

Phase I Works of Dongfang Gancheng Wind Farm

Environmental Impact Report

(Annex: Special Landscape Impact Report)

Construction unit: Hainan Xinfengyuan Industrial Co., Ltd.

Evaluation unit: Hainan Environmental Technology Economy Development Co., Ltd.

September4, 2008 Haikou



Project name: Phase I Works of Dongfang Gancheng Wind Farm

Evaluation unit: Hainan Environment Technology & Economy Development Co., Ltd. (official seal)

Person in charge of the project: Zhao Xin

Information of Evaluators				
Name	Specialty	Professional title	No. of qualification certificate	Duty
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I. Basic situation of construction project

Project name	Phase I Works of Dongfang Gancheng Wind farm				
Construction unit	Hainan Xinfengyuan Industrial Co., Ltd.				
Legal representative		Contact	Lu Dongyan		
Mailing address	1201Room Fuxiang Garden, No. 59 Haidian East 2# Rd, Haikou City Hainan Province in China				
Telephone number	0898-66190269	Fax		Zip code	570208
Construction site	From the Gancheng Town to Banqiao Town in the Dongfang city,30km far away from Dongfang.city				
Construction property	Newly-constructed <input checked="" type="checkbox"/> Reconstructed and extended <input type="checkbox"/> For technological transformation <input type="checkbox"/>		Industry sector and code	4419 Other electric industry	
Permanent floor area (ha)	6.18		Green coverage (m ²)	3050	
Total investment of works (Million Yuan)	502.241	Including: Environmental protection investment (Million Yuan)	0.654	Percentage of environmental protection investment in total investment of works (%)	0.13
Construction scale (MW)	49.5	Expected date of operation	December 2008		
<p>Content and scale of works:</p> <p>1. Project overview</p> <p>(1) Project name: Phase I Works of Dongfang Gancheng Wind farm</p> <p>(2) Project property: Newly-constructed</p> <p>(3) Construction address: From the Gancheng Town to Banqiao Town in the Dongfang city,30km far away from Dongfang.</p> <p>See Fig. 1 for its geographical position.</p> <p>2. Content and scale of construction project</p> <p>Phase I Works of Dongfang Gancheng Wind farm in Hainan will be installed with 33 S70-1500KW wind power generating sets at the hight of 65 meters with total installed capacity of 49.5MW, annual electric quantity for incorporation into the power network of 103857MWh/a every year and annual equivalent hourage of 2098 hours. The works include a new 110kV step-up transformer substation (including an office building), an erected 10kV line about 19.52km long (this 10kV overhead line does not fall under this evaluation). For the project components, see Table 1.</p>					

Table 1 Project Composition Table						
Designation			Unit (Or model)	Quantity	Remarks	
Location of wind farm	Altitude above sea level		m	6m-9m		
	Longitude (East)			108°37'30"-108°41'40"		
	Latitude (North)			18°44'- 18°51'		
	Annual average wind speed (At wheel hub height)		m/s	6.74	65m	
	Wind power density (At wheel hub height)		W/m ²	366		
	Prevailing wind direction			S		
Major equipment	Major mechanical and electrical equipment at wind field	Wind generator set	Quantity	set	33	
			Rated power	kW	1500	
			Number of blades	piece	3.0	
			Diameter of wind wheel	m	70	
			Swept area of wind wheel	m ²	3850	
			Cut-in wind speed	m/s	3.0	
			Rated wind speed	m/s	12	
			Cut away wind speed	m/s	25	
			Extreme wind speed	m/s	59.5	
			Wheel hub height	m	65	
			Wind wheel speed	rpm	9-20	
			Rated power of generator	kW	1500	
			Generator power factor		≥0.98	
			Rated voltage	V	690	
			Rated current	A	660	
		Major mechanical and electrical equipment	10kV tank type transformer	YBF2-1600-0.69kV/10.5kV	33	
	Step-up substation	Main transformer	Type	SFZ10-50000/110, 121±8×1.25%/10.5kV Yn, dll		
			Quantity	Set	1	
			Capacity	MW	50	
			Rated voltage	kV	110/10	
Number of outgoing circuits and voltage class		Number of outgoing circuit	circuit	1		
		Voltage	kV	110		
Civil work	Wind generator set foundation	Quantity	set	33		
		Type	Reinforced concrete foundation			
		Foundation characteristics				
	Tank type transformer foundation	Quantity	set	33		
		Type	Reinforced concrete foundation			

Characteristics of Gancheng Wind Farm Project

Designation		Unit (or model)	Quantity	Remarks		
execution of works	Quantity	Earth rock excavation	m ³	24123		
		Earth rock backfill	m ³	14850		
		Wind generator foundation concrete	m ³	9900		
		Wind generator set foundation steel bar	t	907.5		
		Wind generator foundation corrosion protection	m ²	7260		
		Wind generator foundation pile foundation Φ1000	m ³	8290		
		New roads	km	15		
		Reconstructed roads	km			
		Construction period	Total project duration	Month	12	
		First batch of power generators	Day	270		
Budget indices	Static investment (Compiling year)		Million Yuan	485.6629		
	Total project investment		Million Yuan	502.241		
	Static investment per kilowatt		Yuan/kW	9811.37		
	Dynamic investment per kilowatt		Yuan/kW	10116.28		
	Mechanical and electrical equipment and installation work		Million Yuan	397.0545		
	Construction work		Million Yuan	38.2784		
	Other expenses		Million Yuan	40.8072		
	Basic contingency fund		Million Yuan	9.5228		
	Interest in construction period		Million Yuan	15.0928		
	Economic index	Installed capacity		MW	49.5	
In line electrical quantity per year		MW.h	103857			
Equivalent full load hours per year		h	2098			
Average on line power rate (Not including value added tax)		Yuan/kW.h	0.625	(Not including value added tax)		
Average on line power rate (Including value added tax)		Yuan/kW.h	0.679	(Including value added tax)		
Earning capacity indices		Profit ratio of investment		%	3.33	
		Profit and tax investment ratio		%	4.51	
		Capital profit rate		%	16.7	
		Financial internal return rate of project				
		Total investment (Before tax)		%	9.10	
		Financial present net value of total investment		Million Yuan	172.072	Before income tax. Ic=5%
		Financial internal return rate of capital		Year	8.0	
		Financial present net value of capital		%	0	After income tax. Ic=8%
Repayment ability	Loan repayment period		Year	14.4		
	Asset-liability ratio		%	80	Highest	

3. Layout of works and the primary buildings

(1) Wind generating set and roads inside the plant layout

The topographic relief of Dongfang Gancheng Wind Farm is relatively small. According to optimization layout and comparison analysis by means of Software Wasp and GHWindFarmer, the optimal fan arrangement scheme is as follows: The first line is arranged along the coastline, located in position 200m from the highest tide level and in the land use scope of coastal shelter forest. The second line is to be arranged parallel to the first line, about 560m to the first line. However, microscopically, the specific position shall avoid foresty, low-lying land and gully and choose position of high topography where the wake influence between fans is small as far as possible. Wind farm road is built along the fans, which is newly-built simple grit road of 4.5m width and 15km length.

2) Step-up transformer substation

The Step-up transformer substation occupies an area of 1.16 hectares and its construction includes construction of framework supports and foundation, comprehensive office building, 10kV distribution room and auxiliary structures.

Stressed reinforced concrete poles and triangular steel beams will be used for main transformer framework; the main transformer foundation will be reinforced concrete foundation; the cable line will be directly buried underground.

The comprehensive office building is made of 4 stories with offices, garage, oil depot, tool room, deep water pump house, archive room, meeting room, dormitory etc.

4. Electric system

The outlet voltage for wind turbine is 0.69kV. After step-up transformation, the power of wind generator set is transmitted with power collection line to the 110kV step-up transformer substation of the wind farm, and then through the secondary step-up transformation the electric power is transformed to 110kV by the main transformer and then transmitted to main grid of Hainan Power Grid.

The capacity of the main transformer of the booster station will be 50MVA and 15m gantry cement pole will be used for 10kV overhead line; resistance to typhoon is considered for 110kV line, so an iron tower will be used for erection (this 110kV line doesn't fall under this evaluation).

5. Communication

The communication means are mainly digital optic fibre and local call with optic fibre communication as the main communication mean and local call alternative communication mean. In the wind farm, the production scheduling communication and administrative management communication share the same set of exchange equipment. A set of 40-gate digital programme-controlled exchangers with dispatching function will be established and arranged in same communication room with the system dispatching communication equipment.

6. General construction arrangement

The permanent occupation area of the project is 6.18 hectares, including wind generator sets, box transformer foundation, 110kV booster transformation substation, centralized control center building, cable trenches and permanent roads in the wind field. The temporary land of this project is 12.72 hectare with the temporary project as mixing building, temporary living area for building workers, temporary storage area for equipment, temporary area for hoisting fan, excavation for cable trenches and other works required during construction.

The main construction materials are mainly cement, reinforcing bar, stones and timber to be purchased from Dongfang City. Wind generator sets will be purchased from abroad.

The total construction period is 12 months.

7. Water supply and drainage

Source of water: Dig a well in the booster station to take and filter groundwater as domestic water.

Drainage system: in the project, the drainage system adopts a system of separate flow of rain and sewage, namely the rainwater and sewage are discharged independently. The building roofing rainwater discharge adopts the exterior drainage. The rainwater outdoor flows outside the factory through rainwater pipe network; The indoor sewage discharge adopts a single riser drainage system and domestic sewage can be used to fertilizer farmland after treatment in three level septic tank.

8. Fire safety system

The net width of roads inside and outside the wind field is above 3.5m, which can be used as fire-fighting lanes simultaneously and all main buildings have exit passageway to exterior. In addition to fire hydrants, sand boxes and portable fire extinguishers equipped according to regulations, 10kV switch cabinet room, cable corridor are equipped also with fixed dry powder automatic fire distinguishers in important positions, and corresponding automatic fire alarm devices are also established. Main escape ways, staircases and extra exits inside the transformer substation are equipped with fire accident lights and escape direction indicating lamps.

9. Land for works

The occupation type of phase I project of wind farm is mainly seashore protection forest land, woodland, melon land, shrimping ponds. The total occupation area of the project is 18.90 hectares, among which permanent occupation area is 6.18 hectares and temporary occupation area is 12.72hectares.

see Table 2. Table3

Table 2 Land Occupation Table

Number	Item	Land Occupation (ha)	Remarks
1	Coastal defense forest	3.78	Permanent occupation 6.18 hectares ; Temporary occupation 12.72 hectares.
2	Foresty land	10.01	
3	Melon land	2.69	
4	Shrimping ponds	2.42	
Total		18.90	

Note: The above datas for planning estimates , the specific nature and the actual implementation of land area will be implemented after completion.

Table3 Land Occupation Table

Number	Item	Land Occupation	Unit
I	Permanent occupation of land for project	61740.6	m2
1	Wind turbine base	5828.6	m2
2	Box transformer base	132	m2
3	Tower base	1680	m2
4	voltage-raising transformer station and centralized control center	11600	m2
5	Reconstruction of access road	15000	m2
6	Maintaining roadway in the farm	27500	m2

II.	Total area of temporary occupation	127120	m2
1	Hoisting site	66000	m2
2	Temporary construction facilities	4800	m2
3	Temporary road within the farm	55000	m2
4	Cable trench	1320	m2

10. Investment in works

The total project investment is 502.241 million yuan.

II. General layout of the Wind farm

See Fig. 2 for the details of the general layout of the project works, see Fig. 3 for the main electric connection line of the booster station and see Fig. 4 for the layout of the booster station.

