

Environmental Management Plan

CNG GLASS (NIGERIA) FZE

2017.02

1. Project Overview

1.1 Project Name

Project name: Nigeria 500t/d Float Glass and On-line Solar Control Coated Glass Production Line

1.2 Project Construction Unit

Project Construction unit: China Glass Holdings Limited

1.3 Location

The proposed location of the project is in Ogun Guangdong Free Trade Zone of Ogun State in Federal Republic of Nigeria.

1.4 Introduction of project construction unit

China Glass Holdings Limited (hereinafter referred to as “CGHL”) is China’s leading flat glass producer and the largest coated glass producer. Founded in 2004, CGHL was successfully listed in the main board of Hong Kong Stock Exchange in 2005 (stock code: 3300). The company’s main shareholders include Legend Holdings, Pilkington and International Finance Corporation, powerful shareholder background is the strong backup force for the company’s robust development.

CGHL is specialized in R&D, production and sales of coated building glass, the glass featuring energy conservation and environmental protection and new energy glass, and takes the leading position with regard to high-end technologies in domestic glass industry. CGHL holds dozens of national and world-class glass product patent technologies, currently being one of the three companies in the world having on-line LOW-E glass and on-line TCO glass technologies, the only company in China with a full set of independent IPRs for such products, and the leader in on-line coated glass technology R&D in domestic market.

1.5 Regional environment of the Production line

It is proposed that this Project will be constructed in Ogun-Guangdong Free Trade Zone in the State of OGUN of Federal Republic of Nigeria. Ogun-Guangdong Free Trade Zone is located in Igbessa, State of Ogun in the southwest of Nigeria and its overall planned area is 100K m²; Phase I involves 2.5km². The free trade zone is advantageous in geographical location; it is about 103km away from or 1h and 40min drive to Abeokuta, the capital of the state; about 30km away from Port Apapa of Lagos, about

30km away from the Murtala Mohammed International Airport of Lagos; and about 20km from the site available for the construction of a new port.

1.6 Introduction of the Project

The total area of the land requisitioned for this Project is 249,452 m² the plan layout of the factory area of this Project should comprehensively consider the natural conditions as well as fire control, health, environmental protection, transportation and other factors around the factory area and should be conducted effectively on basis of the actual landform. The factory area is arranged in rectangular form with the length of south to north about 236m and east to west about 1057m. The factory area has already saved the area for build a second 500t/d production line.

2. Principles of Environment Protection

2.1 Persevering with the "three simultaneous" principle, namely the facilities of environmental engineering and the main project shall be designed, constructed and operated simultaneously, the technological design of this project shall adopt as much as possible the new technology and equipment that can produce no or fewer pollutant and reduce the pollutant a minimum limit as far as possible during the production process.

2.2 The environment protection standards adopted in design

- "Ambient air quality standards" GB3095-1996,
- "Integrated emission standard of air pollutants" GB16297-1996;
- "Standard of Environmental Noise of Urban Area" GB3096-1993;
- "Emission standard for industrial enterprises noise at boundary" GB12348-2008
- "Integrated Wastewater Discharge Standard" GB8978-1996;
- "Discharged into Urban Sewage Water Quality Standards" CJ3082-1999;
- "Emission standard of air pollutants for industrial kiln and furnace" GB9078-1996;
- "Environmental quality standards for surface water" GB3838-2002;
- "Emission standard of air pollutants for coal-burning oil- burning gas-fired boiler"
- "Emission standard of environment noise for boundary of construction

site" GB12523-1990;

- "Design requirements for environment protection of flat glass factory" JCJ08-95;
- "Cleaner production standard -flat glass industry" HJ/T361-2007;
- "The reuse of urban recycling water -water quality standard for industrial uses" GB/T 19923-2005
- The second grade standard of "ambient air quality standards" GB3095-1996 shall be performed for ambient air;
- The third grade standard of "environmental quality standards for surface water" GB3838-2002 shall be performed for surface water;
- The third grade standard of "quality standard for ground water" GB/T14848-1993 shall be performed for ground water;
- The second grade standard of "emission standard for industrial enterprises noise at boundary" GB12348-2008 shall be performed for noise;
- The second grade standard of "Emission standard of air pollutants for industrial kiln and furnace" GB9078-1996 shall be performed for exhaust gas;
- The third grade standard of "Integrated Wastewater Discharge Standard" GB8978-1996 Table 4 shall be performed for waste water;

3. Environmental, occupational health and safety management responsibilities

- 3.1 CNG Glass (Nigeria) FZE will follow the lead of Free Trade Zone Management Company and set up the environmental, occupational health and safety management standard of the company and take the responsibilities.
- 3.2 CNG Glass (Nigeria) FZE will set up Environmental, occupational health and safety management, this department wills general lead by the management team and a vice president will in charge of relevant specific job.
- 3.3 The company will set up the Environmental, Occupational Health and Safety Management network to implement all-round management of environmental protection, occupational health and safety in all departments of the Company.

4. Construction environmental management plan

Environmental impact analysis and implementation of measures during the construction period:

The main environmental impacts during the construction period are generated during land levelling, factory building construction, equipment installation and other processes, and the pollutants are primarily dust, noises, waste water and solid wastes. Since the environmental impacts during the construction period are characterized by locality, temporality, etc., the normal life of surrounding people and the regional environmental quality will not be greatly influenced through civilized construction education to the construction team, and the impact to the regional environmental quality during the entire construction period is limited.

4.1 Dust Management

The project site is located in the Ogun FTA, which is far from the surrounding residential areas, thus having less impact. Among the potential receptors identified in the environmental impact assessment, only the dust receptors are located in the areas around the project site (ecological life), which means that the resulting dust may pollute the atmosphere and the surrounding vegetation.

