the demerits can be minimized and in the mean time the merits can be brought into full play. All in all, the site is basically feasible.

10.3 Analysis of the Rationality of the General Arrangement

The general arrangement of the enterprise reflects the small environment of the enterprise. The production quarters and living quarters should be strictly divided according to its respective functions. Source of drinking water, discharge points of industrial wastewater and domestic sewage should be properly arranged. After the comparison of technical economy, considering the natural conditions of the field, field for accessorial functions such as water treatment plant, liquefied gas station, stock place of waste residue and sewage farm should be reasonably positioned according the enterprise's nature, size, production flow, traffic and transport, and environment protection demands.

The general arrangement is adequately reasonable, with clear division of production quarters from living quarters.

- (1) Green belt will be built surrounding the plant site, which will separate the plant site from the external environment, alleviating the influence upon the external environment.
- (2) The two lakes in the plant site south and north lake divides the whole plant sites into two parts. West to the two lakes is the living quarter and east to the two lakes is production quarter. Living quarter lies in the side wind direction of production quarter. Owing to the separation of the two lakes and green belt, living quarter will not be greatly influenced by the production quarter.
- (3) Self-provided access railroad divides production quarter into south and north districts. To reduce the interference of different workshops, considering the leading wind direction in the plant site is north east, workshops that exert less pollution to the air and environment, such as finished products warehouse, papermaking workshop, chemicals warehouse, pulping workshop and general pressure degradation station should be located in the upper drift of the plant site ---- north to the railroad; workshops that exert more pollution to the air and environment, such as heat power station, sewage disposal plant, pulverized fuel ash and concrete building blocks plant, alkali recovery plant and PLG station should be located in the lower drift of the plant site ----south to the railroad.

- (4) Sewage disposal plant is located in the south east of the plant, close to the Binjiang Road along Gan river, which is favorable for the lay of scupper pipes. However, the influence of the protecting distance against effluvium emitted by sewage disposal plant upon Binjiang Road should be taken into consideration. Furthermore, liquefied gas station is just one railroad away from the finished products warehouse, so danger prevention distance and fireproof distance of the station should be taken into full consideration.

11. Environmental Management and Monitoring

This planned project is a specially large-sized enterprise of paper manufacturing, which is well equipped with thermal power station, water supply plant and sewage disposal station, etc. In accordance with the state stipulations, the factory shall establish a highly efficient monitoring section and a series of good management regulations. Moreover, the factory shall avail itself of the monitoring and analyzing devices for the purpose of keeping clean in the course of production after completion of the project.

The formulation of the planned project's regulations with regard to environmental management and monitoring is conducive to the guidance and controlling of environmental protection ranging from program design and operation, which can reflect the environmental situation of the program construction and operation in a dynamic way, such as having a good command of pollution source as well as measures for lessening pollution and countermeasures for compensation so as to meet the requirements of environmental laws and stipulations.

11.1 Environmental Management

11.1 The Formation of Environmental Management Unit

The formation of Environmental Unit for the program is composed of Management Unit and Supervision Unit.

11.1.1.1 Management Unit

In order to reinforce the environmental management of the program's construction, an environmental protection section will be established, and some licensed units for environmental engineering will be invited to join in the program's environmental supervision, which will feature turning the passive environmental management into an active one, a post-management into a process management. The duties of the Management Unit can be described as the following:

- (1) To propose the specific requirements and goals to the Construction Unit, with a special emphasis to urge the unit to adopt down-to-earth measures to decrease elevating dust as well as the tail gas produced by the construction machinery on an as-less-as – possible basis.

- (2) To urge the Construction Units to control the noise.
- (3) To control the construction residuals in an effective way, especially with a rational arrangement for its transportation.
- (4) To enforce a rule for the avoidance of soil erosion, the protection and transplanting of ornamental plants within the construction region.
- (5) To supervise and urge construction unit to resume the original shape of the construction spots.
- (6) To supervise the designing of environmental protection project and its construction in accordance with the regulations concerned.

After completion of the planned project, the owner of the project, Chenming Paper Manufacturing Co.Ltd shall establish a special division for handling the affairs concerning environmental protection, with the chief leader of the corporation as the responsibility bearer, this special division will be responsible for the following :

- (1) To be in charge of the communication and liaison with the provincial, municipal and district administration of environmental protection in an effort to have a smooth access to the policy information from the respective administrative organizations.
- (2) To set up the indexes of environmental protection. Specific regulations concerning waste water, gas and solid waste residue noise pollution control shall be formulated. Furthermore, measures of water saving , electricity and energy saving as well as the equipment repairing and maintenance shall be presented.
- (3) To be in charge of the organizational training. The personnel of various kinds in the corporation shall be given great publicity to the law, the policies and regulations of the various administrative organizations of environmental protection.
- (4) To formulate the regulation of inspection and monitoring on a regular basis, which shall include a regular examination of the production equipments and the appliance for pollution prevention and a regular inspection of the performance of the technical procedures.
- (5) To establish emergency treatment system for pollution when pollution incident occurs.
- (6) To establish the year-end evaluation system for stimulation, i.e. to award the good and penalize the backward.
- (7) All the above-mentioned shall be placed on file.

11.1.1.2 Environmental Monitoring Unit

The State Bureau of Environmental Protection has authorized the Provincial Bureau of Environmental Protection of Jiangxi to investigate the Report of the Program's Environmental Effect, and to charge Jiangxi Provincial Bureau with the program before acceptance after its completion.

As for the professional affairs, the Province Bureau of Environmental Protection shall accept the instructions from the State Bureau of Environmental Protection, and shall be in charge of the program's monitoring management, organizing and coordinating with other units for better service to the program, ensuring the program's enforcement of the statutes of environmental management as well as providing the program's guidance concerning the period of construction and operation for the Municipality Bureau of Environmental Protection of Nanchang.

Then the Municipality Bureau of Environmental Protection of Nanchang shall accept the professional guidance from the Provincial Bureau of Environmental Protection of Jiangxi, dealing with the affairs concerning the subdivided functions from the Provincial Bureau with a more specific emphasis on handling things such as levying sewage removal, mediating disputes, giving much publicity to the laws and regulations and its implementation.