III. Environmental profile of the site of construction project

1 Natural environment profile

(1) Geographical position

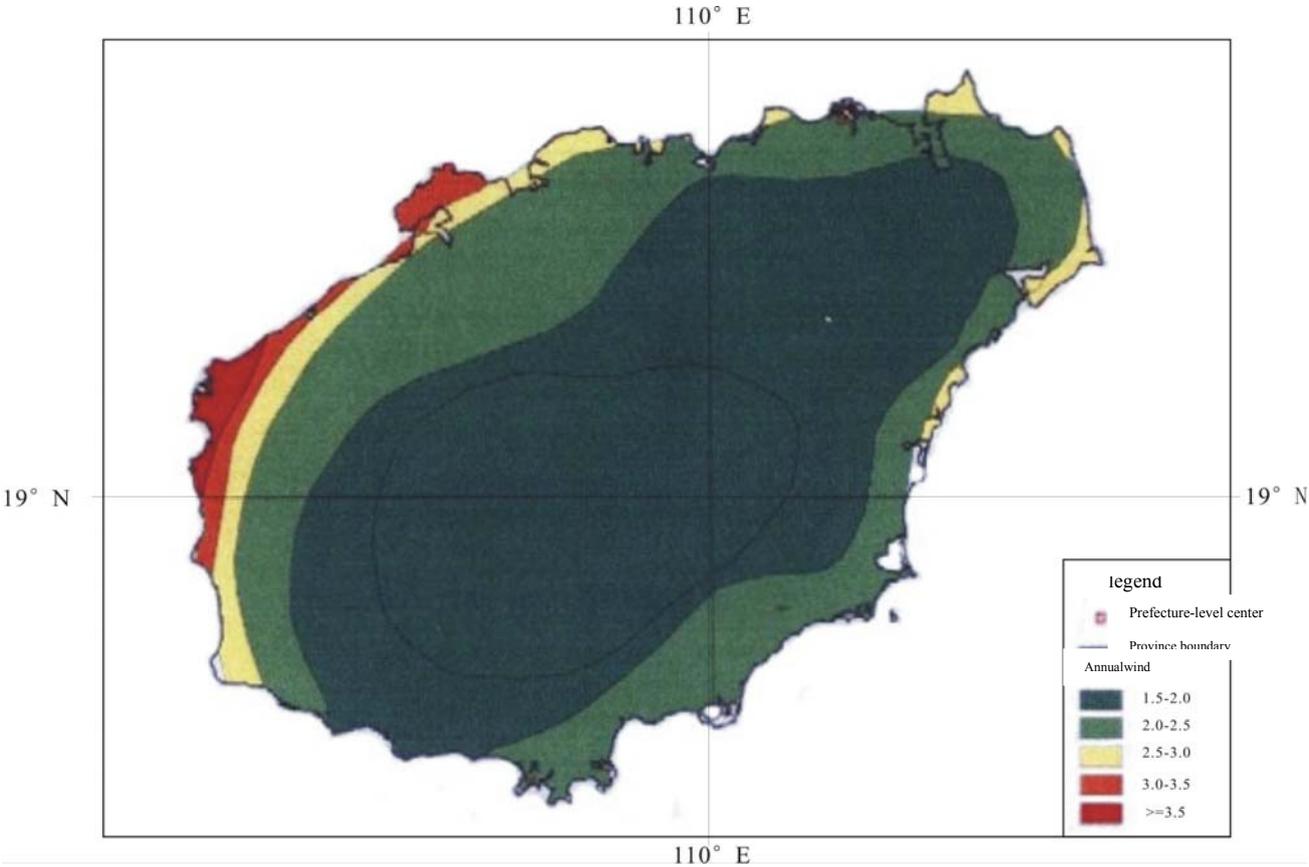
The plant is located in a coastal zone 6 km long south of the estuary of Gan'en River whose geographical coordinate is 108°37' ~ 108°41'E. longitude and 18°44' ~ 18°51'N. latitude and whose average height above sea level is 6- 19m with open terrain and abundant wind power resources.

(2) Characteristics of weather and wind

Dongfang lies in the tropical monsoon ocean climate area, so it's frostless and snowless through the year with an annual average temperature of 24℃-25℃, average annual sunshine hours of 2777.15 hours and average annual rainfall of 1639mm. The period from May to October is its main rainfall period when rainfall accounts for 70%-90% of total annual rainfall while the period from November to April of the next years is its drought season. South wind prevails in the wind farm around the year and the S-direction wind has the largest wind speed and the highest frequency with wind energy accounts for 47.62% of that of the whole year. The secondary is the NNE-direction wind whose wind energy accounts for 19.95%. SSE-direction wind has the smallest wind speed and lowest frequency. According to the surveyed data, average wind speed at height of 10m, 30m, 50m, and 70m is 5.04m/s, 6.04m/s, 6.53m/s and 6.70m/s respectively. With respect to the characteristics of wind speed, the wind speed is mainly 4.0m/s~8.0m/s, and then 9.0m/s~11.0m/s. With little wind speed change, generation can be conducted all the year round, with much wind in summer and winter and less wind in spring and autumn. The turbulence intensity value of the wind field is relatively small, so it causes little damage to the wind-driven generator; the height of wheel hub is 65m and the largest wind speed in 50 years is 59.0m/s. All of these indicate that the wind resources in this wind field are rather abundant.

According to the result of general investigation of wind energy resources all over the province in the *Preliminary Work Achievements of National Wind Power Construction* (Wind Energy Evaluation Part)

(Hainan Province), “the western coastal area is close to Beibu Bay and has even terrain and the south-north strike direction of Beibu Bay conduces to the formation of “venture effect”, obviously accelerating the predominant northerly in the winter half year and predominant southerly in the second half year. The representative point - Dongfang Wind Power Station has average annual wind speed of 6m/s and over 6000 hours of wind speed of more than 3m/s with wind of high stability and good continuity, little disastrous gale and extremely abundant wind power resources as a rich wind energy area in Hainan Island. We may know based on various data and materials that there is very good wind situation and abundant wind energy resources in the coastal zone of the areas from Gan’en Town, Dongfang City in the west coast to Maniao, Lin’gao County northwest along the coastline and the economically developable capacity of the wind energy resources in these areas is estimated to be 600-800MW. In addition, because of their geographical position, these areas suffer less disastrous weather such as typhoon, so these areas are the first selection for the setup of the wind farm. "Below is the Distribution Map of Average Annual Wind Speed in Hainan Island



(3) Geological conditions of works

The project area is located within the Baoban uplift area of Wuzhi Mountain fold belt, and its peak in south boundary – Diaoluo Big Rupture is the main rupture in the area. This rupture is rather far from the project area and has little influence over the project. Other ruptures do not develop. The terrain is high in east and low in west. The geomorphic type from east to west is Wuzhi Mountain middle-low mountain landform, hills landform, coast and plain landform, and I grade seashore terrace landform surrounded by sand embarkment successively. The topographic relief in the field is small without geographic disasters such as mud-rock flow, landslide, collapse and subside.

(4) Geological and hydrological conditions

The groundwater in the field is $\text{HCO}_3\text{-Ca.Mg}$ type with a pH value of about 7 and salinity of 1.0 York / liter. The field water is mainly pore water in the survey depth scope with nature of phreatic water and supplied by rainfall. The groundwater has no corrosivity to concrete while middle-high corrosivity to reinforcing bars in concrete structure, so the concrete structure shall be protected.

(5) Vegetation

Main vegetation type on the site includes beef wood, eucalyptus and some weeds, so the vegetation type is comparatively simple.

2 Social and environmental profile

(1) Administrative division

Dongfang City borders on Beibu Gulf in the west, abuts Changhua River in the north and northeast, and meets Ledong County in southeast with length from north to south of 65.4km and width from east to west of 53.6km. Dongfang City is where Han, Miao and Li people live together with a land area of 2256.21km² and population of 393,000, in which the Han people is 298,000, Li 79,000, Miao 886, Zhuang 289, Hui 23 and other nationalities 178.

The administrative division of Dongfang City includes four levels of zoning system: City - Township (Town) - Village Committee (Neighborhood Committee) - Villager Group. It has jurisdiction over 10 towns (Basuo, Gancheng, Sanjia, Banqiao, Sigeng, Xinlong, Datian, Donghe, Tian'an and Jiangbian) and 176 village committees (neighborhood committees) and there are three state-run farms called Guangba, Gong'ai and Hongquan, one overseas Chinese farm, provincial state-run Daoxi Forest Farm, national-level Datian Brow-antlered Deer Conservation Zone and state-run Caihouling Felling Space in it. In addition, part of forest of Jianfengling Forestry Bureau is also in it.

Dongfang has 57853.333 hectares of land suitable for agriculture, 47,040 hectares of land suitable for rubber, 9333.333 hectares of land suitable for hot work, 68626.667 hectares of land suitable for forestry; 19373.333 hectares of other land. It currently has 25,060 hectares of cultivated area, accounting for 11.1% of total land area, and including 11,580 hectares of paddy field and 13473.333 hectares of nonirrigated farmland (including sloping field and garden plot); Gan'en Plain with an area of 28,000 hectares is even as a grain-producing area of the city. There is more than 50,000 hectares of land suitable for plantation to be developed in the whole city.

(2) Economic situation

Dongfang City is an important part of the western industry corridor of Hainan Province with centralized industry and complete power supply system. According to the statistics data issued by Dongfang Statistics Bureau on June 11, 2008.

1) The industrial added value in Dongfang City increases quickly. According to preliminary statistics, from January to May in 2008, the added value of large scale industry in the whole city is RMB 1.43944 billion Yuan, 17.2% increase compared with the same period last year. The main factors that drive the growth in industrial added value are increase in output of urea, methyl alcohol, generated energy etc. In the

output of main products in the statistics: output of methyl alcohol is 0.264 million tons with an increase of 2.4%; output of nitrogen is 0.269 million tons with an increase of 10.7%; output of raw salt is 16638 tons with an increase of 22.7%; output of power is 120.13 million kilowatt hour, 10.3 times of that of the same period last year; electricity sales amount is 97.85 million kilowatt hour with an increase of 38.7%; running water production amount is 3.59 million tons with an increase of 13.2%; output of plastic products is 2025 tons with a decrease of 3.0%; sugar products and cement are new products with output of 20300 tons and 92465 tons respectively.

2) Key project construction develops smoothly and fixed assets increase quickly. This year is the “development environment construction year” of the city, so the whole city strengthen the tracking and service to key projects to promote the smooth progress of construction of key projects and quick increase of investment in fixed assets. From January to May, fixed assets that are put into production and finished are 1.36338 billion yuan with an increase of 97%. To be specific, construction and installation engineering is 1.35428 billion yuan with an increase of 102%; equipment purchased expense is RMB 5 million yuan with a decrease of 64%; other investment is 4.1 million yuan with a decrease of 43.8%.

3) Consumption increases, and wholesale and retail develop faster. With the spur of adjustment in festivals and holidays and advance in price in our country, consumption in our city accelerates growth. According to preliminary statistics, in May the total volume of retail sales of social consumption in the whole city is RMB 91.87 million Yuan with an increase of 24.1%. The increase degree is 9.8 percentage points higher than that of the same period last year. Seen based on selling area, the total volume of retail sales of consumer goods in cities and towns is RMB 66.45 million Yuan with an increase of 24.7%; total volume of retail sales of consumer goods in rural area is RMB 25.42 million Yuan with an increase of 22.6%. Seen based on selling industry, wholesale and retail trade is RMB 74.35 million Yuan with an increase of 24%; lodging and catering trade is RMB 13.04 million Yuan with an increase of 24.2%; sales amount of others is RMB 4.48 million Yuan with an increase of 25.8%. From January to May, total volume of retail sales of social consumption in the whole city is RMB 425.03 million yuan with an increase of 20.4%.

Financial income grows fast and finance functions well. According to statistics of financial department, from January to May, the local general financial budgetary income of the whole city is 113.35 million yuan, with an increase of 37.1% compared with the same period last year; the local general financial budget expenditure of the whole city is 250.83 million yuan with an increase of 35.4%. According to statistics of financial department, by the end of May, the balance of RMB deposits of financial organizations of the whole city is 3.70101 billion yuan with 6.4% decrease compared with the same period last year; resident savings account is 2.17543 billion yuan with a 16.4% increase. RMB Loan balance of financial organizations is 691.23 million yuan with an increase of 5.9%.

3 Current situation of environmental quality

- (1) Ambient air: The ambient air of the area where the project lies is of good quality in compliance with Grade One standard of the *Ambient Air Quality Standard* (Revised Edition).
- (2) Sea water quality: The sea water quality in this area meets Type Two standard of the *Sea Water Quality Standard* (GB3097-1997).
- (3) Acoustic environment: The environmental noise in this area meets Type Two standard of the

Standard of *Environmental Noise of Urban Area* (GB3096-93).

- (4) Groundwater: The underground quality in this area meets Type III standard of the *Groundwater Quality Standard* (GB/T14848-93).
- (5) Ecological environment: The vegetation type in the area where the project lies mainly includes beef wood, long-beak eucalyptus and some weeds. So the vegetation type is comparatively simple with low bio-diversity.