Potential sources of dust during the construction phase of the development project:

- ✓ On-site cleaning
- ✓ Ground excavation, piling and earthworks
- ✓ On-site soil transport operations, site levelling, cut and fill, etc., and transportation of vehicles on the haul roads (especially unpaved roads)
- ✓ Vehicles running on site during the drying period
- ✓ Re-suspension of particulate matter generated from vehicles running on the construction site, and wind blowing through the entire site during the drying period
- ✓ Pile-up of excavated materials
- ✓ Cutting, grinding and drilling operations
- ✓ Accidental spillage, leakage and loss of load of vehicles carrying loose materials, deep excavation operations
- ✓ Dumping

✓ Earthworks

For the occurrence of dust nuisance, the following additional factors are required to be taken into consideration:

- Prevailing wind (wind speed, wind direction)
- Prevailing climatic conditions, including rainfall
- Locations of sensitive receptors (including residential and commercial buildings, habitats and river channels)

The following favourable environmental regulations are utilized, to control dust emissions and mitigate any dust hazard problems.

4.1.1 Supervision

The construction superintendent should regularly supervise the on-site and off-site eye-catching signs of dust emissions and deposits, to ensure exactness of the mitigation measures taken, and conduct dust emission monitoring of any construction activities deemed to constitute a hazard on site every day.

Windy conditions may increase the spread of dust. Local weather forecasts should be considered as part of the supervision regulations. These conditions should be documented, and under windy conditions, the activities that may cause the risk of dust nuisance (e.g. excavation and earthworks) should be restricted or mitigation should be enhanced. The construction superintendent should assess whether climatic conditions are suitable for construction activities or not.

4.1.2 Mitigation Measures

Mitigation measures should be implemented, to ensure effective control of dust emissions from construction works, and should be the best practice in the industry, which refers to a proven and improved method for mitigation of dust emissions.

Common Mitigation Measures for Various Construction Activities include:

Activities	Mitigation Measures
Construction vehicles	<ul style="list-style-type: none">- All construction vehicles should follow clearly defined routes- Limit the vehicle speed of all vehicles running on site- Including all vehicles carrying loose materials- Clean the tires of vehicles driving off the site
Roads	<ul style="list-style-type: none">- Use road sweepers if necessary, to ensure that roads are kept clean and free from dust and mud

	<ul style="list-style-type: none"> - Sweep roadsides and trails with your hand, and sprinkle water if necessary
Material piles	<ul style="list-style-type: none"> - Sprinkle, seal up or cover if necessary - Use chemical adhesives to seal or spray chemical binders if necessary - Store material piles away from any sensitive receptor if possible
Dust suppression	<ul style="list-style-type: none"> - Regularly deploy portable water troughs on site if necessary - Increase monitoring and mitigation activities in particularly dry and windy seasons - Consider using fences, to ensure reduced dust emissions if necessary - Sprinkle water around evidently dusty materials, to reduce the risk of potential dust - Perform all cutter grinding operations in a variety of ways, to reduce the risk of dust - Sprinkle water before operations in the construction area

It is strictly prohibited to burn any materials on site during construction.

The on-site ready-made mitigation equipment should be used since commencement of the project, including cutting machines and humidifying equipment, such as tractor tanker trucks and road sweepers.

If a process itself causes dust blowing all over, and there is a process where less dust is produced, then the process producing less dust should be implemented. Where feasible, prefabricated components and equipments should be used, to decrease the possibility of blowing dust during on-site construction.

4.1.3 Control procedures suitable for reducing dust in all construction phases

- Earthworks and piling operations

Excavation and piling operations as well as on-site material handling and storage are likely to become major factors for dust emissions. During the excavation operation, a stabilized surface is destroyed and exposed to the wind. Such plentiful materials are caused to be easily suspended in the air by wind or mechanical interference because they are usually dry.

Make sure not to damage the surface as much as possible, and if necessary, spray water to stabilize as soon as possible after destruction, to reduce dust emissions and re-suspension.

Permitted by the on-site construction logistics, pile materials away from the areas recognized as sensitive receptors. All piled materials should be sprinkled, to prevent dust blowing, or if necessary, properly covered with firm tarpaulin.

- **Reinforced concrete structures**

The production and construction processes will involve construction of reinforced concrete (RC) foundations and structures. The open and enclosed work areas are likely to be dusty in the phase of reinforced concrete construction, and it is necessary to take mitigation measures to reduce dust.

Carry out off-site fabrication and construction if feasible. If not, fabricate in a place away from the areas of sensitive receptors.

Use fixed fences or sprinkling devices, local exhaust ventilation or particle extraction/reduction systems, so as to implement the dust suppression method.

- **On-site roads, access roads and public roads (throughout the construction period)**

During development, it is necessary to build access roads and on-site roads for on-site vehicle and equipment operations, in order to facilitate delivery of the specified materials.

Dust emission can be easily caused on unpaved on-site roads, especially in dry or windy conditions, therefore compacted hard road surfaces should be adopted wherever possible, even if the route is only temporary. The number of vehicles on the site road in close proximity to the location of sensitive receptors should be minimized if the construction requirements permit.

The on-site vehicle operations and actions should be controlled by appropriate signs and supervised by the construction superintendent for compliance. The on-site vehicles should meet the construction requirements at least, and the speeds on an unpaved road and a properly paved and maintained road should be limited to 5mph and 10mph respectively, which are favourable for lowering dust re-suspension due to running vehicles.

The on-site roads should be inspected periodically and maintained in a compacted state through fixed sprinklers, bowsers, low-emission additives and binders (if necessary). During the weekday, the access roads to the main construction site should be cleaned everyday, and if necessary, cleaned regularly with a mechanical road sweeper. The edges of access roads and walkways are swept with a handheld broom and controllable humidifying equipment.

The humidification method used for reducing dust re-suspension in the air can also result in the fact that clay soil and dust on wheels are accumulated on roads. Hence,

before vehicles enter the public roads and roads at other places, its wheels should be washed, and grates should be installed, to prevent from taking soil and dust away.

Any vehicle leaving the construction area should be inspected at a wheel washing bay and thoroughly cleaned if necessary.