11.1.2 The plan for Environmental Management

The following is a plan concerning environmental management for the program, see Table 11.1-1

Table 11.1-1 Plan for the Program's Environmental Management

Environmental Issue		Management Measures	Performance Unit
1	Construction Period		
	Dust Air pollution	.Pollution prevention measures include water sprinkling on the construction spot for the reduction of elevating dust to the air . Covering the truck full of construction materials with canvas for the reduction of leakage . Mixers' being well sealed, dust remover being properly installed	

2	Noise	<p>. To prevent the infringement of noise on the architectural workers, to urge the workers to put on earplug and steel helmet, working on a time-limit basis.</p> <p>. Strictly conduct the regulations about noise limits for the architectural construction spots, any highly noisy construction should be forbidden.</p> <p>. To maintain the construction machinery and vehicles in a satisfied way for keeping a low noise level</p>	Jiangxi Chenming Paper Manufacturing Co.Ltd.
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Operation Period		
1	Water Management	To strengthen the management of water saving and water recycling, to make the sewage disposal plant go smoothly.
2	Waste Gas Dischargement Management	To control the waste gas from the thermo-electricity station and its dischargement
3	Solid Waste Material Management	Mainly including the dischargement of solid waste material of various kinds to a minimum level as well as the disposal of solid waste material in a comprehensive way
4	Harnessment of Facilities Management	To make the facilities good operation and maintenance and train the personnel of various kinds
5	Emergency Plan for Unexpected Environmental Incidents	Emergency organization should be created, and its responsibility, name lists, special service units, the liaison plans and measures should be offered.

6	Environment Monitoring	Boiler installed with smoke and dust dischargement	The licensed Environmental Monitoring Station is responsible for the pollution affairs
		Inoffensive passage, CEMS installed and Water quality monitoring on a real-time basis	
		All should be done in accordance with the regulations of environmental monitoring technology and the monitoring standards, methods promulgated by the State Bureau of Environmental Protection	

11.2 The Plan for Environmental Monitoring

11.2.1 The Purpose of Environmental Monitoring

Environmental monitoring will guarantee the enterprise's environmental management and promote the pollution control .The corporation will obtain much information concerning the environmental quality so that they can adjust the environmental plan in a good way.

11.2.2 The Environmental Monitoring Unit

We suggest that environmental monitoring should be conducted by the licensed environmental monitoring unit during the period of conduction and operation .The routine monitoring will be executed by the Factory's Division of Environmental Protection on a regular basis, who will be responsible for the regular monitoring of the dischargement of waste gas, water, noise and residue as well as the sampling, analysis and reporting in order to establish the system of corresponding documents and data management .

11.2.3 Monitoring Items and Monitoring Plan

According to the forecasting and analysis of environmental effects, the monitoring items refer to those during the period of construction and the period of operation .As for the period of construction, TSP will be the monitoring items. Meanwhile, environmental air

(such as TSP, smoke and dust, SO₂), water environment (such as COD_{cr}, SS, BOD₅) and noise (between the factory boundary) will be the monitoring items during the period of operation.

The detailed items in the monitoring plan will be listed as follows, see Table 11.2-1----11.2-3.

Table 11.2-1 Environmental Monitoring Plan

Stage	Monitoring Spots	Monitoring Items	Monitoring Frequency	Monitoring Time	Executive Units	Supervision Units
Construction Period	Two spots will be observed, one is on the factory boundary, the other is on the main wind direction	TSP	Twice per year, random sampling	One day	The licensed environmental monitoring station	The administrative unit of environmental protection
Operation Period	Boiler&stovepipe	Smoke&dust,SO ₂	Online monitoring		Owner	

Table 11.2-2The Monitoring Plan for Noise

Stage	Monitoring spots	Monitoring items	Frequency	Time	Sampling Time	Executive units	Supervision units
Operation Period	1 meter beyond the factory boundary	Noise	Twice per year	One day	Once Day&night	The licensed environmental monitoring station	The administrative unit of environmental protection
	The factory's office building		Twice per year	One day	Once Day&night	Owner	owner

Table 11.2-3 The Monitoring Plan Water Environment

stage	Monitoring spots	Monitoring Items	Frequency	Executive unit	Supervision unit
Operation period	Sewage disposal station(entrance	PH,SS,COD _{cr} ,BOD ₅	Once per week	The factory's lab	Owner

	& exit)	PH,SS,COD _{cr} ,BOD ₅	Once per quarter;four times per year Random sampling	The licensed environmental monitoring station	The administrative unit of environmental protection
	Sewage disposal station (exit)	Water volume,pH,COD _{cr}	On-line monitoring	Owner	The administrative unit of environmental protection
	A neutralization pool for acid & alkali	pH	Once per month	The lab for analysis	Owner

12 Public Participation

12.1 The Aim of Public Participation

Public participation is a nice way for two-way communication between the environmental evaluated units and the public, which will enable the public to have access to the environmental monitoring in an effort to express their opinions for the improvement of the environmental protection programs. Furthermore, public participation can also offer the people to have the close relationship with the government of the community and the administrative organizations like construction, program designing, approval and environment evaluated units, which will have a higher far-reaching social effects.

12.2 The Investigation Methods and Content of the Public Participation

12.2.1 The Investigation Methods

We held a hearing into the environmental affairs of the program in the light of its construction features and spot selection. The assessed unit, Chen Ming Paper Manufacturing Co., Jiangxi, entrusted Changbei Administration of Development Zone to organize the hearing, the attendees ranging from some of the surrounded college faculty and students, to community citizens and employees of the units nearby. The hearing followed such a procedure: First, the presenter from the assessed unit explained and publicized the aims and implications of the environmental assessment as well as the

significance and impacts of public participation; Second, one of the construction unit representatives told the attendees some basic information concerning the program and its operational things in other cities and provinces as well as the present construction enterprise situation of its kind both in China and abroad, questions were also asked and answered for this step; Third, the environmental assessed unit distributed the “Investigation Questionnaires about Environmental Effect” to the people present for filling in, then collected and sorted out, and a final conclusion have been reached.

Table 12.2-1 Statistics concerning the investigated’s

Age Range	Numbers of male	Numbers of female	Total	Percentage
20 years old below	7	2	9	7.32
20—30 years old	18	9	27	21.95
31—40 years old	42	4	46	37.40
41 —50 years old	22	2	24	19.51
Over 51 years old	17	0	17	13.82

12.2.2 Investigation Time

The investigation was conducted on April 1, 2003, on a whole-day basis.

12.2.3 Investigation Scope

The investigation scope includes some government employees from the units nearby and the representatives from the units subject to the environmental pollution, like Jiangxi Polytechnic School of Railway Machinery, East China Jiaotong University, Jiangxi University of Finance and Economics and Jiangxi Branch School of South China Institute of Metallurgy, Bei Shan Village and Nanchang Factory of Hard Alloy.