4 Main environmental protection objects (with the list and protection level indicated)

According to the characteristics of the evaluated construction project, the booster station is 2000m far from Fengting village and the wind generator foundation is 3000m far from the nearest distance of the residential quarters of Gan'en Town based on the following major environmental protection goals:

- (1) The life and health of the residents of Fengting village and Gancheng Town are not affected by the project construction;
- (2) Agricultural production around the project is not affected by project construction;
- (3) Project buildings have no influence on the view of whole design and surrounding construction and harmonize with the surrounding environment.
- (4) Strictly control the degree and range of ecological environmental disruption for project construction and reduce the negative impact of project construction on coastal defense forest to the minimum extent.

VI. Standards applicable to evaluation

1 Environmental quality standards (water, air and sound)

- (1) Grade One standard of the *Ambient Air Quality Standard* (GB3095-1996) (Revised Edition) applies to ambient air.
- (2) Type Two standard of the *Sea Water Quality Standard* (GB3097-1997) applies to sea water quality.
- (3) Type Two standard of the *Standard of Environmental Noise of Urban Area* (GB3096-93) applies to acoustic environment.
- (4) Type III standard of the *Groundwater Quality Standard* (GB/T14848-93) applies to groundwater.
- (5) The regional electromagnetic environment meets the limiting-value requirements in the *Technical Code on Environmental Impact Evaluation of Electromagnetic Radiation of 500kV Ultrahigh-voltage Power Transmission and Transformation* (HJ/T24-1998).

2 standards of pollutant emission

- (1) Grade One standard of GB8978-1996, the *Integrated Sewage Emission Standard* applies to sewage emission.
- (2) GB12523-90, the *Noise Limits for Construction Site*, applies to construction noise.

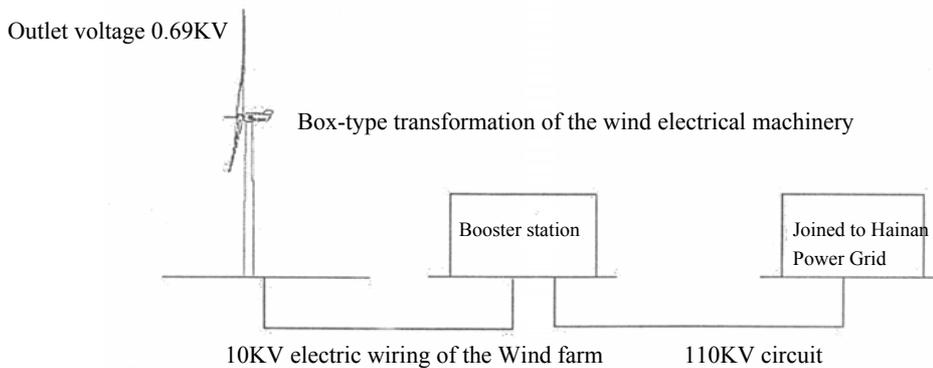
- (3) Type II standard of the Standard of Noise at Boundary of Industrial Enterprises (GB12348-90) applies to the noise within the boundary of an industrial enterprise.

V. Analysis of construction project works

1 Process flow profile (graphic presentation)

Driven by wind power, the blades of the wind generators turns wind energy into mechanical energy which is changed into electric energy under the function of the gearbox and the generator with the voltage at the outlet of the generator as 0.69kV. After boosted, electric quantity of wind generator sets are transmitted through line collection circuit to the 110kV booster station of the wind electricity field, and then connected to Hainan Power Grid through single 110kV circuit after boosted to 110kV by main transformer for the second time.

Below is the process flowchart:



2 Main pollution source strength

(1) Noise

Construction period: The noise during the construction period mainly includes mechanical noise and transport noise. Mechanical noise mainly comes from excavation and backfilling of foundation earthwork of the wind electric machinery, pile driving, cast-in-place of the foundation, concrete mixing, installation of the set equipment and building of the booster station. Transport noise is mainly the noise of transport trucks with an approach sound level of the truck up to 90dB (A).

Operation period: The noise during the operation period mainly includes the noise of the Wind farm and the noise of the booster station. The noise of the Wind farm is mainly the noise of the wheel hub when the blades of the wind turbine rotates with a noise level of about 105dB (A) at the wheel hub of the wind power of the wind power generating set. The noise of the booster station is mainly the noise of the main transformer, air cooler and high-voltage electrical reactor with a noise source strength of about 80dB (A) for the main transformer and a noise source strength of about 75dB (A) for the air cooler and high-voltage reactor.

(2) Dust and soil erosion

The excavation of the wind generator foundation, road and booster station foundation will cause slight soil erosion and dust pollution will appear during the construction. In addition, a little dust will appear during the vehicle transport.

(3) Waste slag

See table 3 for statistics for earth and stone excavation and backfill amount of project earth and stone.

Table 4 Statistics table for amount of earth and stone excavation and backfill in project

Item	Earth and stone excavation (m ³)	Earth and stone backfill (m ³)
Wind turbine foundation	24123	14850
Box transformer base	330	231
Cable trench	924	924
Main transformer equipment foundation	340	124
Distribution equipment foundation	1840	1290
Total	27557	17419

The total amount of earth and stone excavation in this project is 27557m³ and total backfill amount is 17419m³. The earth and stone backfill is about 10138m³. A waste slag field is needed to be built for stacking.

(4) Waste water

Construction period: The waste water during the construction period mainly includes productive waste water and domestic sewage. Productive waste water is mainly waste water coming from concrete mixing. The construction period is relatively short, so there's only a small amount of productive waste water with SS as major pollutant which can be emitted directly after natural precipitating. Major pollutants of domestic sewage are COD and ammonia nitrogen. The number of workers averages about 100 people during the construction period, so supposing a worker consumes 250L of water a day and sewage emission accounts for 80% of water consumption, then the sewage emission during the construction period will be 20m³/d. Domestic sewage can be used to fertilize the soil after treated through Grade III septic tank.

Operation period: The waste water during the operation period is mainly domestic sewage resulting from administrative staff with COD and ammonia nitrogen as major pollutants. There are 15 fixed workers during the operation period, so supposing a worker consumes 150L of water a day and sewage emission accounts for 80% of water consumption, then the sewage emission is 1.8m³/d. The concentration of COD in domestic sewage is about 400mg/L and the concentration of ammonia nitrogen is about 35mg/L, so the discharge of COD is 0.72kg/d and the discharge of ammonia nitrogen is 0.063kg/d. Domestic sewage can be used to fertilize the soil after treated through Grade III septic tank.

No waste oil will appear when the booster station operates normally, and when main transformer is examined and repaired or suffers an accident, the oil in the main transformer should be emptied to the accident oil sump near main transformer, when a small amount of

waste oil will appear.

(5) Solid waste

Construction period: The solid waste during the construction period mainly includes domestic rubbish of construction personnel and building rubbish. The discharge of domestic rubbish is about 1kg/d per person and there are 100 workers on average during the construction period, so the discharge of domestic rubbish is about 100kg/d. Building rubbish mainly includes some dregs resulting from equipment packing and site clearance.

Operation period: The solid waste during the operation period mainly includes domestic rubbish of administrative staff and discarded lubricating oil resulting from the wind generator. The discharge of domestic rubbish is about 1kg/d per person and there are 15 fixed administrative staff members, so the discharge of domestic rubbish is about 15kg/d, 5.5t/a.

The lubricating oil of the wind generator should be replaced regularly and a certain amount of discarded lubricating oil will appear at the replacement. Supposing annual lubricating oil consumption is 10kg for an wind generator and the volume of discarded lubricating oil accounts for 80% of the consumption, annual volume of discarded lubricating oil resulting from 33 wind generators will be about 264kg/a.

(6) Electromagnetic radiation

Power-frequency , electric field, power-frequency magnetic field and radio interference mainly come from such electrified electric equipment as bus bar, electric transformer, high-voltage reactor, circuit breaker, current transformer, voltage transformer and lightning arrester. A relatively complicated high field is formed around various electrified electric equipment to incur a certain electromagnetic field which has certain electromagnetic impact on the surrounding environment; electrical gradient can also be formed around it to cause a corona discharge and radio interference.

(7) Landscape

For details, see special landscape evaluation.

3 Feasibility analysis of project site selection

(1) Analysis of compliance with industrial policy

This project is a wind power generation project. According to the Guiding Catalogue of Industrial Structure 2005, this project falls under the project of the type of "development and use of renewable energy such as wind power generation and solar energy, geothermal energy, ocean energy and biomass energy" in the electric industry in the first encouragement type, so the construction of this project accords with relevant national industrial policies.

(2) Feasibility analysis of wind power resources

Dongfang Gancheng has obvious advantage in wind resources in Hainan Province. The open and smooth I grade seashore terrace is an ideal place to build wind farm. At height of 65m of the wind farm, the annual average wind speed is 6.74m/s and wind power density is 366W/m², so the wind energy index is rather good. In addition, the wind farm is near to the provincial highway of west line, and the traffic is rather convenient. With the development of wind farms in succession, wind

power will become another important industry of Dongfang City and will play an important role in providing new point of economic increase, promoting the development of local economy and accelerating to realize a well-to-do society.

(3) Analysis of the compliance of the plan

According to the Eleventh Five-year Plan on wind farm of Hainan Province in the Construction Plan:

" 1. Planning situation on wind farm in our province

According to the wind resources condition of our province, the Wind Farm Planning determines preliminarily that the land of our province is divided into 12 wind farms which are Duihuiwen, Yueliangwan, Baohujiao, Chaotanbi, Yubao, Maxiao, Lingaojiao, Eman, Haiwei, Qiziwan, Sigeng, Gancheng and Yinggehai wind farm in the order from east seashore to west seashore of Hainan Province. The concrete positions and installed capacities are as follows:

.....

The total installed capacity of Dongfang Gancheng Wind Farm phase I project is 49.5MW and there are 33 wind generator sets with unit capacity of 1500 kilowatt are installed. Therefore, the construction and site selection of Dongfang Gancheng Wind Farm phase I project meet the requirements of overall planning of wind farm in Hainan Province.

According to the industrial layout in the development layout of the *Outline of the 11th Five-year Plan of Dongfang City for National Economy and Social Development*: "Rely on the advantages of port resources to set up an industrial park bordering on the port. Step up efforts to develop oil and gas chemical industry in the industrial park bordering on the port with consideration given to the development of related local industry. Form a pattern of "one town and two industries" on the principle that natural gas and chemical industry are highly gathered and agricultural products and resource processing industry are relatively concentrated.

(I) One town, refers to Dongfang Chemical Town. Its planned site is the belt area west of Basan Railway Line south of Yulinzhou and the area south of Luodai River, west of Haiyu West Line and east of Basan Railway Line. The area of the planned land is 13.5 sq. km. and the infrastructure of the chemical town will be arranged wholly, implemented by stages and appropriately leading. The chemical town is divided into heavy chemical industry zone, fine chemical industry zone, energy industry zone and related local industry zone. Below is their location:

- Heavy chemical industry zone. Coastal area south of Luodai River and west of the railway line.
- Fine chemical industry zone. East of the railway line and west of the Third Ring Road.
- Energy industry zone. Coastal area from Gaopai Village to Tongtian River.
- Related local industry zone. North of Luodai River and west of the railway line. This area serves as non-public economic park with emphasis on development of related

local industry.

(II) Two industries refer to resource processing industry and energy industry.

1. Resource processing industry. Rely on the advantages of agricultural products and mineral resources with multipoint layout along the road:
 - Fresh-keeping processing of agricultural products. It's laid out west of urban area, north of the Beili River, east of Duntou and in GanCheng Town and Datian Town.
 - Fine and deep processing of quartz sand deposits. It's laid out in the related local industry zone north of Luodai River and west of the railway line.
 - Building material industry. It's laid out in the area from Haiyu West Line to the intersection of the expressway and Basuo Exit.
2. Energy industry. Rely on the resource advantage with scattered layout:
 - Fire power generation. It's laid out in the coastal area from Gaopai Village to Tongtian River, i.e. the energy industry area in Dongfang Chemical Town, with emphasis on development of gas and clean fire coal generating plant.
 - Wind power generation. It's laid out in the coastal area from Gaopai to Banqiao and the area in front of Sigeng with planned development of wind energy generation.
 - Hydroelectric generation. Develop a step hydroelectric generation in the suitable area of the Changhua River Basin. "Wind power generation is laid out in the coastal area from Gaopai to Banqiao. This project lies in the coastal area south of the estuary of Gan'en River and the layout area for wind power generation and the project site selection complies with the industrial development plan of Dongfang City.