During the main construction work, a permanent wheel washing facility with a protective enclosure should be installed at the access road at the main site exit point.

- **Relieving site staff from dust exposure**

Although it is very important to reduce the impact of the project on local residents and other sensitive receptors, it is also necessary to consider the impact of dust on site staff during each construction phase.

The training on suppression of pollutant emissions and reduction in exposure to potentially harmful emissions should be provided to all site staff. Appropriate personal protective gear should be worn according to the risk assessments of the relevant activities. The staff should always reduce its exposure to pollutant emissions. No staff may spend too much time on an activity carried out at a place full of dust, and appropriate dust masks as specified should be provided for site staff working in dusty areas.

If equipment is used in confined spaces, a ventilation or particle extraction system should be always used.

4.2 Noise Control

Construction machinery noise during construction is also an important factor affecting the environment, wherein, the impact pile drivers, air compressors, excavators, loaders, jolters and other high-noise equipment are the primary sources of noise pollution. Although such noise sources are of intermittent sources, the noise reduction measures like confinement or basic damping, etc. should be taken as much as possible; the construction time at night should be strictly controlled, to minimize the impact of construction noises on the environment; in case of works beyond normal working hours, the local authorities must be sought for prior permission, including the details about any noises possibly caused by relevant activities. Noises at the construction site may have an influence on the current living conditions of local residents.

Noise Monitoring Program

If any noise complaints are received, the Site Manager should thoroughly investigate and take actions, to ensure that the problem is avoided.

Noise control measures

A series of control measures should be implemented at the site, in order to reduce noises, and in particular, the following control measures should be adopted:

- ✓ Where necessary and feasible, fixed and movable barriers dedicated for noise insulation are used. The degree of noise insulation depends on the nature and operation of the machines as well as the ventilation requirements.
- ✓ All construction facilities and equipment should be in compliance with the noise emission limitations in Nigeria.
- ✓ All vehicles and mechanical devices employed in the works should be respectively equipped with an effective exhaust muffler.
- ✓ Materials should be conveyed to the site during normal working hours on the construction site.
- ✓ All auxiliary equipment such as generators, compressors and pumps should be put in place, to minimize noise interferences, that is, in appropriate places away from receptors as far as possible, or if necessary, put at the rear sides of the acoustic enclosures and/or barriers. If possible, loading and unloading should also be performed in the position away from such areas.
- ✓ Periodic inspections and examination operations
- ✓ The feedback from local residents during field activities should be supervised.
- ✓ In light of site actions, on-site training and awareness-raising of all site staff should be carried out, to reduce public nuisance, and a thoughtful approach should be developed.
- ✓ Maintenance: It is essential to carry out regular and effective maintenance by trained personnel, which helps reducing machine noises.
- ✓ Do not run unnecessary machines.

4.3 Solid Wastes Management

The Site Waste Management Plan should comply with the waste management regulations and laws in Nigeria. It is therefore important to build appropriate infrastructures, to dispose various wastes. Pollution may be caused if wastes are not

properly managed, and may also have an adverse effect on the health and environmental quality of the residents nearby.

During the excavation operation, the general solid wastes (gravel, cement bags, paint bottles, damaged equipment, etc.) and accumulated materials generated by the construction work should be removed.

General wastes produced by construction activities, especially those non-biodegradable materials may cause environmental pollution. Solid wastes are primarily construction wastes and domestic garbage generated during construction. Construction wastes are mainly from civil work, etc., and can be backfilled after construction. Domestic garbage is chiefly the wastes in the daily lives of construction workers. Construction wastes and domestic garbage should be disposed in a unified manner, and management should be strengthened, to prohibit cluttering and dumping illegally, and reduce the impact of solid wastes on the environment during the construction period.

4.4 Wastewater Discharge Management

The water for production use during the construction period is principally the water used for concrete mixers and spraying on road surfaces and earth. With lower wastewater effluent discharged, the wastewater is mainly resulted from spillage, sweating, dripping and leakage during washing by equipment and production, only contains a small amount of silt without other impurities, and can be used for greening in the factory area and discharged externally after being subjected to deposition and removal of suspended matter. In addition, the construction workers also produce a small amount of domestic sewage, which enters the urban sewage pipe network in Ogun FTA after being treated in a septic tank.

4.5 Major Goals of Environmental Protection:

Environmental Factors	Environmental Protection Object Name	Location	Distance (m)	Environmental Function
Ambient air	Ogun FTA and surrounding communities	Surroundings	500	Grade II, <i>Ambient Air Quality Standard</i> (GB3095-1996)
Water Environment	Drainage system in the FTA	Southeast	300	Class IV, <i>Environmental Quality Standard for Surface Water</i>

				(GB3838-2002)
Acoustic Environment	Ogun FTA and surrounding communities	Surroundings	500	The standard value of Class III in the <i>Standard for Acoustic Environmental Quality</i> (GB3096-2008)
Solid Wastes	Ogun FTA and surrounding communities	Surroundings		

4.6 Environmental Quality Standards

(1) The standard of Grade II, *Ambient Air Quality Standard* (GB3095-1996)

Standard of Grade II, *Ambient Air Quality Standard*

Unit: mg/Nm³

Pollution Factors	Environmental Quality Criteria	
	Value-getting Time	Concentration Limits
SO ₂	Annual mean value	0.06
	Daily mean value	0.15
	1-hour mean value	0.50
NO ₂	Annual mean value	0.08
	Daily mean value	0.12
	1-hour mean value	0.24
PM ₁₀	Annual mean value	0.10
	Daily mean value	0.15

(2) The standards of Class III, IV in the *Environmental Quality Standard for Surface Water* (GB3838-2002)

Standard Limit Values for Surface Water Unit: mg/l (excluding pH)

Class	pH	COD _{Cr}	BOD ₅	DO	TP	NH ₃ -N
IV	6~9	30	6	3	0.3	1.5

(3) The standard value of Class III in the *Standard for Acoustic Environmental Quality* (GB3096-2008)