12.2.4 Investigation Objects

All the investigated are adults, and 150 questionnaires have been distributed, 132 have been retrieved, with nine having no personal information. Among 123

complete questionnaires, the range of sex and age is the following, 106, male, 17, female; the youngest, 18, the oldest, 65.
Messages concerning the objects' age, educational level, professions are listed in the table 12.2--1 and table 12.2—2.

Table 12.2—1 Statistics concerning the investigator's Age and Sex

Age range	Male	Female	Total	Percentage
20 years old below	7	2	9	7.32
20—30 years old	18	9	27	21.95
31—40 years old	42	4	46	37.40
41 —50 years old	22	2	24	19.51
51 years old above	17	0	17	13.82

The above-mentioned table shows that the investigated people are middle-aged and youngsters,

with the age from 20 to 50, covering a percentage of 78.86, who will represent the interests of the

majority.

**Table 12.2-2 Statistics concerning the investigator's educational level and
occupation**

Education level	Number of persons	Percentage	Occupation	Number of persons	Percentage
Primary School and below	9	7.32	Government employee, student	53	40.15
Junior education level	34	27.64	Worker	13	9.85
Senior school and polytechnic education level	18	14.63	Farmer	48	36.36
College level and above	62	50.41	Miscellaneous	18	13.64

The above-mentioned table 12.2—2 shows that the investigator's quality is comparatively higher,, and the formation structure is comparatively rational, with over 50 per cent having received college education, over 50 per cent being government employees and workers and the rest being farmers and other professionals:

12.3 The investigation results of public participation and Its analysis

Of the distributed 150 questionnaires, 132 have been retrieved ,the recovery rate is 88 per cent, all the questionnaires are valid. As for the seven questions designed in the questionnaire, things concerning answering are listed in Table 12.3—1

Table 12.3-1 Statistical results of the Investigator's

Serial number	The content of investigation	Responses			
1	How much do you know about the programmer ?	Much understanding	55		
		Some understanding	67		
		None understanding	4		
2	Are you satisfied with the environmental situation of the planned factory spot?		Satisfaction	Almost satisfaction	None satisfaction
		Surface water	90	27	9
		Environmental air	77	27	7
		Sound environment	80	21	3
		Ecological environment	79	24	3
3	Do you think whether the construction spot is feasible or not?	Feasible			56
		Feasible to the state dischargement standards			51
		Not feasible			17
4	What are main problems after completion of the project?	Air pollution	60		
		Water body pollution	76		
		Noise pollution	30		
		Solid pollution	42		
		Ecological erosion	25		
5	What measures do you think that can reduce pollution?	Pollution control	91		
		Cleaning production	49		
		No way	12		
6	Do you think the programmer is conducive to the local economy?	Largely	105		
		Fair	21		
		Minor	3		
7	How do you think what should be done to improve the programme's environmental management?	Governmental monitoring	86		
		The factory's self-discipline	78		
		Mass supervision	58		

By analyzing the above-mentioned table, we can conclude:

- (1) The investigated have a fair understanding of the planned construction program. Of the 126 investigated, 92.4 percent of the people knew a lot about the program, only 3 percent answered that they knew none about it. This group of figures prove that Chen Ming Paper Manufacturing Co. have done a lot in publicizing and communicating with the residents nearby.
- (2) From the statistics concerning the satisfaction degrees of current environmental situation, we can know that a majority of the investigated felt comparatively satisfied with the current environmental quality, only a small number of people showed no answer. As for the surface water, 88.6 per cent of the investigated are satisfied or almost satisfied, only 6.8 per cent are dissatisfied. In the case of environmental air, 78.8 per cent of the investigated show satisfaction or general satisfaction, but 5.3 per cent show dissatisfaction. As for as the sound and ecological settings are concerned, 76.5 per cent and 78 per cent of the investigated felt satisfied respectively, but 2.3 per cent felt dissatisfied in the meanwhile. The data reflects that residents and employees in the vicinity of the factory felt comparatively satisfied with the current environmental situation there.
- (3) With regard to the selected construction spot, 56 investigated believe it is feasible, which covers a percentage of 42.4, 51 investigated (with a covering of 38.6 per cent), consider it is feasible on the premise that pollution control should be conducted up to the state dischargement standards. Only 17 (with a covering of 12.9 per cent) think it is not feasible. All the above show that the spot will be accepted by a majority of people on condition that the factory will take effective measures for the reduction of environmental pollution.
- (4) Considering main environmental problems after completion of the program, the investigated believe that the focal points depend on waste water and waste gas, especially for waste water, with a highest percentage being 57.6, and a second one being 45.5 in waste gas, then the orders of noise, solid waste material discarding and ecological erosion followed, with the percentage being 22.7 ,31.8, 18.9 respectively. A majority of the investigated highly demand that measures should be taken for the improvement of environmental protection.
- (5) As to what measures should be taken to reduce pollution, 91 investigated (with a percentage being 68.9) believe that immediate action should be taken to control pollution, 49 investigated (with a percentage being 37.1) consider that production in a clean way is necessary; 12 investigated claim that nothing can be done for the reduction of pollution, which suggests that the program is a little harmful to the surroundings nearby. With further publicity of the environmental protection as well as the down-to-earth action, the program will be greatly improved.
- (6) 105 investigated (covering a percentage of 79.5) believe that the program is greatly conducive to the development of local economy, 21 investigated (covering a percentage of 15.9) believe that the program is moderately conducive to the local

economy, only 3 (covering a percentage of 2.3) regard that the program is least conducive to the local economy.

(7) As for the program's environmental management, 86 investigated (covering a percentage of 65.2) think that governmental monitoring should be strengthened, 78 investigated (covering a percentage of 59.1) believe that the factory should be self-disciplined, and 58 investigated (covering a percentage of 43.9) consider that mass monitoring should be enhanced.

To sum up, a majority of people believe that the program is feasible, but some other people gave their own proposals as the following:

- (1) Considering the pollution concerning paper manufacturing is a difficult problem to tackle, the present construction spot that is close to several universities, and the population in this district will increase dramatically in the near future, some attendees suggest that the construction spot should be selected in the south region of the city because the north region now is an upper wind direction subject to pollution.
- (2) Some attendees propose that proper arrangements should be made for the placement of the labor forces near the factory.
- (3) The investigated hope that the government should take effective measures to make rational planning and conduct its monitoring together with the mass monitoring, strictly control the pollution like the total volume of polluted discharges in an effort to keep sustainable development.