(4) Environmental feasibility analysis

At present, the engineering site is mainly coastal defense forestland, melon land and forest land, and the land is open and smooth in the scope of engineering sites. The construction of wind electricity field needs to occupy coastal defense forestry, melon land and shrimping ponds and the project construction will take up coastal defense forest land, which will cause certain losses to coast defense forestry and is unfavorable to the protection of coastal protection forest land and wind prevention and sand fixation, thus causes losses to coastal defense forest land.

According to the Management Regulations for Coastal Forest Zone Given Special National Protection, the forest land inside coast forest zone given special national protection shall not be occupied or expropriated. If it needs to be occupied or expropriated owing to such special situations as the construction of national key works, reporting for approval must be made in accordance with relevant regulations and the following expenses must be paid in accordance with the regulations: compensation for woods, compensation for forest land, allowance for arrangement and recovery expense for forest vegetation. Recovery expense for forest vegetation shall be dedicated to special use and competent forestry department

shall uniformly arrange tree planting and forestation pursuant to relevant regulations to recover forest vegetation on the condition that the area of afforestation is no less than the area of forest vegetation reduced for occupation and expropriation thereof. According to the *Management Methods of Hainan Province for Protection of Coastal Defense Forest*, if the coastal forest zone given special national protection is in the sand bank area, it shall be extended 200 meters inland from maximum tidal level when the tide rises; no individual or unit may occupy or expropriate coastal defense forest land without authorization, or change coastal defense forest land into commercial forest land or other land; if the coastal defense forest land need be expropriated or occupied for national or provincial key construction project, the examination and approval formalities for construction land shall be gone through in accordance with relevant regulations of Chapter Four of the *Management Rule of Hainan Province for Forest Land*.

After measures to recover forest vegetation are taken in accordance with the regulations, the land occupation of the Wind farm will have a little impact on the coastal defense forest only, so from the angle of environmental protection, under the prerequisite of strict implementation of above regulations, the site selection of the Wind farm is basically feasible. Or the wind generator foundation must be built outside of coastal defense forest land, that is, an onshore extension of 200 meters from the area suitable for tree planting.

VI. Analysis of environmental impact, prevention measures intended to be taken and expected management result

1 Noise

Noise during the construction period: It mainly includes mechanical noise and transport noise. See Table 4 for the source strength of the noise of each construction machine and pad value of different distance.

Table 5 Source Strength of the Noise of Construction Machinery and Predicted Result of Its Impact on Acoustic Environment at Difference Distance

Name of machinery	Noise source strength. dB(A)	Predicted noise level at different source distance (m) dB (A)			
		15	30	60	120
Excavator	89	79	71	63	56
Earth scraper	110	92	84	72	65
Loader	103	84	77	69	62
Impact pile driver	95	82	74	67	60

Mixer	105	95	78	70	65
Vibrator	100	83	75	69	61
Truck	95	82	74	67	59

We can see from Table 4 that when the noise coming from other mechanical equipment but the earth scraper spreads for 60 meters, its equivalent noise level has met GB12523-90, the *Noise Limits for Construction Site* (70dB(A)), and the construction site is 2000m far from the nearest residential quarters, so the noise of the construction site has no impact on the residential quarters.

As wild animals are rather sensitive to noise, and the construction noise will destroy the peaceful environment nearby for wild animals to live and make them move to other places, however, there have no wild animals within the construction area yet been seen, so the influence is limited.

Noise during the operation period: The noise during the operation period includes the noise of the wind generator and the noise of the booster station which are mainly low frequency noises. The noise of the wind power generating set includes the noise coming from the wind blowing of the blades and the noise coming from the operation of built-in machinery of the set. The noise level at the wheel hub of the wind generator of the wind power generating set is about 100dB(A) and the wheel hub is 65m far from the ground, so the noise level at the foundation of the tower of the set is about 49.6dB(A). Prediction is made based on the noise level of noise source strength of the wheel hub of the wind generator at a different distance. See Table 5 for the prediction result.

Table 6 Noise Source Strength of the Wheel Hub of the Wind Generator and Prediction Result of Its Impact on Acoustic Environment at a Different Distance

	Noise source strength dB(A)	Predicted noise level at a distance from the wind generator being foundation (m) dB(A)							
		15	30	60	100	150	200	250	300
Wheel hub of the wind generator	105	49.4	48.8	47	44.5	41.7	39.5	37.7	36.2

We can see from Table 5 that the noise level can meet Type II standard of the *Standard of Noise at Boundary of Industrial Enterprises* (GB12348-90) (60dB in the daytime and 50dB at night) at a distance of 15m from the wind generator foundation, so the noise of the Wind farm has a little impact on the surrounding environment only.

The noise of the booster station is mainly the noise of the main transformer, air cooler and high-voltage reactor with a noise source strength of about 80dB(A) for the main transformer and a noise source strength of about 75dB(A) for the air cooler and high-voltage reactor. Prediction is made of the noise at the boundary of industrial enterprises according to above source strength.

See Table 6 for the prediction result.

Table 7 Prediction Result of Noise Impact Unit: dB(A)

No.	Position	Main transformer	Air cooler	High-voltage reactor	Superposing value
1	1m outside the enclosure at the east boundary,	37	32	32	39
2	1m outside the enclosure at the north boundary,	42	37	37	44
3	1m outside the enclosure at the west boundary,	47	42	42	49
4	1m outside the enclosure at the south boundary	44	39	39	46

We can see from the prediction result in Table 6 that the noise at the boundary of the booster station meets Type II standard of the *Standard of Noise at Boundary of Industrial Enterprises* (GB12348-90) (60dB in the daytime and 50dB at night). The noise coming from the booster station during the operation period has a little impact on the surrounding environment only.

The noise of the wind generator and the booster station is low frequency noise which imposes a sense of oppression on the human body and has major impact on sleep, physiology and psychology to the extent of possible neurasthenia and melancholia, especially for the old. In view of the harm of low frequency noise to the human body, It's proposed 50m health protection distance should be guaranteed.

2 Waste slag

As the excavation and backfill of earth and stone can not be conducted at the same time, there exists the issue of temporary stacking of excavated earth and stone. For the convenience of backfill, the excavated earth and stone are to be stacked around the fan foundation, and at the same time, it is suggested to establish a temporary slag stacking field in the middle part of construction field of wind electricity field. As the field is located in seashore where wind is strong and the excavated sands are easy to fly with the wind due to their small diameter, therefore, there is need of covering the excavated waste slag to prevent fine sands from flying in the air. Conduct timely backfill to temporary waste slag to reduce the impact of waste slag upon the environment. In addition, according to balance of earth and stone, the total amount of wate slag of the project is 10138m³, consequently, it is advised to establish waste slag field to stack the waste slag.

As the report does not propose reasonable plan to the stacking of waste slag, this evaluation advises the waste slag field adopts the following principles:

- (1) "Occupy little arable land and no fertile farmland", and do not move villages.

- (2) Locate the dumping site near to the slope as far as possible to reduce transport distance on the condition that the engineering progress and production safety are not influenced.
- (3) Take priority to utilize open-air excavation area as waste slag field.
- (4) Choose several waste slag fields of different horizons to shorten transportation distance.
- (5) It is advisable to choose the leeward side of cardinal wind of residential block

3 Waste water

Construction period: The waste water during the construction period is mainly productive waste water and domestic sewage. Productive waste water is mainly waste water coming from concrete mixing with SS as main pollutant which has a relatively small impact on the surrounding environment after natural precipitating for retrieval and utilization. The discharge of domestic sewage is 20m³/d. Grade III septic tank will be constructed during the construction period and domestic sewage can be used to fertilize the soil after treated through Grade III septic tank, so it has a little effect on the surrounding environment only.

Operation period: The domestic sewage during the operation period is mainly the domestic sewage of administrative staff with COD and ammonia nitrogen as major pollutants, so the sewage discharge is 660.6m³/a, the COD discharge 264.64kg/a and the ammonia nitrogen discharge 23.12kg/a. Domestic sewage can be used to fertilize the soil after treated through Grade III septic tank, so domestic sewage has a little effect on surrounding environment only.

When the main transformer of the booster station is examined and repaired or suffers an accident, a little waste oil will appear. Because there is an accident oil sump near the main transformer, the waste oil will be discharged to the accident oil sump without directly entering the surrounding environment at the examination and repair or the occurrence of the accident. As hazardous waste, the waste oil in the accident oil sump will be treated by a qualified unit after gathered, so the waste oil has a little effect on the surrounding environment only.

4 Dust during the construction period

Dust during the construction period mainly comes from earth and stone excavation and vehicle transport within the site. This project lies in the seashore and the site is seabeach land with a lot of fine sand and heavy sea wind, so in case of any neglect at the earth and stone excavation, dust and sand are apt to wave with the wind to have a certain impact on the ambient air environment; in addition, some dust results from the transport vehicles. In the light of earth and stone excavation, excavated earth and stone should be concentrated and stacked as far as possible and covered and used for backfilling in time to reduce dust. The construction site should be watered regularly to reduce dust.

5 Solid waste

Construction period: The solid waste during the construction period mainly includes domestic rubbish of construction personnel and building rubbish. The discharge of domestic rubbish is about 100kg/d. Domestic rubbish will be totally treated by the local sanitation department after

gathered. Building rubbish mainly includes some dregs coming from equipment packing and site clearance. If the rubbish of equipment packing can be recycled, it should be recycled as far as possible, and if it cannot, it should be transported to the appointed place together with building rubbish to have a little effect on the surrounding environment only.

Operation period: The solid waste during the operation period mainly includes domestic rubbish of administrative staff and discarded lubricating oil resulting from the wind generator. The discharge of domestic rubbish is about 5.5t/a. After totally gathered inside the site, domestic rubbish will be completely treated by local sanitation department to have a little effect on the environment only.

A certain amount of discarded lubricating oil will appear when the lubricating oil of the wind generator is replaced and the volume of resulting discarded lubricating oil is about 264kg/a. Discarded lubricating oil is hazardous waste, so it will be treated by a qualified unit after gathered. So the discarded lubricating oil coming from the wind generator has a little effect on the surrounding environment only.

6 Main ecological impact

33 Wind turbines will be installed for the project. According to the *Management Regulations for Coastal Forest Zone Given Special National Protection* and the *Management Methods of Hainan Province for Protection of Coastal Defense Forest*, an inland extension of 200m from the maximum tidal level when the tide rises in the sand bank area is a forest zone given special national protection. So the first row of wind generators for project construction lies in the specially protected forest zone (refers to seashore forest shelter), especially protected forest zone is used for project construction, which is unfavorable to windbreak and sand fixation, which has a certain impact on the construction and protection of coastal defense forest. According to relevant provisions of Articles 11, 12 and 13 of the *Management Regulations for Coastal Forest Zone Given Special National Protection*: "

Article 11: The forest land within the coastal forest land given special national protection should not be occupied or expropriated. If it needs be occupied or expropriated for such special situations as construction of national key works, the verification opinion of competent administrative forestry department under the people's government at provincial level and above must be attached when the reporting is made to the people's government for approval pursuant to legal authority and formalities.

Article 12: Where it's approved to occupy or expropriate forest land within coastal forest zone given special national protection, the forest land shall be used based on approved quantity and scope. Where it's necessary to fell forest trees in the occupied or expropriated forest land, a tree felling license must be gone through in accordance with the provisions of relevant laws and regulations.

Article 13: Where it's approved to occupy or expropriate forest land within coastal zone given special national protection, the land user shall pay the compensation for forest trees, compensation for forest land, allowance for arrangement and recovery expense for forest vegetation in accordance with relevant national regulations.

According to relevant provisions of Articles 17 and 18 of the *Management Methods of Hainan*

Province for Protection of Coastal Defense Forest: "

Article 17: No individual or unit may occupy or expropriate coastal defense forest land without authorization.No coastal defense forest land may be changed into commercial forest land or other land.If it's necessary to expropriate or occupy coastal defense forest land for national or provincial key construction project, the examination and approval formalities for construction land shall be gone through in accordance with relevant provisions of Chapter Four of the *Management Rules of Hainan Province for Forest Land*.

Article 18: No coastal defense forest tree may be felled.If it's actually necessary to fell forest trees for the sake of national or provincial key construction project or fostering or replacement of forest trees, it shall be subject to the verification of competent forestry department under the people's government at county level and reported to competent forestry department under provincial people's government for approval. Relevant competent forestry department shall check and issue the license for forest tree felling in accordance with stipulated annual felling limit. If any unit or individual is approved of the felling of coastal defense forest trees, he/it shall complete the task of renewal afforestation in that year or the next year in accordance with stipulated area, number of trees, seeds and quality, provided that the area and the number of trees of renewal afforestation are no less than the felled area and number of trees."