Standard for Acoustic Environmental Quality Equivalent Sound Level L_{Aeq}: dB

Class	Daytime	Nighttime
3	65	55

4.7 Pollutant Discharge Standards

(1) Standards for Air Emissions and Ambient Air Quality

Unit: mg/Nm³

Pollution Factors	Environmental Quality Criteria	
	Value-getting Time	Concentration Limits
SO ₂	Annual mean value	0.06
	Daily mean value	0.15
	1-hour mean value	0.50
NO ₂	Annual mean value	0.08
	Daily mean value	0.12
	1-hour mean value	0.24
PM ₁₀	Annual mean value	0.10
	Daily mean value	0.15

(2) Sewage Discharge Standards for Project Construction

Unit: mg/L (excluding pH)

Class	pH	COD _{Cr}	BOD ₅	DO	TP	NH ₃ -N
IV	6~9	30	6	3	0.3	1.5

(3) Boundary Noise Limits for Construction Sites

Unit: LAeq: dB

Construction Phase	Major Noise Sources	Noise Limits	
		Daytime	Night-time
Earth-rock	Bulldozers, excavators, loaders, etc.	75	55
Piling	Various pile drivers, etc.	85	Prohibited construction
Structure	Concrete mixers, vibrator rods, electric saws, etc.	70	55
Decoration	Cranes, lifters, etc.	65	55

(4) Solid Wastes: Unified recycling

5. Operational Environmental Management Plan

5.1 Primary pollution source and pollution factor

5.1.1 Primary pollution source

- Noise
- Wastewater
- Solid Wastes
- Atmospheric Emission

- Greenhouse Gases

5.1.2 Analysis of pollution factor

Main pollution sources and pollutants

Name	Types of pollutants							
	SO ₂	NO _x	Smoke dust	Dust	Waste water	Noise	Solid waste	Radiant heat
Raw materials ingredients and mixing house				√	√		√	
Raw material warehouse				√			√	
Hot end	√	√	√	√		√	√	√
Finished products warehouse						√	√	
Circulating water pump house					√	√		
Power workshop					√	√		
Chimney	√	√	√					

5.1.3 Pollution factor

Analysis of noise pollution factor

Noise is mainly produced from cooling fans, pumps, air compressors and other high noise machinery and equipment, the sound level of equipment described in the following table.

The Sound Level of Equipment Noise

Shop Name	Equipment Name	Sound level dB (A)
Hot end	Cooling fan	80~85
Circulating water	Water pump	80~85

Nitrogen hydrogen station	Air compressor	80~85
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Analysis of water pollution factor

The production water of this project is mainly for joint workshops and protective gas workshop, mostly of them is recycled. The exhausted wastewater includes production wastewater and domestic sewage, mainly including:

- The production wastewater is mainly the water used for washing the ground surface of workshop (mainly raw material workshop). The main pollutant in wastewater is suspended solids.
- Cooling water used for equipment of Joint workshop. The cooling water has no toxic substances and can be recycled after cooling tower.
- Domestic sewage, mainly produced from workshop toilet, contains a certain amount of SS and BOD.

Analysis of pollution factors for solid waste

The solid waste generated during the production of this project includes the following aspects:

- Broken glass generated from production process.
- Waste refractory discharged when doing cold and hot repair of melting furnace.

Analysis of dust pollution factor

The dust generated during the production of this project comes mainly from raw materials workshop, joint workshop and broken glass system.

Analysis of pollution factor for exhaust gas

The exhaust gas is mainly from chimney flue of glass melting furnace.

The main waste gas of this project is flue gas generated by combustion of natural gas in glass melting furnace and small amount of SO₂, NO_x, smoke dust and other pollutants due to the thermal decomposition of melted mirabilite in exhaust gas.

Analysis of Greenhouse Gases

High temperature flue gas is the mainly greenhouse gas of the project.

5.1.4 Environmental protection and Treatment Measures

Noise Control

- When arranging the factory general arrangement, the workshop can generate strong noise shall be arranged sufficient distance to factory boundary in order to reduce the noise impact for outside the factory boundary.

- Adopt as far as possible the equipment with low noise or vibration.

- The antivibration device shall be adopted for equipment with strong vibration.

- The noise silencer shall be installed on combustion fan and air compressors with strong noise and the anechoic facilities shall be as much as possible arranged on air inlet and air outlet where the aerodynamic noise can be generated.

- The equipment with strong noise shall be arranged within the sealed room as much as possible, to reduce the noise impact with building insulation method.

Wastewater Treatment

The wastewater of production line is mainly cooling water of equipment and water used for washing the ground surface of raw material workshop. Because the suspended solid of water drainage in raw material workshop is too much, the sedimentation basin is arranged in factory for sedimentation process and then the water can be used for production after circulation. The production wastewater contains mainly suspended solids. It shall be drained regularly into the factory sewage treatment system after processing of sedimentation tank and discharged uniformly.

The domestic sewage is mainly from washing water of workshop. It shall be drained regularly into the factory sewage treatment system after processing of septic tank and discharged uniformly.

The water quality of wastewater after treatment shall reach the requirements of China National Standards of "The reuse of urban recycling water -water quality standard for industrial uses" GB/T 19923-2005 and the third grade standard of "Integrated Wastewater Discharge Standard" GB8978-1996 Table 4.

Solid Waste Management

The broken glass can be taken as clinker aggregate and reused for the production of kiln, the refractory waste can be generated only when cold and hot repairs, its main ingredient is silicide, free of toxic material and cannot cause environmental pollution.

Dust Control

Dust is generated from the transporting, pouring and mixing of raw materials and the transshipment point of broken glass systems, the following measures shall be adopted for dust production point: sealing equipment of the dust production point suction tube bag type dust collector blower fan discharged to the outdoor or is hermetically sealed dust collecting unit to achieve the negative pressure operation.