According to the results from the public investigation, we'd like to give our suggestions to the factory as follows:

- (1) The factory should regard environmental protection as a most important policy for the construction and product development, which will be beneficial to the economic efficiency on the one hand and its own CI (Corporate Image) on the other hand.
- (2) Followed by the principle of "Three Meanwhiles" (i.e. designing, construction, application), the environmental protection project should be completed together with the principal part of the project. Environmental inspection and controlling conceptions should be adopted to cover all the stages like designing, construction and application.
- (3) Environmental management and monitoring should be further enhanced for the purpose of coping with the unexpected and emergent incidents in an effort to ensure the production and operation to go smooth and highly efficient.

13 Profit and Loss Analysis of Environmental Impact on Economy

13.1 Investment of Project Environmental Protection

The investment (see Table 13.1-1) of project environmental protection is estimated according to the surroundings of the future project and various environmental protection measures proposed in this assessment report. The total investment for the project is 1.3599 billion yuan RMB, and 11.7% of it is lump-sum investment for environmental protection facilities which cost 158.574 million yuan RMB.

Table 13.1-1

Project Environmental Protection Investment Estimation

	No	Item	Amount	Unit Cost	Value (million yuan)	Remark
Lump-sum Investment in Environment Protection	1	Factory Greening	390,000m ²	20.5 yuan/m ²	8	Included in main project
	2	Detection in construction period	2 years	100,000 yuan/year	0.2	
	3	Environmental protection cost in construction period (sprinkling, waste slag, temporary sewage disposal, etc.)			0.2	Temporary lump-sum
	4	Sewage disposal plant	22,000t/a		37	Disposal scale design
	5	Malodor control system of sewage disposal plant			0.5	
	7	Circulating water treatment			20	
	8	Boiler smog abatement			30	Cyclone and bag dust precipitation
	9	Recycling of fly ash			40	Hollow brick production line
	10	Coal yard & other solid waste yard			10	
	11	Noise abatement			2	
	12	Online monitor of waste water			1	
	13	Online monitor of smoke and sulfur dioxide			2	

	14	Employee training	62 persons	2,000 yuan per capita	0.124	
	15	Miscellaneous (5% of above cost)			7.55	
		Total			158.574	
Environmental Protection Cost within Operating Period	1	Operating period monitoring			0.3	Quarterly per year
	2	Sewage disposal cost		0.81 yuan/t	6.04	Water volume 22000 t/d
	3	Water recycling cost		0.25 yuan/t	10.226	120308 t/d
	4	Waste gas disposal cost			15	
	5	Waste slag disposal cost			3.5	
	6	Labor and wage	62 persons	15,000 yuan per capita	0.93	
		Total			35.996	

13.2 Project Profit Analysis

13.2.1 Social Profit Analysis

This project makes good use of the local raw material, energy, talents and regional advantage of Jiangxi Province, innovate the equipment introduced by the contract about international bidding on equipment acquisition. The project not only increases the output of the corporation, and enhance the competence of products varieties, but also recovers the State's loss of economy and reputation.

Advanced and appropriate technology will be adopted in the project of low quantification coated paper with annual output of 200,000 ton of Jiangxi Chenming paper-making Co., Ltd. to restructure the traditional industry, remarkably increase the resource utility efficiency, upgrade and optimize the industrial structure, promote the economic strategy adjustment, and improve the quality and efficiency of the economic growth. In order to bridge the domestic gap in low-quantification coated paper containing mechanical pulp, the project takes the self-made BTMP pulp and commodity bleaching chemical wood pulp as raw material to produce the low-quantification coated paper so as to meet the needs of the market. The establishment of the project and its going into production will strengthen the Jiangxi paper-making industry, solve the unemployment problem of nearly a thousand paper-making technicians and workers, and lead to a higher living standard of local residents.

The project will infuse new life into the economic growth of Jiangxi Province; establish closer cooperation among enterprises by taking advantage of each other's strength; form characteristic economic regions and economic belts to cultivate new points of economic growth; and finally find a new way of industrialization with intensive high technology, high economic efficiency, low cost of resource, less environmental pollution, and the full use of human resource, which may play a significant role in promoting rapid industrialization and urbanization of Jiangxi Province. Meanwhile, it will lead to the development of related industries, such as construction, coal, transportation, forestry and chemistry, and even the development of the whole region. This has been proved by the experience of both adjacent provinces and foreign countries that the development of the regional core enterprise will lead to jump-up of the development in the whole region.

13.2.2 Environmental Profit Analysis

Benefit from the pollution abatement measures, the project may reduce its discharge amount of various pollutants towards the standards, therefore, it can mitigate its pollution to the surroundings. The pollution produced and its discharge after the completion of the project are shown in table 13.2-1.

Table 13.2-1

Pollutants and Discharge Amount

Category	Pollutants	Produced Amount(t/a)	Discharge Amount(t/a)	Reduced Amount(t/a)	Efficiency (%)	Remark
Waste Water	COD _{Cr}	21233.2	2036	19197.2	90.4	
	BOD ₅	9931	203.6	9727.4	97.9	
	SS	8159.3	407.3	7752	94.6	
Waste Gas	Smoke	51307	154	51153	99.7	
	SO ₂	7208	1080	6128	85.0	
Solid Waste	Fly Ash	1.281 million				Recycled Completely
	Others	40,640				Recycled Completely

13.2.3 Economic Profit Analysis

Having been completed and put into production, the project may produce 200,000 ton coated paper annually with aggregate investment of 1.3599 billion yuan RMB, among

which 1.31394 billion yuan RMB is invested for construction and 45.96 million yuan RMB as flow capital. The main technical and economic index are shown in table 13.2-2.

13.2-2

Main Technical and Economic Index

No.	Index	Unit	Value
1	Aggregate Investment	Million yuan	1130.4026
2	Annual Sales Income	million yuan	1377.7778
3	Gross Annual Profit	Million yuan	207.7224
4	Gross Annual Profit and Tax	Million yuan	294.1595
5	Profit Rate of Annual Investment	%	14.16
6	Rate of Profit and Tax of Annual Investment	%	20.05
7	Collection Period (including construction period)	Year	5.88(2)
8	Internal Rate of Return	%	18.19

As shown in table 13.2-2, once the project comes into use, the profit rate of annual investment will be 14.16%, the rate of profit and tax of annual investment will be 20.05%, the payback period of the whole investment will be 5.88 years (after tax), internal rate of return (after tax) will be 18.19% ,which is higher than the basic return rate of 14%, and the gross annual profit will be as much as 207.7224 million yuan RMB. All the above data indicates that the project has strong capacity in making profits, paying off debts and resisting risks, and may bring considerable economic benefits to strengthen the enterprise; meanwhile, the rate of profit and tax of annual investment is as high as 20.05%, the gross annual profit will be as much as 207.7224 million yuan RMB which shows that tremendous economic benefit brought by the project will enable the region where the project is located to develop quickly and result in a great leap of local economic growth.