The owner shall, pursuant to relevant provisions of the *Management Regulations for Coastal Forest Zone Given Special National Protection* and the *Management Method of Hainan Province for Protection of Coastal Defense Forest* as well as legal authority and procedures, go through the formalities for occupation or expropriation of forest land within the forest zone given special national protection and pay the compensation for forest land, compensation for forest trees, allowance for arrangement and recovery expense for forest vegetation. The recovery expense for forest vegetation shall be dedicated to special use and competent forestry department shall uniformly arrange tree planting and afforestation in accordance with relevant regulations on the condition that the area of recovered forest vegetation and tree planting and afforestation may not be less than the area of forest vegetation reduced for expropriation or occupation of forest land. These measures are taken to reduce the negative impact of project construction on coastal defense forest and protect the ecological environment.

The project will occupy melon land, shrimping ponds and forestry land.The melon land is not basic farmland , so it only will cause small influence over agricultural production; the project's occupying shrimping ponds will cause certain influence over the local aquaculture, it is advisable to make compensation or try to avoid the shrimping ponds to decrease the losses; while the engineering's occupying forest land will cause permanent losses. Therefore, after completion, afforestation will be made in the booster station and the two sides of the road to reduce the impact of the project upon ecological environment.

A certain area of coastal defense forest will be felled in the project construction area.So the ecological function of the coastal defense forest will be affected to some extent and remedial measures had better be taken. Whereas the east of the project land includes forest land, young forest land, graveyard and melon land, it's proposed to strengthen the management and protection of existing forest land, timely recover forest vegetation and enhance fostering of trees in the graveyard so as to remedy the weakening of the function of coast defense forest caused by project

construction. Meanwhile, it's proposed forest culture, management and protection expenses should be disbursed from the "recovery expense for forest vegetation" paid by the construction unit.

7 Soil erosion

The project area is mainly seabeach. For the project construction, 27557m³ of earth and stone will be excavated and 17419m³ will be backfilled. Due to unbalance between excavation and backfill of earth and stone, a waste slag field needs to be built. In addition, the excavation and backfill of earth and stone can not be conducted concurrently, so a temporary stacking place should be provided. It is suggested to establish a temporary waste slag field in the middle part of the construction area of the wind electricity field, and built breast wall and escape canal around the temporary stacking field. In addition, escape canal should be built on both sides of road and around the fan foundation to discharge extra water in time and reduce soil erosion. Measures for water and soil conservation shall attach much importance to engineering measures to give full play to their rapidity and controlling ability, lay stress on follow-up and ecological effect of plant measures while take temporary protection measures during construction period. After completion, the disturbed surface area of the project is 187330.6m² and the background value of soil erosion modulus is 480t/km².a. During construction period, the disturbed surface erosion modulus is 9890t/km².a and the new added soil erosion amount after completion of the project through calculation is 1762.78t.

8 Impact of electromagnetic radiation

Analogous to the monitoring materials of 110kV transformer substation, after 110kV transformer substation is completed and put into operation, the fluctuating range of the intensity of its power frequency electric field will be 1.22-1.25V/m and the fluctuating range of the magnetic induction intensity of its power frequency will be 0.0150-0.985μ T, far lower than the evaluation standard of 4kV/m for electric field and 0.1mT for magnetic induction intensity recommended in the *Technical Code on Environmental Impact Evaluation of Electromagnetic Radiation of 500kV Ultrahigh-voltage Power Transmission and Transformation* (HJ/T24-1998). So after 110kV transformer substation of this works is completed and put into operation, the intensity of the power frequency electric field and the intensity of power frequency magnetic induction meet relevant national standards and regulations and have no major impact on the environmental.

9 Landscape impact

For details, see special analysis of landscape impact

10 Environmental protection investment

The gross environmental protection investment of the project is about 0.654 million yuan, accounting for 0.13% of static gross investment of the project. For environmental protection investment of the project, see Table 7.

Table 8 Table of Environmental Protection Investment of the Project

Number	Item	Amount (ten thousand Yuan)	Remarks
1	III Sewage treatment facilities	1.8	Including sewage treatment facilities during the construction period and sewage treatment facilities during the operation period

2	Dust prevention and control	0.6	
3	Solid waste treatment	3.0	
4	Green venues	5.0	
5	Recovery expense for forest vegetation	15.0	According to the <i>Written Reply to Collection of Recovery Expense for Forest Vegetation</i> of No.12 Qiong Jia She Zi (1993) of Price Bureau and Department of Finance of Hainan Province, the recovery expense for forest vegetation is 30000-37500 Yuan/ha for forest land; for commercial forest, it's 9000-10500Yuan / ha; for economic forest land, it's 12000-15000Yuan / ha; for fuel forest land, it's 4500Yuan/ha; for special forest land, it's 45000-60000 Yuan / ha.
6	Soil erosion prevention and control	40.0	Mainly build an escape canal around the temporary yard, the road and the wind generator foundation
	Total	65.4	

VII. Environmental benefit

1 Energy-conserving benefit

Wind-powered electricity is a kind of clean and pollution-free renewable energy, so developing and utilizing wind energy resources is an effective means to adjust the energy structure and achieve sustainable energy development.

The installed capacity of the work is 49.5MW and its annual power generation is 103857MWH, so when compared with the same volume of thermal power generation which is supposed to consume 379g of standard coal per kwh, 39361.803t of standard coal may be saved every year. In the face of increasingly severe energy crisis at present, wind energy is a kind of renewable energy and the wind farm project is a project falling under national encouraged development type in compliance with national industrial policy.

2 Emission reduction benefit

Besides the function of energy conservation for wind-powered electricity as a kind of clean energy, the following emission reduction can be achieved every year during the emission reduction of this works in comparison with the fire coal power generation of the same volume based on 0.7% of sulphur content for regular fire coal not desulphurized: about 441.87t/a of SO₂, 456.1t/a of NO₂, 118000t/a of CO₂ and 10.4t/a of CO. In addition, 370,000m³/a of fresh water can be saved. So the construction of the Wind farm is of significant environmental benefit.

VIII. Public Participation

Conduct public participation is an effective way of scientific decision. The purpose of public participation is to learn about the requirement and opinions of the public on the project so as to report information reflected by the republic to relevant responsible institution. In this way, important issues relevant to the public that may occur in the project will be studied and solved, and satisfying and reasonable decisions will be made with the unanimous opinions of the public, which is favorable to specify the evaluation of impact upon the environment. This project will solicit opinions of the public

in form of questionnaire investigation and distribute the Public Participation Investigation Form to the public.

The specific investigation forms are as follows:

- After determining the environmental evaluation unit that bears the work of environment influence evaluation, the owner of the project --- Hainan Xinfengyuan Industry Co., Ltd. issues an announcement on Hainan Daily Paper (edition 6, Tuesday, August 5, 2008) to solicit the public's opinions on the influence of the project to the surrounding environment. The content and flow of the announcement are as follows:

Announcement

Phase I (49.5MW) engineering of Hainan Dongfang Gancheng Wind Farm is located in the area from Dongfang Gancheng Town to Banqiao Town with north edge in estuary of Ganen River and south edge in Lizhang Port of Banqiao Town. The total installation capacity of this phase of project is 49.5MW, annual network electric quantity is about 103857 MW·h, capacity of 33 installed unit is 1500kw and the wheel hub of fan is 65m in height. A 110kV boost transformer substation including office building and farm road of 15km are to be built. A 10kV overhead circuit of 19.52km and a 110kV circuit of 5km (this 110kV overhead circuit does not belong to the content of this evaluation) are to be erected. The total occupation area of the project is 18.90 hectares, among which permanent occupation area is 6.18 hectares and temporary occupation area is 12.72 hectares. Phase I project has a staff of 15 persons and a gross investment of RMB 500.756 million Yuan.

During the operation period of the project, the discharge amount of sewage is about 1095t/a, domestic rubbish amount is 5.475t/a, amount of discarded lubricating oil for the fan is 264kg/a, and the maintenance of main transformer of the booster substation or accidents will generate small amount of waste oil. Domestic sewage can fertilize the farmland after treatment in integrated sewage treatment facilities; collected domestic rubbish will be disposed by sanitation department; waste oil generated in maintenance or accidents and discarded lubricating oil generated by fans are dangerous wastes and will be commissioned to be disposed by qualified units. The intensity of power frequency electric field and power frequency magnetic induction intensity of 110kV transformer substation meet relevant state standard and regulation and the electromagnetic radiation influence is small. After completion, the installation of fans will cause certain space interference to the landscape.

Wind energy is renewable clean energy and wind farm is project that the Chinese government encourages to develop. Besides saving energy, wind power can decrease discharge of dust, CO₂, SO₂, NO_x, C_nH_m and CO compared with coal electricity generation of same output of power.

According to requirement of relevant laws and regulations, our company has entrusted Hainan Environment Science&Technology Economy Development Company to conduct evaluation to the influence of the project to the environment. We hope the public to participate enthusiastically to express their opinions on the project to the construction unit or environmental evaluation unit.

Construction unit: Hainan Xinfengyuan Industrial Co., Ltd. Tel: 0898-66190269, contact person: Ms Lu

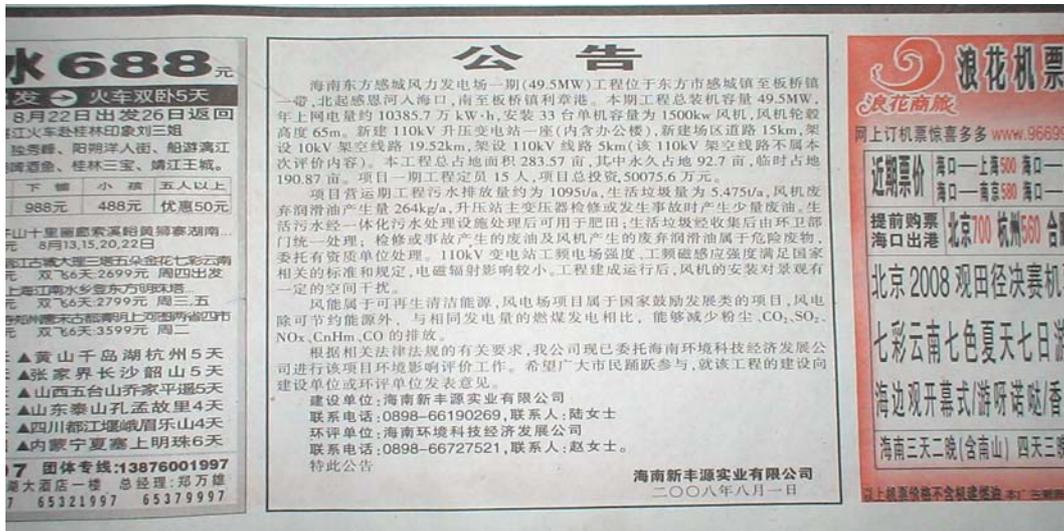
Environmental evaluation unit: Hainan Environment Science & Technology Development Company,

Tel: 0898-66727521, contact person: Ms Zhao.

Hereby announce

Hainan Xinfengyuan Industrial Co., Ltd

Announcement presentation



- ② In the course of establishment of the report, the environmental evaluation units solicited opinions of the public in form of questionnaire investigation and distributed the Public Participation Investigation Form to the public and relevant units. In the process of distribution of investigation forms, the company introduced briefly the overview of the project and main environment problems that may occur and relevant treatment measures, explained that the construction of the project will promote the development of local economy, then collect investigation forms.

Analysis of investigation result:

(1) Distribution quantity and return of investigation forms

There are totally 30 copies of questionnaires distributed and 26 copies returned, with the rate of recovery as 87%.

(2) Information about public participation personnel

See table 8 for information on public participation personnel.