More individual dust collectors are arranged on tops of dolomite, limestone, soda ash

warehouses within batch preparation workshop. A set of centralized dust collection system is arranged in mixing house. The buffer bag type dust collectors are separately arranged at the places of electronic scale and dropping point.

Each centralized dust removal system shall be arranged on storage bin of kiln discharge and original melting conveyer belt within joint workshop, three sets of centralized dust removal systems are arranged at places of breaking edge and dropping plate.

A set of centralized dust collection system and one single dust removal system are arranged for the broken glass system.

The dust removal efficiency of above dust collector and dust remover is more than 99%. The discharged dust concentration after purification by dust collector or dust remover can be controlled in 6080mg/Nm³.

The washing floor is arranged in the raw material workshop, the secondary dust nuisance can be effectively prevented by regularly washing floor and wall.

Waste Gas Disposal

Glass manufacturing is an energy-intensive high-temperature operation, during which raw materials emit combustion by-products when being melted at a high temperature. The main pollutants emitted into the air are from fuel combustion, and carbon dioxide resulted from decomposition of carbonates. The air emissions are expected to be:

- Sulfur oxides (SO_x)
- Carbon dioxide (CO₂)
- Nitrogen oxides (NO)

Gas sources

Such gases are generated at different stages of glass manufacturing, with the sources as follows:

1. Melting furnace
2. Moulding area
3. Annealing process

NO_x Emission Reduction and Mitigation Measures

The primary sources of Nitrogen oxides (NO_x) emissions are: hot nitrogen oxides produced at a high furnace temperature, decomposition of nitrogen compounds in ingredients, and oxidation of nitrogen in fuels. The traditional major technological transformations are usually based on the following technologies or a combination of the following technologies:

- Reduced air-fuel ratio;

- Staged combustion;
- Low nitrogen oxides and sealed burners;
- Fuel selection.

In order to improve the energy efficiency and restrict the formation of nitrogen oxides, the combustion air supplied to a melting furnace should be minimized as much as possible. It is recommended to maintain 0.7-1% oxygen per cubic meter in the melting furnace.

It is important to detect the carbon monoxide level which should be as low as possible (up to 200-300ppm - 1,000ppm CO).

If the level requirements for nitrogen oxides cannot be met by adopting the major measures, the end-of-pipe (secondary) pollution control techniques should be employed, in order to decrease emission of nitrogen oxides during glass manufacturing, and the techniques include:

- Chemical reduction of fuel;
- Adoption of selective catalytic reduction (SCR).

SO_x Emission Reduction and Mitigation measures

Sulfur oxides in exhaust gases emitted from glass melting furnaces depend on the sulfur content in the fuel and the sulfite / sulphate / sulphide content in the raw materials, especially the sodium sulphate or calcium sulphate added for oxidation of glass. Therefore, the recommended pollution control techniques used for reducing sulfur dioxide include:

- Reduction in the content of sodium sulphate or calcium sulphate in the ingredients.
- This project adopts the industry-recognized green energy natural gas fuel, in order to reduce emissions of harmful gases.
- Use of an advanced combustion control system, to reduce the amount of flue gas emissions.
- Use of an advanced flue gas treatment system and equipment featured by dust removal, desulfurization and denitrification, to meet the emission standards of the country of manufacture.

The smoke gas emission process of float glass production line is summarized as follows:

Furnace smoke gas → reserved interface for desulphurization, dust removal,

denitrification → chimney → atmosphere

Greenhouse Gas Treatment

- Use of low carbon fuel: use the green energy source – natural gas as the fuel for melting glass.
- Adoption of an advanced kiln structure: combustion air preheated in the preheating chamber.
- Use of an advanced combustion control system.
- Use of a waste heat power generator.

5.2 Major Goals of Environmental Protection:

Environmental Factors	Environmental Protection Object Name	Location	Distance (m)	Environmental Function
Ambient air	Ogun FTA and surrounding communities	Surroundings	500	Grade II, <i>Ambient Air Quality Standard</i> (GB3095-1996)
Water Environment	Drainage system in the FTA	South east	300	Class IV, <i>Environmental Quality Standard for Surface Water</i> (GB3838-2002)
Acoustic Environment	Ogun FTA and surrounding communities	Surroundings	500	The standard value of Class III in the <i>Standard for Acoustic Environmental Quality</i> (GB3096-2008)
Solid Wastes	Ogun FTA and surrounding communities	Surroundings		

5.3 Environmental Quality Standards

(1) The standard of Grade II, *Ambient Air Quality Standard* (GB3095-1996)

Standard of Grade II, *Ambient Air Quality Standard* Unit: mg/Nm³

Pollution Factors	Environmental Quality Criteria	
	Value-getting Time	Concentration Limits
SO ₂	Annual mean value	0.06
	Daily mean value	0.15
	1-hour mean value	0.50
NO ₂	Annual mean value	0.08
	Daily mean value	0.12
	1-hour mean value	0.24
PM ₁₀	Annual mean value	0.10
	Daily mean value	0.15

(2) The standards of Class III, IV in the Environmental Quality Standard for Surface Water (GB3838-2002)

Standard Limit Values for Surface Water Unit: mg/l (excluding pH)

Class	pH	COD _{Cr}	BOD ₅	DO	TP	NH ₃ -N
□	6-9	30	6	3	0.3	1.5

(3) The standard value of Class III in the *Standard for Acoustic Environmental Quality* (GB3096-2008)

Standard for Acoustic Environmental Quality Equivalent Sound Level L_{Aeq}: dB

Class	Daytime	Night-time
3	65	55

5.4 Pollutant Discharge Standard

(1) Standards for Air Emissions and Ambient Air Quality

Production Line	Amount of Molten Glass	Flow Rate of Flue Gas	Flue Gas Temperature	Oxygen Content in Flue Gas	Nitrogen oxides	Particulate Matter	Sulfur Dioxide	HCl	Other Heavy Metal
Unit	T/D	Nm ³ /hr	°C	%	mg/Nm ³				
standard	500	54019	53	11.8	700	50	400	-	-