13.2.4 Additional Economic Benefit Analysis

After the completion of the project, addition products produced in the process of production, such as fly ash, surplus steam and methane, etc., may also benefit the enterprise and relieve the pollution to the surroundings if they are able to be made in full use.

13.2.4.1 Recycle of Fly Ash

As shown in table 3.8-3, the project will produce 51,200 ton fly ash and 76,900 ton cinder, totally 128,100 ton, which must pollute the surroundings of the development zone severely if nothing has been done with their recycle.

The fly ash produced in the circulating fluid bed boiler is quite activated, and has large potential market. It can be widely used in the production of cement, concrete admixture, walling hollow bricks, and other many construction materials.

In accordance with the development planning of Chenming Paper-making Co., Ltd., a factory of small-sized hollow bricks made by concrete and fly ash will be built to produce this kind of walling materials by using fly ash. With the reference of the condition of a similar brick factory, it is estimated to invest 40 million yuan RMB in such a factory that may produce hollow brick of over 200,000 stere, consume fly ash and cinder of 128,100 ton, bring annual sales income of 23 million yuan RMB and make profits of over 8 million yuan RMB.

13.2.4.2 Recycle of Surplus Steam

According to the figure of steam balance in the whole factory (Figure 3-10), in addition to be used to generate electricity and used in paper-making workshop, the steam from the boilers in thermoelectric power station has surplus of 10 ton with 1.2Mpa each hour, which can be sold with the other 40 ton surplus steam with 0.3Mpa produced each hour in the BTMP pulp making production line. The surplus steam is expected to earn 24.48 million yuan RMB each year at the price of 60 yuan RMB per ton.

Two plans for using surplus steam are made as follows:

Plan I

Nanchang municipal government is to provide the advanced business buildings in Honggutan New Zone with heat supply by taking part of the surplus steam as clean energy. If the plan is adopted, originally equipped boilers for those business buildings will be reduced, the coal consumption amount will be reduced accordingly, and thus the pollution caused by coal firing will be relieved. However, the steam supply project could be very costly due to the long distance between the factory and Honggutan New Zone.

Plan II

According to the development planning of Nanchang National Economic and Technological Development Zone (Baishuihu Industrial Zone), the north area from Chenming Paper-making Co. has been inclusive in the industrial zone. In view of the present layout in the zone, where the requirement of the environmental protection is relatively high, it is suggested that the Development Zone Management Committee shall supply heat in an integrate way to the enterprises that will enter the zone in the future without adding new boilers. A single energy company shall be set up to purchase the

surplus steam produced by Chenming Paper-making Company, and sell it to the enterprises in the zone to ensure enough steam supply for production and daily use.

If the plan is adopted, the enterprises in the zone can purchase the handy surplus steam of Chenming Paper-making Company at a low price, while the surplus steam could make profits for company at the same time, which will lead to a win-win status that both the economic development and environmental protection could benefit from the construction of the industrial zone. Therefore, this plan is recommended to come into use because of its obvious positive effect on both of the economic growth and environment protection.

13.2.4.3 Recycle of Other Pollutants

The waste water produced in BTMP workshop enters the IC reactor undergoing anaerobic and oxygen-consuming treatment, and vapor-liquid separation, which will emit abundance of reclaimable clean energy, methane, approximately 15000m³/d. Therefore, the company can install methane storage tank and recycling system to convey methane into thermoelectric boiler as fuel. In addition, solid waste of around 46,400 t/a produced in the production process, such as bark, wood dust, dirt, etc., could also be delivered as fuel to the thermoelectric boiler.

The decrease of coal-fired amount not only improves the air quality of the local surroundings, but also brings economic benefits to the region.

According to the analogical materials, the average low heating effect of firing 1 kg solid waste is approximately 15680 kJ, equal to 0.535 kg standard coal. Being full used, such waste produced by the project will emit heat of 7.28×10^{11} kJ/a, equal to 24,800 t/a standard coal; While the average low heating effect of firing 1 m³ methane is 20908kJ, equal to 0.714 standard coal, and if the methane is full used, the heating effect will be 3.14×10^8 kJ/d (1.07×10^{11} kJ/a), equal to 10.71 t/d (3641.4 t/a) standard coal.

The recycle of addition products may lower the production cost of enterprises effectively, enhance the competence of products, reduce the coal consumption of boiler, relieve the pollution to the surroundings, and thus play an important role in improving the local environmental quality in the future.

13.2.5 Overall Profit of the Project

The overall efficiency of the project is shown in table 13.2-3

Table 13.2-3

Economic efficiency brought by addition products

No.	Category	Amount	Annual	Remark
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			Value(million yuan)	
1	Annual Sales Income	128,100 t/a	1,377.7778	
2	Fly Ash	400,800 t/a	8	
3	Steam	5,100,000m ³ /a	24.48	at the standard of 50t/h, 60 yuan RMB/t, 8160h/a
4	Methane	46,400 t/a	0.5826	Equal to 3641.4t/a, at the standard of 160 yuan RMB/t
5	Other Solid Waste		3.968	Equal to 24,800t/a, at the standard of 160 yuan RMB/t
	Total		1,414.808	
	Total		18,392.504	Production period of 13 years

13.3 Project Cost Analysis

Generally speaking, the total cost of the project can be categorized as production cost, environmental protection cost and environment pollution cost. The cost of project construction includes internal and external cost. Internal cost is the necessary expenditure to realize the goal, including infrastructure cost and maintenance cost that consists of production cost and environmental protection cost. External cost is the payment for the inefficiency of the project, mainly refers to the environment pollution cost.

The construction period of the project is 2 years, production period 13 years, and economic life 15 years.

13.3.1 Production Cost

The annual production cost includes fixed assets investment, resource investment, and operation and maintenance cost. The production cost covers all expenses incurred in the production process. The production cost of the project is shown in table 13.3-1

Table 13.3-1

Production Cost of the Project

Unit: Million yuan RMB

No.	Category	Value	Annual Cost	Remark
1	Low quantification coated paper with annual output of 200,000 ton	10,894.052	838.004	Cost: 4190.02 yuan RMB/t, Production period: 13 years
2	Bleaching hot grinding mechanical pulp with annual output of 187,000 ton	4,935.5865	379.6605	Cost: 2030.27 yuan RMB/t, Production period: 13 years
	Total	15,829.6385	1,217.6645	

13.3.2 Environmental Protection Cost

Environmental protection cost consists of the cost of environmental protection facilities, pollutants abatement cost and pollution discharge cost.