Table 9 Information on public participation personnel

Number	Name	Number of people	Proportion (%)
一	Sex		
I			
1	Male	21	81
2	Female	5	19
二	Academic degree		
II			
1	Junior college and university	6	23
2	Technical secondary school	2	7
3	High school	12	46
4	Junior middle school	3	12
5	Academic degree unknown	3	12

≡ III	Occupation		
1	Cadre	15	58
2	Peasant	3	12
3	Occupation unknown	8	30

It can be seen from Table 8 that there are 6 persons with academic degree of junior college or above, accounting for 23.0% of public participation number; 2 persons with academic degree of technical secondary school, accounting for 7.0% of the total public participation person; 15 persons with academic degree of high school and junior middle school, accounting for 58.5%; the others' academic degree is not known. In the public participation personnel, those with definite schooling accounts for the majority, so they have certain ability of independent thinking and analyzing and the returned 26 investigation forms are valid investigation forms.

In the public participation personnel, there are 15 cadres who accounts for 58% of the total sum; 3 peasants who accounts for 11.5%; the rest are unemployed or whose occupation is not known. The public participation personnel are from many occupations, so the returned investigation forms have certain social and occupational representativeness and are valid investigation forms.

(3) Analysis of statistics result

See table 9 for the statistics and analysis result of the public participation.

According to the statistics of the investigation questionnaire, 100% of the investigated person know Phase I project of Dongfang Gancheng Wind Power Plant; 92% personnel think that the engineering is favorable to the development of local economy; 80% personnel think that the engineering causes no influence to the environment; 89% think that the main environmental influence of the engineering is change in landscape; 97% support the construction of the project.

Table10 Public participation statistics table

1. How much do you learn about this project?	I know.	I don't know.	
	100%	0	
2. Do you think that the project will promote the development of local economy?	Yes	No	I don't know.
	97%	0	3%
3. How do you think the influence of this project to the environment?	Large influence	Small influence	Little influence
		20%	80%
4. Which are the main environmental influence of the project in your opinion?	dischargesewage	Destroy landscape	Discharge waste gas
	11%	89%	
5. How do you care about the environment protection usually?	Very much	Ordinary	It doesn't matter
	81%	19%	0
6. Your general attitude towards the project?	Support	Not support	It doesn't matter
	97%	0	3%
7. What is the largest characteristic of the project in your opinion?	Enenergy-conservation and emission reduction	Influence to landscape	Promote local economy
	31%	0	92%

(4) Conclusion

In sum, the results of investigation to neighbourhood residents and relevant responsible institution show that majority public support the construction of phase I project of Dongfang Gancheng Wind Farm, thinking it is favourable to the development of local economy and will cause small influence to the environment.

IX. Evaluation conclusion and suggestion

1. Evaluation conclusion

- (1) This project is a wind power generation project encouraged to be developed in compliance with the industrial policy for the type of "development and use of renewable energy such as wind power generation and solar energy, geothermal energy, ocean energy and biomass energy".
- (2) Construction site is from Gancheng town to Banqiao town away from Dongfang city about 30km. Dongfang City with 49.5MW of total installed capacity, 103.857MW·h of annual grid-connected electric quantity and 2089 hours of annual equivalent hourage. The static investment in works is 485.66 million Yuan and gross investment is 500.76 million Yuan.
- (3) Current environmental situation: The quality of ambient air accords with Grade One standard of the *Ambient Air Quality Standard* (GB3095-1996); sea water quality meets Type Two standard of the *Seawater Quality Standard* (GB3097-1997); the acoustic environment accords with Type Two standard of the *Standard of Environmental Noise of Urban Area* (GB3096-93); groundwater quality accords with Type II standard of the *Groundwater Quality Standard* (GB/T14848-93); the vegetation type on the project site mainly includes beef wood, long-beak eucalyptus and some weeds with comparatively simple vegetation type and low bio-diversity; the landscape of the area where the project lies of ordinary quality without unique and scarce characters.
- (4) Impact during the construction period: During the construction period, there is little discharge of productive waste water, the discharge of domestic sewage is 20t/d and the discharge of domestic rubbish is 100kg/d. Reasonably arrange construction time and transport line during the construction period to reduce the impact on the surrounding residents. Some dust will appear during the construction period, so the construction site should be watered regularly and the temporary yard should be covered to reduce dust. The earth and stone excavation and the use for backfilling for the project are basically balanced.
- (5) Analysis of site selection: The construction site of the project lies in a coastal zone 6 kilometers long south of the estuary of Gan'en River which is located within the scope of the planned energy industry development land of Dongfang City in compliance with overall land plan.

The construction of the project needs to take up coastal defense forest. If the owner wants to occupy or expropriate coastal zone given special national protection, it shall, according

to the *Management Regulations for Coastal Forest Zone Given Special National Protection* and the *Management Method of Hainan Province for Protection of Coastal Defense Forest* as well as legal authority and procedures, report it to the the people's government for approval with the verification opinion of the competent forestry department under the people's government at provincial level or above attached, and pay the compensation for forest trees, compensation for forest land, allowance for arrangement and recovery expense for forest vegetation in accordance with the regulations, provided that the area of recovered vegetation is no less than the area of forest vegetation reduced for expropriation or occupation of forest land. These measures are taken to reduce the negative effect of project construction on the ecology of coastal defense forest, so from the environmental angle, the site selection is basically feasible.

- (6) Impact during the operation period: The noise at the boundary of the booster station and the noise of the wind generator foundation at a distance of 15m meet Type II standard of the *Standard of Noise at Boundary of Industrial Enterprises*(GB/T12348-90) (60dB in the daytime and 50dB at night), so the impact on the surrounding environment is minor. The noise of the booster station and the wind generator is low frequency noise. In view of the huge harm of low frequency noise to the human body, it's proposed to set 50m of health protection distance.

After the project is completed, the sewage emission will be 1098t/a, the volume of domestic rubbish 5.5t/a and the discharge of discarded lubricating oil of the wind generator 264kg/a. when the main transformer of the booster station is examined and repaired or suffers an accident, a little waste oil will appear. Domestic sewage can be used to fertilize the soil after treated through Grade Three septic tank; domestic rubbish will be treated totally by the sanitation department after gathered; the waste oil which appears at the examination and repair or the occurrence of the accident and the discarded lubricating oil coming from the wind generator are hazardous wastes, so a qualified unit (provincial hazardous waste treatment center) is commissioned to treat them so that they have minor impact on the environment.

After 110kV transformer substation is completed, the intensity of the power frequency electric field and the intensity of power frequency magnetic induction meet relevant national standards and regulations and electromagnetic radiation has minor impact.

After the project is completed and put into operation, the installation of the wind generator and the erection of the electric transmission circuit will have certain space interference in the landscape; the result is that the project basically harmonizes with the surrounding landscape through analysis of the compatibility of the construction project with the landscape. The project construction has minor negative effect on the landscape and will have positive impact on the landscape of the area where the construction site lies, conducive to the formation of new landscape along the coastal line.

- (7) Gross environmental protection investment of the project is about RMB 0.654 million Yuan, accounting for 0.13% of static gross investment of the project.

- (8) After the project is built up, the following can be achieved every year: save 39361.803t of standard coal, reduce about 441.87t/a of SO₂ emission and save 0.37 million m³/a of fresh water.

In sum, after this project is completed and put into operation, it will greatly promote local social and economic development with significant economic, social and environmental benefits. The construction of the works has minor impact on local water, acoustic, atmospheric, ecological, landscape and electromagnetic environments and major environmental impact may be alleviated by taking corresponding environmental protection and management measures. So the construction of the works will be basically feasible in terms of environmental protection so long as the system of "Three Phases Going Simultaneously (the design, construction and operation of the environmental protection facilities must be simultaneously conducted with those of main works)" are all environmental protection measures proposed in this evaluation are carefully carried out during the construction.

2. Suggestions

- (1) The form and color of the construction project should harmonize with surrounding landscape environment.
- (2) The land for the works should be reasonably compensated according to relevant regulations; the forest land should be occupied in strict accordance with the provisions of the Forest Law and should be constructed after examination and approval of competent forestry department.
- (3) The construction period should not be in rainy season as far as possible so as not to increase the chance of soil erosion.
- (4) A certain area of coastal defense forest will be felled in the project construction area. So the ecological function of the coastal defense forest will be affected to some extent and remedial measures had better be taken. Whereas the east of the project land includes forest land, young forest land and melon land, it's proposed to strengthen the management and protection of existing forest land, timely recover forest vegetation and enhance fostering of trees so as to remedy the weakening of the function of coastal defense forest caused by project construction. Meanwhile, it's proposed forest culture, management and protection expenses should be disbursed from the "recovery expense for forest vegetation" paid by the construction unit.

Preliminary examination opinion:

Officer:

Official seal

Date:

Examination opinion of competent environmental protection department at lower level:

Officer:

Official seal

Date:

Examination and approval opinion:

Officer:

Official seal

Date:

Special Landscape Impact Report of the Project of Phase I Works of Dongfang Gancheng Wind Farm

(For approval)

Construction unit: Hainan Xinfengyuan Industrial Co., Ltd.

Evaluation unit: Hainan Environmental Technology Economy Development Company

September 2008 · Haikou

Special Landscape Impact Report of the Project of Phase I Works of Dongfang Gancheng Wind Farm

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1 General provisions

1.1 Task origin and evaluation's purpose

The project is located on the 6-kilometer coastline south to the estuary of Gan'en River of Dongfang City of Hainan Province. The project was previously undertaken by Hainan Guangshui New Energy Development Co., Ltd. with the installed capacity of phase I project as 48MW and 24 2.0-megawatt units, and the network electric quantity as 11505.7 MWh/a and equivalent hour as 2589 hours. The project covers an area of 9.577 hectares. The land occupation type is mainly seashore protection forest land, forest land, melon land and graveyard. In November 2006, Hainan Guangshui New Energy Development Co., Ltd. commissioned Hainan Environment Science & Technology Economy Development Company to undertake the evaluation of the project's environmental influence and prepare the Environmental Influence Report Form for this project. The Report Form was reviewed by experts in January 2007 and replied by Department of Land Environment & Resources of Hainan Province on January 25, 2007 (QTHZJZ [2007] No.13). So far, the project has not been started yet.

As the owner now is changed into Hainan Xinfengyuan Industry Co., Ltd. and the capacity of phase I project is increased to 49.5MW, there are totally 33 1.5-megawatt units installed with network electric quantity of 103857MWh and equivalent hour of 2098 hours. The total area of the project is 6.18 hectares. The land occupation type is mainly seashore protection forest land, forest land, and melon land. Therefore, in July 2008, Hainan Xinfengyuan Industry Co., Ltd. commissioned Hainan Environmental Technology & Economy Development Company to revise the evaluation report on the environmental influence of the project according to the requirement of Environmental Evaluation Report [2008] No.03. After acceptance of the commission, Hainan Environmental Technology & Economy Development Company conducted revision to the Report Form for Environmental Influence of Phase I Project of Dongfang Gancheng Wind Farm (48MW). On this basis, Hainan Environmental Technology & Economy Development Company organized relevant personnel again to the site to conduct survey and collect relevant materials, revised the environmental influence report form (attached view item) of this project according to the requirement of the country to the project environmental influence evaluation.

Evaluation basis

1.2.1 Laws and regulations

- *Environmental Protection Law of the People's Republic of China* (December 26, 1989);
- *Law of the People's Republic of China on Evaluation of Environmental Effects* (September 1, 2003);
- *Land Administration Law of the People's Republic of China* (August 28, 2004);

- *Forest Law of the People's Republic of China (April 29, 1998);*
- *Law of the People's Republic of China on Water and Soil Conservation, June 29, 1991;*
- *Regulations on the Administration of Construction Project Environmental Protection (No.253 Order of the State Council, November 1998):*
- *Management Regulations for Coastal Forest Zone Given Special National Protection (February 19, 2004);*
- *Management Regulations of Hainan Province on Environmental Protection of Construction Project (July 12, 1999);*
- *List of Classified Management of Environmental Protection of Construction Project (No.14 Order of State Environmental Protection Administration on October 13, 2002);*
- *Interim Methods for Management of Construction Land for the Works of the Wind farm and Environmental Protection;*
- *Environmental Protection Rules of Hainan Province (January10, 2007);*
- *Management Methods of Hainan Province for Protection of Coastal Defense Forest, (July 7, 2004).*

1.2.2 Technical specifications

- *Technical Guidelines for Environmental Impact Assessment (HJ/T2.1-2.3-93);*
- *Technical Guidelines for Environmental Impact Assessment - Acoustic Environment (HJ/T2.4-1995);*
- *Technical Guidelines for Environmental Impact Assessment – Non-pollutive Ecological Impact (HJ/T19-1997)*

1.2.3 Relevant documents

- *Decision on Implementing Scientific Concept of Development and Strengthening Environmental Protection by the State Council (No.39 (2005) Guo Fa dated December14,2005)*
- *Implementing Opinion of Hainan Provincial People's Government on Performance of the Decision on Implementing Scientific Concept of Development and Strengthening Environmental Protection by the State Council (No.30 [2006] Qiong Fu);*
- *Written Reply to Collection of Recovery Expense for Forest Vegetation (No.12 (1993) Qiong Jia She Zi of Department of Finance);*
- *Notice of Department of Land and Resources of Hainan Province on Environmental Impact Evaluation of Construction Project.No.03 [2007] Environmental Evaluation Notice, January 5, 2007; Notice of environmental evaluation No.[2008]219 , August18,2008*

1.2.4 Main materials

Feasibility Study Report on Hainan Dongfang Gancheng Wind Farm Phase I 49.5MW Project,

December 2007, Northwest Survey Design Institute of China Water and Electricity Consultant Group.