(2) Sewage Discharge Standards

Unit: mg/l (excluding pH)

	pH	COD _{Cr}	BOD ₅	DO	TP	NH ₃ -N
IV	6-9	<30	<6	<3	<0.3	<1.5

(3) Noise Emission Standards

1.	Nearby communities (7:00-22:00)	Nearby communities (22:00-7:00)	Nearby industrial enterprises (7:00-22:00)	Nearby industrial enterprises (22:00-7:00)
Unit	dB(A)	dB(A)	dB(A)	dB(A)
standard	54	45	56	56

(4) Solid Waste Discharge Standards

Type	Broken glass	Waste refractories	Others
Recycle Mode	Recycling	Recycling	Recycled for treatment

5.5 Afforestation

Afforestation is not only beautify the environment, improve working and living conditions of workers, and can also clean the air, reduce noise, prevent pollution and achieve the result of civilized production to a certain extent. Combining the local conditions, all vacant land of this project shall be concrete floor as much as possible except the pools, ditches, roads and buildings within entire new construction range, some flowers and trees and shelterbelts can be appropriately planted between the production area and non-production areas for the purpose of environmental beautification.

The production line choose diesel and petroleum coke as the alternative fuel. According to calculation: if use diesel as fuel, the consumption will be 100 tonnes per day, and flue gas emission will be 100,000 m³/hr, SO₂ emission will be 400 mg/Nm³; if use petroleum coke as fuel, the consumption will be 100 tonnes per day, and the flue gas emission will be 80 m³/hr, SO₂ emission will be 400 mg/Nm³; during the production operation period, company will install the flue gas monitoring system to ensure that the flue gas emission up to standard.

5.6 Expected Outcomes of Environmental Protection

This project involves the main pollutants like kiln exhaust gas, dust, domestic sewage as well as motor and fan noises, and has no solid wastes released.

- In the project, the externally discharged dust-laden gas and dust after being purified by a dust precipitator in the production process are effectively disposed, and the dust control measures taken in this project are reasonable and feasible.
- The main production water in the project is recycled, only wastewater after flushing the ground of a part of workshops and domestic sewage are discharged into the drainage pipe network of the factory after being effectively treated, thus the measures for preventing and controlling water pollution in the project are reasonable and feasible.
- By adopting the noise abatement measures, the noise of equipment is greatly reduced after it is transmitted through the factory boundary, and the noise control measures adopted in the project are feasible.
- A variety of measures for energy conservation and consumption reduction have been adopted in the design, thus improving the energy utilization efficiency and recycling efficiency, reducing energy and resource consumption, and greatly reducing pollution.

6. Environmental Monitoring Plan

Monitoring is very important for the success of the mitigation measures developed for the identified significant impacts, and can identify unanticipated impacts, so as to provide sufficient time to analyze the situations and develop measures to minimize the impacts. The records and results of investigations should be retained for such monitoring and inspection, outstanding issues and measures used for addressing the

problems. The General Contractor should present an environmental management plan (at least including locations of the construction camp site, toilet facilities and material storage area, solid waste management plan, dust control measures, activity arrangements, etc.) to the environmental monitoring personnel and the project manager of the construction company for examination and approval prior to site preparation and construction activities. An organizational entity selected for implementing environmental monitoring for construction works should develop an environmental monitoring plan according to the above circumstances, requirements for environmental impact assessments and permissive conditions for development.

6.1 Construction and operational phase monitoring

The monitoring in the construction and operational phases should be carried out in accordance with the Environmental Management Plan, with an aim of ensuring that the recommended environmental control and mitigation measures are being implemented.

The main contents of an environmental impact monitoring plan required to be implemented in the project construction phase are as follows:

Site clean-up is carried out, to ensure that the biodiversity and vegetations in the site area are protected (this issue must be taken into account if biodiversity is required to be re-located) and there is no long-term exposure and denudation of large areas of soil.

Make sure that soil material is transported by vehicles under cover through the areas approved.

Make sure the noises, dust and emissions in the operational and construction phases are within acceptable limits.

In order to identify the nature and magnitude of long-term impacts of the project, the selected variables should be systematically observed and measured. The program includes:

Identify the sources and characteristics of all environmental impacts observed;

Quantify the resources and requirements for emission to the environment;

Quantify and limit the indirect impact on the environment.

The detailed monitoring plan is as follows:

Construction and Operational Monitoring Plan for the Float Glass Factory

No.	Impact Parameters	Impact Indicators	Sampling Site	Sampling Method	Sampling Frequency	Monitoring Duration	End-use of Data
1	Air Quality	Ambient air quality	Factory area and surroundings	In-situ measurement	Monthly sampling during the excavation/con	Long-term	Compliance with the acceptable standards

					struction period, and sampling every three years thereafter		according to the 1976 Air Pollution Control Act
2	Noises	Environmental noise level Leq, L min and L max, db	Factory area (main construction site)	In-situ measurement	Quarterly sampling throughout the construction period	Medium-term	Compliant database
3	Industrial Wastewater	PH (alkalinity acidity) TDS (total dissolved concentration) TSS (Total suspended solids) BOD (biological oxygen demand), COD (chemical oxygen demand) Turbidity THC (total hydrocarbon compounds) Oil content	Wastewater discharge points	In-situ measurement Photoelectric spectroscopy Atomic absorption spectrophotometry Acidity meter	Monthly sampling during the construction period, and drinking water sampling at river intersections along the original river of inhabitants every six months	Construction period	Compliant database
4	Soil Quality	Alkalinity acidity Organic carbon Total hydrocarbon compounds Oil content	Factory area	Atomic absorption spectrophotometry	Quarterly sampling throughout the construction period	Short-term	Compliant database
5	Consultation		All stakeholders	Interviews and dialogues	Every year	Long-term	Open/ongoing discussions

7. Occupational health and safety system

7.1 company policy and guideline of Occupational Health and Safety System

The company will comply with Nigerian environmental and safety regulations, and committed to providing a healthy and safe work environment for employees, minimizing the production and operation of environmental impact.