The cost of environmental protection is shown in table 13.3-2

Table 13.3-2

Environmental Protection Cost

No.		Value(million yuan)	Remark
1	Environmental Protection Facilities	5	
2	Pollutants Abatement Cost		
	Including Sewage Disposal Costs	6.04	Designed water disposal amount of 22000 t/d
	Waste Gas Disposal Cost	15	
	Waste Residues Disposal Cost	3.5	
3	Operating Period Monitoring	0.3	
4	Pollution Discharge Cost		At the cost of 200 yuan RMB/t SO ₂
	Including SO ₂	0.2176	
	Sewage	0.2636	At the cost of 0.05 yuan RMB/t sewage
5	Wage	0.93	
	Total	31.2512	
	Total	406.2656	Production period of 13 years

13.3.3 Environment Pollution Cost Analysis

Badly influenced by the malodor and noise produced by the project, the northern mountainous village, 800 meters southwest to the factory, and the Zhu's in Laohuzhua 400 meters west from the factory, are suggested to move to other places, because the company plans to enlarge its production scale to realize the sustainable development. In addition, the temporary settlement of the Cao's and the Liu's located in north to the factory are also expected to move in the future.

The northern mountainous village has approximately 5000 residents, totally 1200 families; the Zhu's in Laohuzhua has around 120 residents, totally 30 families; the Cao's and the Liu's in the temporary settlement have about 2400 residents, totally 600 families. If the standard of compensation for mass relocation is 10,000 yuan RMB for one person, the total estimated cost would be 75 million yuan RMB.

13.3.4 Aggregate Cost of the Project

The aggregate cost of the project is shown in table 13.3-3

Table 13.3-3

The Aggregate Cost of the Project

No.	Category	Value(million yuan)	Remark
1	Production Cost	15,829.6385	Production factor payment
2	Environmental Protection Cost	406.2656	
3	Environmental Pollution Cost	75	Mass relocation cost
	Total	16,310.9041	

13.4 The Net Profits and the Profits-cost Ratio

The project will bring net profit at present value of 2.0806 billion yuan RMB, with profits-cost ratio of $1.13 > 1$, which indicates that the aggregate profit of the project is satisfying and it is feasible in terms of economic growth and environmental protection.

In conclusion, the project will achieve remarkable economic profits and environmental benefits through pollutants recycle, as well as huge social profits, all of which are operated in good harmony.

14 Assessment Conclusion

14.1 Assessment on the Environmental Quality Status of the Region Where the Project Located

14.1.1 Air Environmental Quality Status

According to the result of air status, monitoring and assessment, the hourly and daily average value of SO₂ detected by the monitoring stations in the assessed region meet the standard of the second level regulated in “Air Quality Status” (GB3095-1996); while the daily average value of both TSP and PM₁₀ go beyond the limit at different degree. All of daily average values of PM₁₀ detected by any monitoring station go beyond the limit. The non-qualified rate of TSP daily average value is 6.7%, and that of PM₁₀ is 26.7%.

Compared the data detected by two automatic monitoring station in Nanchang during the same period, we learn that the daily average value of PM₁₀ also goes beyond the limit at the rate of 30%.

14.1.2 Surface Water Environmental Quality Status

As shown in the monitoring result of surface water quality status and the related records, detected in the northern tributary of Ganjiang River, the value of PH, COD_{Cr}, BOD₅, DO meet the requirement of class IV waster quality standards, and the value of SS meets the requirement of “Farming Land Irrigation Water Quality Standards”(GB5084-92).

14.1.3 Sound Environmental Quality Status

Equivalent noise value detected in the mornings by all monitoring station varies from 40.1dB to 58.6 dB (A), lower than the executive environment standard of 60 dB (A); value detected in the evenings is between 25.7 dB and 49.9 dB (A), also lower than the executive environment standard of 50 dB (A). That's to say, the environmental quality of the region can meet the requirement of Class 2 Area regulated in “Noise Standards of City Regional Environment” (GB3-96-93).

In sum, the air quality of the assessed regions is polluted at different degrees. Investigation shows that it is the big-scaled infrastructure and various constructions around clock in the assessed region that lead to the non-standard value of PM₁₀. In order to prevent the environment deterioration, and to improve the environmental quality in the assessed region, we shall enhance the management of city environment.

14.2 Project Analysis and Clean Production

14.2.1 Project Analysis

(1) Jiangxi Chenming Paper-making Co., Ltd. Chooses to build the factory in Baishuihu Industrial Garden, Nanchang National Economic and Technological Development Zone, and install two production lines which may respectively produce 200,000 ton low quantification coated paper and 187,000 ton BTMP pulp annually. The supporting projects include two combined thermoelectric boilers of 240t/h (one for production, one on standby), a sewage disposal station of 22,000 t/d, and a water supply treatment factory of 50,000 t/d, with aggregate investment of 1.3599 billion yuan RMB.

(2) The main waste gas source of the project is thermoelectric boilers that will emit 225.02913 million Nm³ /a gas. Its main components are smoke, SO₂, emitted outside through the 120-meter-high chimney, with emission amounts of 154 t/a and 1080 t/a respectively.

(3) The project will cause some pollution Area, including malodor from sewage disposal station, stench from grinding pulp, flying dust caused by coal unloading and uploading and when bark and wood dust are being transported.

(4) The sewage discharge amount of the project will be 6.7881 million m³ /a, of which the amount of main pollutant COD_{Cr} is 2036 t/a, and of BOD₅ is 203.64 t/a.

(5) The main solid waste of the project are flying ash, slag, bark and wood dust produced in the process of raw material preparation, and mud left from sewage disposal station. The total amount of solid waste is 174,500 t/a, and all of the solid waste are recycled.

(6)The noise resources of the project are mainly divided into three categories: boiler exhaust noise, outdoors, whose intensity could be as high as 125 dB (A); indoors mechanical and air dynamic noise, is produced in pulp-making workshop during the process of material preparation and pulp grinding, in paper-making workshop, at thermoelectric station, at sewage disposal station, and at water supply treatment site. The noise intensity varies from 90 dB to 105 dB (A). Besides, transportation tools such as freight locomotive, trucks, etc. are also part of the noise resource.