1.3 Range of landscape evaluation and evaluation factor

The range of landscape evaluation of this project includes the range of the land for the project and the visible area.

The site of the project mainly consists of seascape, coastal defense forest, melon land and forest land, of which only seascape is natural landscape and others are man-made landscape.

1.4 Landscape protection goal

The project lies along the coastline, so what should be protected are mainly coastal landscape and visual landscape.

1.5 Evaluation emphasis

Discernment should be conducted according to the characteristics of project works and local landscape and in the light of possible unfavorable impact on the landscape environment and landscape impact factor during the construction and operation period of the works. Below are the evaluation emphases of landscape impact intended to be determined for this project: impact on seascape and coastal defense forest landscape and impact on landscape of wind generators, 33kV circuit, roads and the booster station in the construction project.

2 Investigation and evaluation of current landscape situation

2.1 Investigation content

2.1.1 Natural environment

The geomorphologic type of the project site is Class I seashore terrace with even terrain. There are three engineering-geological layers within the scope of depth of 30m. The first layer is a brown yellow, light gray and yellow-gray gravel layer mainly consisting of silty and fine sand with a gravel diameter of 2-4mm including a lot of medium and coarse grains; the grains are subangular – subcircular and their mineral composition includes quartz and feldspar; clay content accounts for 6-12% of total content and is locally high; there are a lot of coarse sand grains with good grain gradation on the upper and middle parts which are wet or saturated, of slight or medium density and locally loose with a burial depth of 11m at the layer bottom. The second layer consists of grayish white and gray-yellow silty sand in a saturated and medium-density state mainly comprising silty and fine sand of largely medium and coarse grains, the grains are subangular – subcircular and their mineral composition includes quartz and feldspar; clay content accounts for 6-12% of total content; the burial depth is about 15 m at the layer bottom. The third layer consists of gray silty clay which is wet and plastic and locally hard and its composition mainly includes power and clay.

On the site, average annual temperature is 27.69 °C, maximum temperature 36.5 °C, minimum temperature 12.7 °C, average annual atmospheric density 1.166kg/m³, average wind speed at a distance of 10m from the sea 5.6m/s and average wind speed at an inland distance of 10m 5.2m/s; prevailing wind direction and maximum wind energy direction is south-southeaster in the seaward place and prevailing wind direction and maximum wind energy direction is south wind in the inland place. During the wind measurement period, average turbulent intensity of the area is relatively low and the area is an area of medium turbulent intensity. In addition, there's no destructive wind speed during the wind measurement period, which conduces to the service life and safe operation of the wind power generating set.

2.1.2 Culture and coastal defense forest

There are no cultural relics in the area where the project of Phase I Works of Dongfang Gancheng Wind farm lies.

The land for the project mainly includes coastal defense forest. The rear part of coastal defense forest land were cut down to plant watermelon and build shrimping ponds. The northern shrimping pond is unused at present and the southern shrimping pond is still in operation now. On the whole, there are only some remaining tree branches in the coast defense forestry on the north end of the place little, and the melon land has only scattered casuarinas around the idle shrimping ponds with a height of 7~8 meters. The casuarinas forest on the south end of the field is relatively complete with a width of about 70~150 meters and height of about 5~6 meters. The land use scope of the wind farm covers

shrimping ponds and some auxiliary facilities for shrimp raising, including houses and pump house built to guard the shrimping ponds without other building. The booster station of wind farm is 2000m distant to the nearest Fengting village, and the fan is 3000m far from the nearest residential area of Gancheng Town. The residents in Fengting and Ganen Town, melon growers contracting melon land and shrimp raisers are mainly impacted by the construction of wind farm.

2.1.3 Landscape characteristics

Major land type in the area includes coastal defense forestry land, melon land, shrimping ponds which do not constitute scenery. Natural landscape in the area is mainly seascape. However, because of impact of the adjacent view, the seascape within the region is of low appreciation quality on the whole. See picture 1~picture 8 for current situation of view.

2.1.4 Impacted people

The wind generators are 2000m far from the closest residential quarters, so mainly impacted people are residents who live in the visible area.

2.2 Investigation and evaluations of current situations

2.2.1 Sensitivity evaluation

Landscape sensitivity refers to the degree of attention by people generally distinguished through visual angle or relative slope, relative distance, view frequency and view boldness. The landscape in the area where the project lies mainly consists of seascape, coastal defense forest and melon land. At a certain distance or within a certain period, the higher the possibility or the longer the time to see the landscape, the higher the landscape sensitivity. In terms of visual impact, because the seascape on the project site is of low overall enjoyability under the influence surrounding landscape and its lasting view time is 5-10s, the seascape is sensitive landscape; the lasting view time of the coastal defense forest and forest land in the south of the site is less than 5s, so they are of ordinary sensitivity; if the view time lasts for over 0.3s, the coastal defense forest and melon land in the north of the site can be seen, but they will be glanced at only, so they are not sensitive.

2.2.2 Qualitative evaluation

Major landscape resource on the project site is seascape, but because there is special land (graveyard) on the project site and a large number of northern coastal defense forest trees are felled, which impact the quality of seascape and reduce its enjoyability so that the regional landscape is of low overall quality.

2.2.3 Quantitative evaluation

The current landscape quality is evaluated through the aesthetic quality evaluation model for natural scenery of the scenery resource management system of the Bureau of Land Management of USA. Seven factors impacting scenery quality are selected for the evaluation model and the mark is given in grades. Grading standard: Grade A, over 19 points; Grade B, 12-18 points, Grade C, 0-11 points. See Table 2.1 for evaluation model factors and see Table

2.2 for evaluation results.

It can be seen from table 2.1 that the evaluation score for the view quality in the project area is 4 and the view quality is grade C, which indicates that the quality of the view in the region is low without uniqueness and scarcity.

Table 2.1 Grading Evaluation Table of Scenery Quality

Evaluation factor	Grading evaluation standard and marking value			
Terrain	High and vertical topographical feature such as cliff and summit; uncovered rock layer of large area; intense earth surface oscillation or height erosion construct (mainly include scabland or sand dune); dominative and attention-drawing detail characteristic (such as glacier etc.)	Dangerously steep gorge, tableland, isolated mound, volcanic mound ice mound; interesting erosion shape or terrain change; non-dominant but interesting detail characteristics (3)	Low undulating hills, hill foot, hillock or even valley bottom, interesting rare or scarce detail landscape characteristics (1)	1
Plant	A great variety of plant and interesting and changeable structure and shape (5)	Plant diversity is general with only one or two main plant types	Simple tree variety lacking comparability (1)	1
Water body	Clean water, calm water surface or waterfall as landscape highlight (5)	Flowing or motionless water surface not dominant among the landscape (3)	No water body or unattractive water body (1)	3
Color	Abundant color combination; changeable or vivid color; rock, plant, water body or snowfield in pleasant contrast (5)	Certain intensity change of colors of soil, rock and plant not dominant factor of landscape (3)	Slight color change; comparability or interest; generally speaking, the tones are all dull (1)	1
Impact of nearby landscape	Great enhancement of vision-related aesthetic quality for nearby landscape (5)	Enhancement of vision-related aesthetic quality for nearby landscape to some extent (3)	A little or no impact of nearby landscape on overall vision-related aesthetic quality (1)	1
Scarcity	Rare or precious species within the region; steady opportunity of plant or wild flower etc. with peculiar appreciation quality(5)	Special despite its similarity to some things in the area (3)	Interesting within the environment but popular in this area (1)	1
Man-made change	Increase view type favorable to sight and promote harmony of sight view(2)	Increase a little or do not increase type of sight view and introduce elements unfavorable to harmony of sight view (0)	Increase type of sight view, but the change is not harmonious and increases greatly the incongruity of the sight view(-4)	-4
Total				4

3.Prediction and Evaluation of Landscape Impact

3.1 Landscape impact during the construction period

Because of a great deal of earth and stone excavation during the construction period, the excavation and stacking of earth and stone will have certain impact on the surrounding landscape of the project, but this impact is local and temporary as it will disappear when construction ends. The construction period has major impact on coastal defense forest land. Because there's no sheltering by coastal defense forest in the north of the site, the construction of the works during the construction period will have certain impact on seascape; because there's sheltering by coastal defense forest in the south of the site, the construction of the works during the construction period will have minor impact on seascape.

Slight soil erosion will arise from a great deal of earth and stone excavation and site leveling as well as temporary dreg stacking and have certain yet minor impact on the landscape. At the construction of the works, removal of surface vegetation will cause the surface to be exposed, so it has certain impact on the landscape.

3.2 Landscape impact during the operation period

After the project is completed and put into operation, the following will have major impact on the landscape: wind generator (65m), road, 10kV circuit and booster station. The landscape impact during the operation period is mainly analyzed from the angles of landscape compatibility, the impact on sensitive landscape and the impact of the construction project on the landscape.

3.2.1 Analysis of landscape compatibility

Landscape compatibility is analyzed in a traditional landscape design method, a method that specific social and technological conditions are used to reflect the utilitarianism and enjoyability under specific natural environmental circumstances, with reference to relevant national or local standards. The landscape compatibility between the construction project and scenery resource background is measured mainly through landscape indexes. For evaluation grading and standard of landscape indexes, see Table 3.1.

Landscape grade can be evaluated in grades in a traditional landscape design method and the evaluation of landscape compatibility can be graded in a scoring method based on the following procedures: preliminary index grading → expert system → standard index grading. See Tables 3.2 and 3.3. for grading standards for landscape compatibility evaluation. Shape index refers to geometrical elements of developed and constructed project buildings, their mutual combination relationship and their position; linear index refers to the harmonious requirements of different angles and distance for the buildings in the scenery; color index refers to basic appearance and lightness of the colors of the buildings; texture index refers to visual reaction caused by the thickness, evenness, smoothness and gloss of the surface of the buildings.

For detailed analysis results of the project landscape compatibility, see Table 3.4.

Table 3.1 Evaluation Grading and Standard of Landscape Indexes

Evaluation grading Allowance Landscape type	4 (Bad) (Inharmonious)	3 (Acceptable) (Ordinary)	2 (Medium) (Harmonious)	1 (Excellent) (Scenery increase)
Special protection zone	Unacceptable	Unacceptable	Considerable	Acceptable
Key protection zone	Unacceptable	Considerable	Acceptable	Acceptable
Ordinary protection zone	Unacceptable	Acceptable	Acceptable	Acceptable
Protection control zone	Considerable	Acceptable	Acceptable	Acceptable

Table 3.2 Evaluation Indexes of Landscape Compatibility

Evaluation index of landscape compatibility	maximum score	Index division
Shape	40	Dimension: 25;Figure: 15 Close view: 15; Medium view: 10; Distant view: 5 Hue: 10; Lightness: 10
Line shape	30	
Color	20	
Texture	10	

Table 3.3 Evaluation Grading Standard

Evaluation grading	(4)Bad	(3)Acceptable	(2)Medium	(1)Excellent
Score range	<60	60-75	75-90	>90

Table 3.4 Table of Analysis of Project Landscape Compatibility

Evaluation index of landscape compatibility	Grade	
Shape	Dimension	20
	Figure	13
Line shape	Close view	10
	Medium view	9
	Distant view	5
Color	Hue	8
	Lightness	8
Texture		8
Total		81

We can see from Table 3.4 - Table of Analysis of Project Landscape Compatibility that the score of the construction project is 81 points, falling under Grade (2) in harmony with surrounding landscape. The first row of wind generators for the project lies in the coastal defense forest zone given special national protection and it's considerable to lay out the first row of wind generators here; other buildings of the project are laid out around the coastal defense forest zone which is protection and control zone and it's feasible to lay out the buildings here. The land for the project construction lies within the planned energy industry area of Dongfang City, so the project construction basically harmonizes with surrounding landscape in terms of regional planning.