To implement the policy and guideline, we promise we will:

- (1) To implement the relevant laws, regulations and other requirements of Nigeria, and fulfill its obligations;
- (2) To provide the necessary resources, the implementation of full training, the implementation of the company-wide implementation of effective environmental and occupational health and safety management system;
- (3) Assessing potential risks of occupational health and safety under existing environmental conditions;
- (4) Manufacturing products to minimize environmental impact, to ensure their safety in the course of use, and to enable its recycling or safe disposal;
- (5) To implement pollution prevention, reduce the generation and discharge of waste, to maintain effective control of air pollution and water pollution;
- (6) Minimize employee safety, health and environmental hazards through the use of safe technology, operational practices and prevention of emergencies;
- (7) In the production process, the effective and rational use of energy and various natural resources, to minimize the use of ozone depleting substances and hazardous chemicals;
- (8) Conduct periodic reviews of safety and environmental performance, develop and implement plans to address actual and potential nonconformities, and implement them;
- (9) Fire training for staff and the installation of fire extinguishers in the staff quarters to ensure staff fire safety;
- (10) Communicate to all persons working for or on behalf of the organization.

7.2 Main factors of occupational health and safety, and the adopt measures:

7.2.1 Thermal contact

Thermal contacts appear during operation and maintenance of the furnace, the prevention and control methods include:

- Reduced working hours in high-temperature environments with shorter shift intervals at these locations;
- In order to avoid overheating in the workplace, the operating space should provide adequate ventilation and cooling air, remove smoke and dust.
- Install heat shields on the surfaces of high-temperature equipment near or likely to come into contact with personnel, and use personal protection as required

- the worker in these area is required to wear personal protective equipment (PPE), including insulated clothing, insulated gloves and insulated shoes.

7.2.2 Noise

Some of the worker in particular position may be exposed in noisy environment and cause to a certain extent of hearing loss. Hearing protection devices is one of the PPE which is required the workers in certain position to wear.

7.2.3 Respiratory system Hazard Contact (dust, smoke and toxic compounds)

The workers work in raw material and packing workshop may suffer from dust, smoke and toxic compounds. The prevention and control measure include:

- Separate the raw material storage and batch preparation areas from other operating areas;
- Required to implement the correct loading and unloading specifications;
- Using a closed conveyor or pipeline transport the material to the furnace.
- Install ventilation and dust removal system.

7.2.4 Physical hazard

Damage to the eyes caused by broken glass and splashing glass chips is a common risk factor in the glass industry. Float glass in the treatment of broken, there may be serious cuts.

Broken glass may cause different degrees of cut, and the splashing glass chips may cause damage to the eyes.

Protective measures of physical hazard:

All staff and visitors should wear uniform safety glasses to prevent such hazards. The risk of personal injury can be minimized by the float glass automating cutting process and by providing cut-resistant gloves and aprons to the workers.

8. Human Resource policy, employee complaint mechanism and process

8.1 Human Resource policy

- The human resource policy relevant to employment, recruitment, dismissal, salary, welfare, labor insurance, labor protection and labor discipline of the employees of the Company shall be carried out in accordance with the relevant policies and practices of the Federal Republic of Nigeria and the Guangdong Free Trade Zone regulations;
- The company has the right to give a warning to workers who violate the rules and regulations of the company and disciplines of labor discipline, and pay a reduction of wages. If the circumstances are serious, they may be dismissed, and the dismissed workers shall be reported to the FZE Management Company for record.
- Wages and salaries of employees of the Company shall be in accordance with the relevant laws of the Federal Republic of Nigeria and the board of directors shall determine the standards in accordance with the operating conditions of the Company;
- Employee benefits, bonuses, labor insurance and other matters, the company will be provided in the system;
- The Company provides training to employees in terms of occupation, work skills and working knowledge, so as to promote positive progress and improve their abilities.

8.2 Employee Complaint Mechanism

There are several reasons to set up the Employee Complaint Mechanism:

- to safeguard the legitimate rights and interests of the company and employees,
- to detect and deal with hidden problems in time,
- to smooth the communication between employees and the management,
- to improve work motivation,
- to establish a harmonious labor relations, enhance enterprise cohesion,

to improve employee satisfaction

Principle: The claimant shall make a complaint according to the provisions of this system according to the facts. If the complainant proves that the applicant has deceived behavior, the company will punish according to the relevant provisions, and the appellant shall, under the principle of confidentiality, Take seriously and ensure that the legitimate interests of employees are not infringed.

The scope of the appeal shall be within the functions of the Human Resources

Department, including but not limited to the following:

1, if employees disagree with the performance appraisal, rewards & punishments they should follow the policy of "staff performance evaluation feedback and rewards and punishments management approach";

2, the objection about the position, grade rank adjustment;

3, the objection about recruitment, training;

4, the objections about salary, benefits, attendance;

5, the objection about signing labor contract, and renewal, change, release, termination and other aspects of employment contract;

6, the objection about meal, reasonable vehicle arrangement and other administrative stuffs.

7, the complaint about unfairly treatment by superior or colleagues

8, the other matters which complainants have evidences to prove that his/her rights have been violated.

Channels and methods of complaint:

1, the company set up a complaint handling committee, composed by department managers and the human resources department members (including staff relations assistant, staff relations and remuneration and benefits commissioner), the appeal receiver has right to answer the complaint within the admissibility scope, if the complainant accepts the reply and then ends the appeal. If the complainants do not accept the answer by the committee member, it may be dealt with in accordance with the complaint handling procedure of Article 8.3. If the complaint is submitted to the Human Resources Department, the Human Resources Department will be responsible for investigating, obtaining evidence, making preliminary comments, participating in research, provide feedback and so on.