14.2.2 Clean Production

With the design principle of clean production, the project uses clean raw materials, production, clean manufacturing techniques, and clean equipments, and reduces the unit consumption of raw materials as much as possible. By comparing the energy consumption such as water, electricity, steam, etc., with the unit consumption of pollutants production and discharge, we may conclude that this manufacturing technique is up to the international advanced level.

14.3 Environmental Influence Anticipation and Assessment

14.3.1 Air Environmental Influence Anticipation and Assessment

(1) The maximum value of annual average concentration of SO_2 and produced by the project will be $4.02 \mu\text{g}/\text{m}^3$ and $0.76 \mu\text{g}/\text{m}^3$ respectively, far lower than the second standard level of air quality, only at the percentage of 6.7 and 0.76 of the standard. The main affected regions are 1-3km west from Ganjiang River, within the area of 6km south from the future factory, which makes small influence on the downtown of Nanchang that is located at the east to Ganjiang River and south to the factory.

(2) When under unfavorable diffusion condition, the emission of produced of the project in the assessed region will make the average daily value of SO_2 detected at part of the stations at the downward wind direction take 25% of the second standard level, however, the average daily concentration of PM_{10} only take 6% of the standard.

(3) The five days with the highest average daily concentration appear when the atmosphere is stable and neutral, and the average wind speed is low; while the maximum value ground concentration occurs in the region 2-6km southwest from the location of the project. The maximum daily concentration value of SO_2 and PM_{10} in the whole year is respectively $37.4 \mu\text{g}/\text{m}^3$ and $8.4 \mu\text{g}/\text{m}^3$, accounting for 25% and 6% of the standard respectively. The maximum hourly concentration value of SO_2 in the whole year occurs at the place 4.7 km southwest from the thermoelectric station with the maximum value of $61.93 \mu\text{g}/\text{m}^3$, accounting for 12.4% of the second standard level.

(4) In abnormal production, the emission of SO_2 and smoke will make the maximum hourly average concentration of SO_2 increase to account for 80% of the standard, and of PM_{10} up to $410 \mu\text{g}/\text{m}^3$.

It may conclude from above anticipation that the gas pollutants emission won't worsen the regional air quality to be beyond the limit. Through dust precipitation, the smoke produced by thermoelectric station boilers has little effect on the concentration of PM_{10} in the air. However, the project will affect the average daily concentration of SO_2 in unfavorable condition for diffusion. Therefore, strict measures shall be taken to control the emission of SO_2 , and prevent emission accidents resulting from the purified facilities de-activated partly or completely.

14.3.2 Analysis of Influence on Surroundings by Malodor

Malodor is mainly produced in the sewage station. According to the analogical analysis, malodor from the sewage station without any treatment will affect the people within the radius of 300 meters. In order to protect people outside the factory from malodor, it regulates that the sanitary protection distance of sewage is 100m, and the permitted discharge amount of stink pollutants is 0.47kg/h for NH_3 , 0.023kg/h for H_2S , and 0.00166kg/h for Methanthiol.

14.3.3 Surface Water Environment Influence Anticipation

(1) Under the normal condition of discharge

When discharged normally, the maximum added value of COD_{Cr} pollutants is 2.32mg/L, and that of BOD₅ is 0.48mg/L. As shown in table 5.3-6 and 5.3-7, added value plus present monitoring value, the anticipated sum of COD_{Cr} and BOD₅ meets the No. 3 standard of “Surface Water Environment Quality Standard” (GB3838-2002). Therefore, the construction project has little effect on the water quality of northern tributary of Ganjiang River under the normal condition of discharge

(2) Under the abnormal condition of discharge

When discharged abnormally, the maximum added value of COD_{Cr} pollutants is 24.14mg/L, and that of BOD₅ is 11.26mg/L. As shown in table 5.3-6 and 5.3-7, when added value plus present monitoring value, the concentration of COD_{Cr} 3000m along the downstream of discharge goes beyond the No.3 standard of “Surface Water Environment Quality Standard” (GB3838-2002), and the anticipated sum meets the requirement of No. standard of “Surface Water Environment Quality Standard” (GB3838-2002)’. In accordance with the No. [2002] 120 file “Confirmation Letter about Environment Quality Standard on the Project of Annual Production of 200,000 ton Low Quantification Coated Paper by Jiangxi Chenming Paper-making Co., Ltd. ”, surface water environment quality is temporarily assessed with the No. 4 standard of “Surface Water Environment Quality Standard” (GB3838-2002) till the new regulation is issued. Therefore, in order to protect the water quality of northern tributary of Ganjiang River, the construction organizations should attach more attention to the environmental protection management, and ensure the normal operation of sewage disposal that waste water is discharged within limit, with strict prohibition on non-standard discharge and discharge accident.

14.3.4 Sound Environment Influence Anticipation

After the project comes into use, the noise in the neighborhood of the factory will be increased by 0.0 dB (A) ~2.1 dB (A) in the daytime, and by 0.1 dB (A)~2.8 dB (A) at night. The noise will be 41.6 dB (A) ~56.6 dB (A) in t, the daytime and 36.0 dB (A) ~49.2 dB (A), which meets the requirements of the present standard (60 dB (A) for daytime, and 50 dB (A) for night).

When the accident discharge of boiler exhaust noise is at the value of 125 dB (A), the radius of affected region by the noise could be as far as 4000 meters. If some treatment measures are taken to reduce the noise to 105 dB (A), the radius of affected region will be shorten to 500 meters. When the discharge decreases to 95 dB (A), the radius of the affected region will be 150 meters within the factory limitation.

In conclusion, if all pollution prevention facilities are ensured to be in line with the design and being operated normally, the project will somewhat influence the quality of air, surface water and sound. When accidents occur with the pollution prevention facilities, the environmental protection targets within the 4.0 km radius of assessed region will be affected severely.

14.4 Pollution Prevention Countermeasures

14.4.1 Waste Gas Abatement Measures

Thermoelectric Boiler Smoke: Circulating fluid bed boiler is installed with interior calcium spray, tail humidification, and bag dust precipitation to ensure the precipitation rate up to 99.7% and removal rate of SO₂ up to 85% with the proper ratio of calcium and sulfur and improved design of dust precipitation. The concentration of emitted smoke and smog is 68.4mg/Nm³, and that of SO₂ is 480mg/Nm³, both of which are lower than the limit regulated by “Coal-fired Power Plant Pollutants Discharge Standard” (GB 13223-1996). What’s more, according to the regulation of GB5468-91 and 16157-1996, chimneys should be equipped with monitoring holes for eternal sampling and other related facilities.