3.2.2 Impact on sensitive landscape

Sensitive landscape on the project site mainly includes seascape and coastal defense forest, ordinary forest land landscape, of which the coastal defense forest is a forest zone given special national protection. Because the first row of wind generators is laid out within the scope of the coastal defense forest, coastal defense forest will be occupied for project construction, and the second row of wind generators and the booster station are mainly laid out within the scope of ordinary forest land, so ordinary forest land will be occupied. The wind generator foundation and the maintenance road cross the coastal defense forest and ordinary forest land, so the project construction will destroy and break the completeness of the landscape of coastal defense forest and ordinary forest land, having major impact on the landscape of coastal defense forest and ordinary forest land. In view of current management and protection situation of coastal defense forest, it's proposed to strengthen the management and protection of coastal defense forest within the site and disburse forest culture, management and protection expense from the "recovery expense for forest vegetation" paid by the construction unit to remedy the weakening of the function of coastal defense forest by construction project and reduce negative impact of project construction on the landscape of coastal defense forest as well as form new coastal defense forest landscape.

Because wind generators relatively high, they can be easily seen in the seashore, having indirect impact on seascape.

3.2.3 Impact of wind generators on landscape

The appearance of the wind generators are white and the wind generators are 65m high as an overhead structure. The impact of wind generators on the landscape is analyzed through the relationship between vertical view angle and psychological sense. See Table 3.5 for detailed relationship between vertical view angle and psychological sense.

Table 3.5 Relationship between Vertical View Angle and Psychological Sense

Viewing distance D/ Building height H	Vertical view angle (°)	Observation content	Psychological sense
1/2	63.4	Look up to the buildings and the sky	Sense of oppression
1	45.0	Observe the detail and locality of the buildings	Sense of closeness
2	26.6	Observe main body of the buildings	Sense of equality
3	18.4	Observe the overall situation of the buildings	Sense of openness
4	14.0	Observe the building outline	Sense of comparison
5	11.3	Observe the environment of the building	Sense of strangeness
10	5.7	Observe the horizon	Sense of spaciousness

The land around the the wind generator foundation is mainly used to plant watermelon. Because the height of wind generator is 65 m, if the wind generator foundation serves as the center of a circle, within the scope of a radius of 65m, D/H value will be no more than 1 so that the people who act within such scope will have senses of closeness and oppression; within the scope 65m-130m far from the wind generator foundation, D/H value will be more than 1 but less than 2 so that the people who act within such scope will have a sense of discomfort; when the distance to the wind generator foundation is more than 134m, D/H value will be more than 2 so that wind generators will become viewing object of people and with the further increase of D/H value, the visual impact of wind generators on the landscape space will completely disappear. Since the distance from the residential quarters near the project site to the wind generator foundation is more than 130m, wind generators will become a viewing scene of nearby residents.

3.2.4 Impact of erection of 10kV circuit on landscape

The wire pole for erection of 10kV circuit is a cement pole 15m high as an overhead structure, so its impact on the landscape is analyzed through the relationship between vertical view angle and psychological sense. See Table 3.5 for detailed relationship between vertical view angle and psychological sense.

If the wire pole foundation serves as the center of a circle, within the scope of a radius of 15m, D/H value will be no more than 1 so that the people who act within such scope will have senses of closeness and oppression; within the scope 15m-30m far from the wire pole foundation, D/H value will be more than 1 but less than 2 so that the people who act within such scope will not have a sense of discomfort; when the distance from the wire pole foundation is more than 30m, D/H value will be more than 2 so that people will have senses of comparison and strangeness, and with the further increase of D/H value, the visual impact of the wire pole and bus on the landscape space will completely disappear.

3.2.5 Impact of roads on landscape

Because wind generators need to be maintained, roads 4.5m wide will be built between wind generators, and the roads for wind generator maintenance will be 15km long and others 5km long. The first row of wind generators lie within the scope of coastal defense forest land and the second row of wind generators lie within the scope of ordinary forest land. The roads for wind generator maintenance will be built along wind generators and the land used for building of roads mainly includes coastal defense forest land and ordinary forest land. The building of roads basically has no impact on the seascape, but has certain impact on the landscape of coastal defense forest and ordinary forest land.

3.2.6 Impact of the booster station on landscape

The booster station is mainly laid out on the inland side and its design should harmonize with surrounding landscape as far as possible. What surrounds the booster station is mainly forest land, so it's proposed landscape planning should be made for the booster station. After the landscape planning is completed, the construction of the booster station will have minor impact on the surrounding landscape.

3.2.7 Impact of wind generator shadow on landscape

In the daytime, the shadow arising from the sunshine on the rotating blades has unfavorable impact on the landscape, often making people exposed to this environment vexed or dizzy. The shadow of wind generators may be as long as 200m, so the impact scope are mainly the people who act within the scope 200m far from the wind generator foundation. The distance from the wind generator foundation to the nearest residential quarters –Fengting village is 2000 m, so the shadow of the wind generator has no impact on nearby residents and has certain impact on the landscape within the scope 200 m far from the wind generator foundation.

3.2.8 Analysis of compatibility with planned landscape

According to the *Overall Urban Plan of Dongfang City*, the project area lies in Yuanjing Industrial Zone of Dongfang Chemical Town. According to industrial layout for the coastal zone from Gaopai Village to Banqiao and the zone in front of Sigeng in the development layout in the *Outline of the 11th Five-year Plan of Dongfang City for National Economy and Social Development*, this area is planned as an energy industry area to develop thermal power, wind power and hydroelectric generation. Thermal power generation is laid out in the coastal zone from Gaopai Village to Tongtian River with emphasis on development of gas and clean fire coal generating plant; wind energy generation is planned to be developed in the coastal zone from Gaopai to Banqiao and the zone in front of Sigeng; hydroelectric generation is developed in the suitable area of the Changjiang River Basin.

The construction site of the project –from Gancheng Town to Banqiao Town in the Dongfang city, 30km far away from Dongfang is a wind power generation area in the energy industry zone according to the plan, and in the future, this zone will mainly serve as industrial land for such energy as wind power generation and thermal power generation.

4 Measures to alleviate landscape impact

Natural landscape is a kind of unrenovable resource. The landscape on the project site is greatly impacted by people and great changes occur to natural landscape which is mainly seascape here. To prevent the construction project from having harmful effects on the existing landscape, the following measures are taken:

- (1) The size, form, color and style of the project buildings should conform with existing surrounding landscape;
- (2) Both sides of roads and the surrounding of the booster station should be afforested to play a role in hiding landscape with vegetation so as to reduce the impact of the construction of roads and the on surrounding landscape.
- (3) The temporary land for the project should be recovered, relevant compensation expense for vegetation should be paid for occupied coastal defense forest land and ordinary forest land according to relevant regulations and forestry department should be responsible for their recovery to reduce their impact on the landscape.
- (4) If conditions permit, make every effort to use a design conducive to beautifying environment and improving landscape so that the design of the works harmonizes with surrounding environment in terms of sense.
- (5) Select wind generators with matt exterior coating to reduce visual light pollution caused by wind generators.
- (6) Cover earth and stone which cannot be used in time during the construction period to reduce dust and prevent soil erosion and lower the impact on the surrounding landscape of the project.
- (7) The shape and color design of the construction project should not breach local folk custom and religious taboo.

5 Brief summary

- (1) The landscape in the project area mainly includes seascape, coastal defense forest and ordinary forest land, among which only seascape is natural landscape; most part is seabeach with good infiltrability in the area. There are no cultural relics in the area and wind generators are 2000m far from the nearest residential quarters, so the impacted people are residents who live in the visible area.
- (2) The view evaluation adopts the aesthetic feeling quality evaluation model of scenery resources management system of Bureau of Land Management to the natural scenery and the result indicates that the view quality in the project area is grade C and the view quality is low without uniqueness and scarcity.
- (3) The earth and stone excavation, soil erosion and surface vegetation removal during the construction period have certain impact on surrounding landscape, but this impact is local and temporary.
- (4) After the project is completed and put into operation, the installation of the wind generator and the erection of the electric transmission circuit will have certain space interference in the landscape; the result is that the project basically harmonizes with the surrounding landscape through analysis of the compatibility of the construction project with the landscape.
- (5) The measures to alleviate landscape impact mainly proceed from the size, form, color, style and landscape hiding with vegetation.
- (6) Relevant compensation expense for vegetation should be paid for occupied coastal defense forest land and ordinary forest land according to relevant regulations to reduce the negative impact on the landscape of coastal defense forest and ordinary forest land.

On the whole, the project construction has minor negative effect on the landscape and will have positive impact on the landscape of the area where the construction site lies, conducive to the formation of new landscape along the coastal line

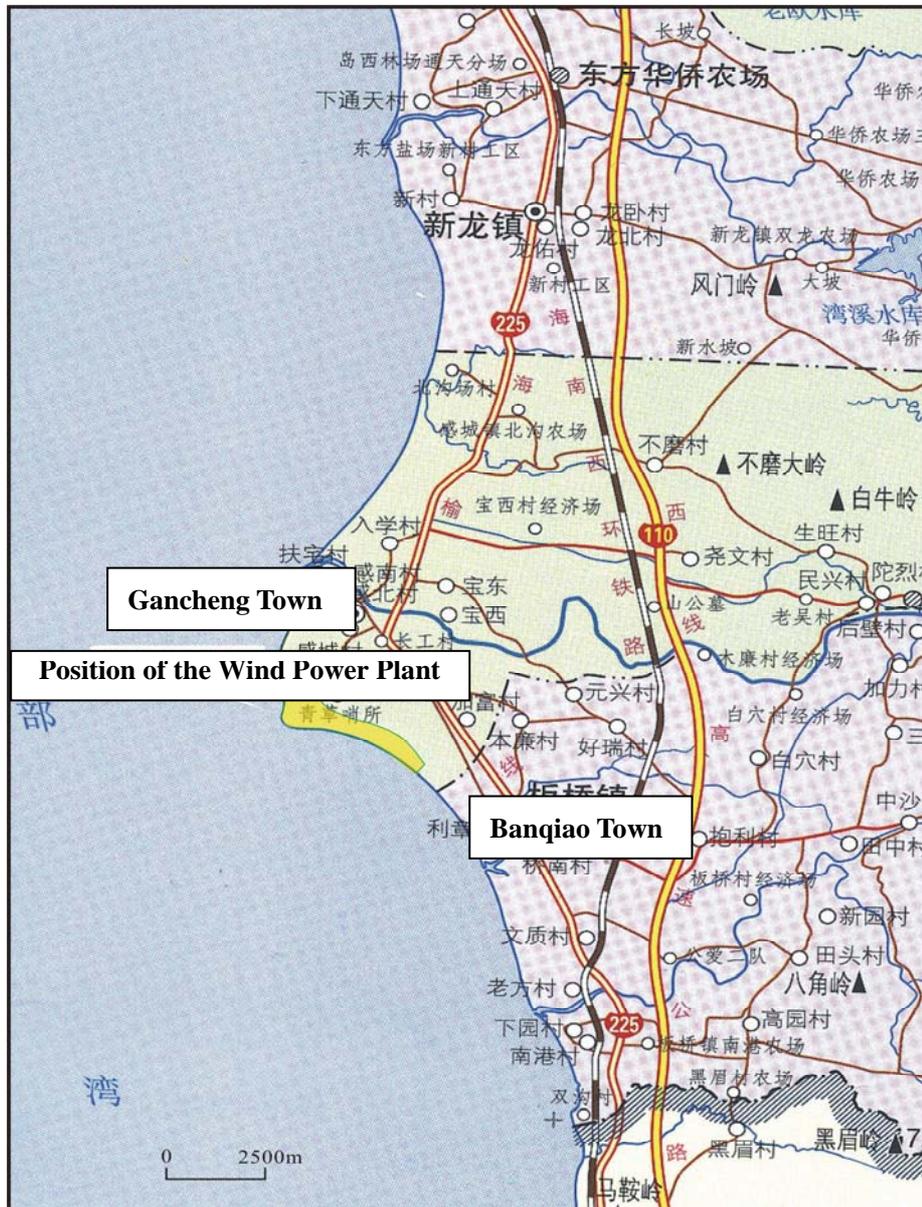


Fig.1 Geographical Position Map of the Project