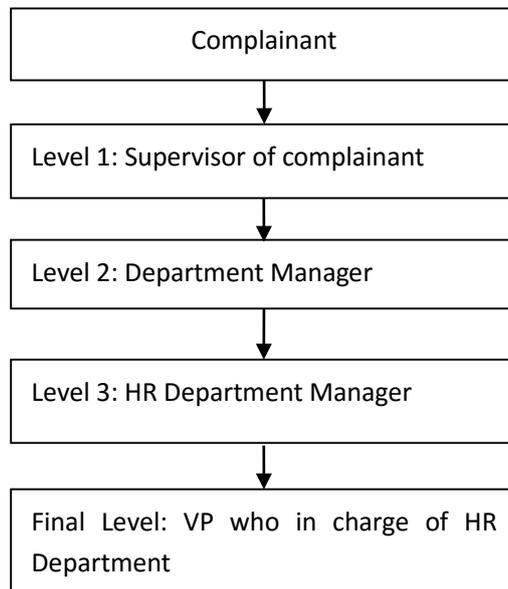
2, the validity of complaint is 10 days (postpone in case of statutory holidays). It means the complainant should be complaint incident within 10 days, due to force majeure caused by overdue, should apply to the appeal handling committee to apply for an extension of the appeal period, and the extension should not more than 10 days.

3, the complainant should be filled out by the Human Resources Department to provide the <employee complaint> to describe the relevant matters.

4, the <employee complaint> is required to be record by the appeal receiver, and signed by the complainant.

5, the complainant in the waiting for the handling of complaints should be strictly abides by the relevant rules and regulations, and ensure normal work.

8.3 Procedure for complaint processing:



1, there are four level of complain process, once the complaint event occurred, the complainant should fill out the <employee complaint> form and hand in to his/her supervisor within 10 days, the appeal process should only be apply by the complainant himself/herself.

2, the supervisor should check the <employee complaints> whether it is fit with the complaint policy of the Company, if the complaint is unaccepted, explain the reason of rejection to the complainant, and leave note on the <employee complaints>. If the complaint is accepted, the supervisor should then estimate whether he/she have the right and whether he/she is able to make a decision to this complaint, if the supervisor could, the supervisor should explain the decision to the complainant, and if the complainant accept the result, the process of complaint is completed, they should implemented the complaint according to the result, and do not need to apply to the next level; if the complainant do not accept the result provided by the supervisor or the supervisor estimate he /she do not have the right or unable to make a decision on the complaint, the supervisor should leave a note on the < employee complaint >, and pass it to the next level the department manager to handle.

3. The process of level 2 and level 3 is similar with level 1, in each level; the responsible person could investigate, take evidence, and dispose by themselves. if the complainant reject all the proposed solution made by the supervisor, department

manager and HR department manager or the supervisor, department manager and the HR department manager all estimate that they have no right or unable to provide a suitable proposed solution, the complaint should then be applied to the final level the vice president who is in charge of HR department, each level should process the case within 10 days after they receive it. The result provided by the vice president is the final conclusion, the complainant should be unconditional compliance, no more appeal.

4. If related to cross-sectoral complaints, the case should be discussed by all the relevant departments and reach a consensus solution.

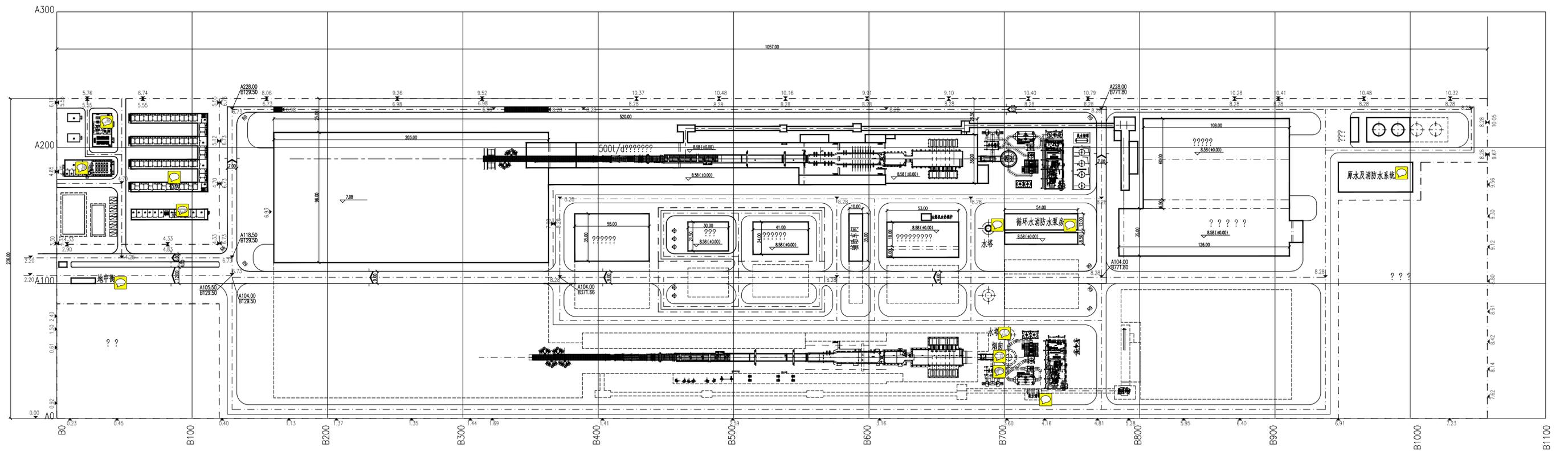
- The result of the complaint response should be recorded as a three-part Employee Complaint: one for the complainant, one for the complainant's personnel file, and one by the Personnel Administration Department.

- During the entire complaint process, the person concerned should be confidential, and if there is a compromise, it will be punished according to the relevant provisions. If the complainant is retaliated, the person concerned will be punished according to the relevant regulations.

- After the conclusion of the complaint is concluded, the staff member of the Human Resources Department is responsible for tracking and supervising the implementation of the conclusion.

There is an Attached a General Layout Plan of the project.

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