Malodor of Sewage disposal Station: The mud dehydrating facility and mud pile site are set indoors. Dehydrated by screw pressing, the substituted air indoors enters spray tower through collecting system. Meanwhile, mud produced in anaerobic process is collected through special mud trough instead of going into sewage dehydrating facility, and is sold to project design unit. As to the malodor produced in pulp grinding process, it can be handled with the techniques of directed collection and absorption.

Emission of Fly Ash and Dust from Bag Dust Precipitation: Discharging from outlet seal, cooled fly ash is delivered as airstream to brick-making production line through sealed can, and shielded by the collection equipment at the unloading site of the brick-making production line.

14.4.2 Waste Water Abatement Measures

In this report, BTMP waste water is suggested to be processed in highly effective internal circulating anaerobic reactor and go into distribution pool with other production and living waste water before it enters oxygen consumption processing system. The anticipated indices of effluent will be COD_{Cr} 300mg/L, BOD₅ 30mg/L, and SS 60mg/L, GB35 meeting the requirement of “Paper-making Industry Water Pollutants Discharge Standard” (GB3544-2001). It is proposed to install accident pool so as to avoid unqualified waste water pouring into Ganjiang River.

14.4.3 Solid Waste Treatment Measures

The fly ash produced in circulating fluid bed boiler is so active enough to be used to produce bricks, tiles, cinder cement, heat insulation materials and road building materials. It is proposed in the report that boiler fly ash can be consumed by hollow brick production line or being burnt in boilers to produce cement clinker; and bark, wood dust and mud left from sewage disposal are burnt in thermoelectric boilers with annual burnt amount of 46,400 ton. In accordance with the regulation of “General Industrial Solid Waste Storage and Treatment Site Pollution Standard” (GB18599-2001), totally-enclosed fly ash storage and half-enclosed coal site and cinder storage should be built to avoid filter liquid leaking, meanwhile, rain-proof roof is also expected to be installed to control dust pollution.

14.4.4 Noise Prevention Countermeasures

Boiler exhaust noise can be reduced through the process of restriction and depressurization—spray—resistive compound muffle. If the muffle works effectively, it can reduce noise by 30 dB.

Following are the noise abatement principles for mechanical and air dynamic noise produced by other noise resource: firstly, low-noise facilities should be taken into consideration at the time of design; secondly, measures and facilities of sound insulation, shock absorption should be used in the project, and all noise resources must be built in separate enclosed structure and installed with sound insulation doors and windows.

The aggregate investment for pollution abatement is 158.574 million yuan RMB, and annual operating cost is approximately 35.996 million yuan RMB.

14.5 Gross Quantum Control

The discharge gross quantum of all pollutants produced by the project is within the limit of gross quantum indices provided by Nanchang Environmental Protection Bureau: Smoke 154t/a, SO₂ 1080t/a, COD_{Cr} 2036t/a. However, according to the official written reply from the State General Environmental Protection Bureau, the gross quantum of the project should be regard as part of the gross quantum of Jiangxi Chenming Paper-making Co., Ltd., therefore, the pollutant abatement of the company need to be further improved, especially the abatement of SO₂, because its combined gross quantum has been beyond the gross quantum of the company, thus its gross quantum shall be reduced by 2118t/a accordingly.

14.6 Public Participation

The public is concerned about the project inquiry very much, and has disagreement in the construction and location of the project. Most people involved in the survey think waste water and smoke as main pollution source and suggest that related environment protection measures shall be taken to ensure qualified discharge. In general, the public holds positive manner to the construction of the project, and their environmental protection consciousness is being strengthened.

14.7 Factory Location Choice and General Layout

The Baishuihu Industrial Zone in the works is located at the upwind of “both sides of the river” in Nanchang city. The decision of the industrial zone location is relatively unscientific and unreasonable in terms of city environmental protection and the sustainable development of the industrial zone, because the air quality of city will be affected, the city image will be harmed and the sustainable development capacity will be weakened. The obvious deficiency of the choice lies in the bad pollution influence of the environmental protection, weakened capacity of enterprises’ long-term development, high cost, and increased burden of the government and enterprises due to the regional movement.

The general allocation is decided on the basis of combining technological flow and environmental protection in harmony. It's generally reasonable, but it must be designed to ensure the protection distance of liquefied gas station and sewage disposal station.

14.8 Other Concerned Environment Issues

(1) The safety of liquefied gas station

Since the explosive yield of a 50m³ -liquefied gas bottle is as high as 67.2NT, the radius of the involved area in the explosion is 39~62m, and that of the high-temperature affected area is 108m. Therefore, measures proposed in the report should be taken to prevent the risk of explosion.

(2) Unorganized Environmental Pollution

In the report, in view of the possible unorganized pollution, prevention measures are considered in the process of technological design to stop the unorganized pollutants discharge.

14.9 Related Requirements

(1) Carrying on environment supervision. Environment supervision is expected to be carried on to manage and supervise the environmental protection design, facilities choices, and the project construction in a fair and scientific way, and ensure the realization of the promises on environmental protection made by the enterprise and various requirements mentioned in the report.

(2) Centralized heat supply. The surplus 50t steam per hour of the enterprise shall be sold to other organizations and enterprises in Baishuihu Industrial Zone to contribute to the regional environment with stable air quality.

(3) Improving the waste recycle. According to the report, the circulating fluid bed boiler should be designed scientifically to guarantee the proper treatment of bark, wood dust and mud; the discharge, piling and delivery of fly ash and slag shall be handled in the ways proposed in the report, meanwhile, fly ash and slag shall be best recycled based on its chemical property.

(4) Establishing management system. A scientific, highly effective and strict management system shall be established in accordance with the real condition of the enterprise itself and the requirements of ISO 14001 Environmental Protection Management System, so as to ensure the normative and effective environmental management during the operating period of the enterprise.

(5) On-line monitoring. An online monitoring system shall be set up to monitor the main pollutants discharge in time, i.e. the smoke from sewage disposal station and thermoelectric station, and ensure the pollution abatement facilities work normally and effectively. Meanwhile, an automatic monitoring system shall be considered to be installed to monitor the air, water and sound environment around the factory.

14.10 Conclusion

The conclusion is drawn as follows:

At the angle of environmental protection and city function planning, the location choice of the future project has advantages as much as disadvantages. Because of the advanced technology and high clean production level, the project construction is acceptable in terms of environmental protection, as long as all pollution prevention and abatement measures and environmental management are carried on properly and strictly, stopping accident discharge, and pollutants discharge is ensured to meet the requirements of executive standard and gross quantum control indices.

