
SHANDONG POWER SECTOR FLUE GAS DESULPHURIZATION (FGD) PROJECT Environmental Management Plan

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Shandong Yantai Bajiao Power Plant**

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1. Project Introduction

Yantai Economic and Technical Development Area Zone (YETDZ) is located in the west of Yantai. It is one of the first batch of the national-level economic and technological development zones set up with the approval of the State Council in October, 1984. group national development zones (14) approved by the State Council in October 1984. The enterprises that have made investments in YETDZ constructed the preliminary industry frame of YETDZ. Machinery, automobile and auto parts, electronic information, fine fiber, foodstuff processing□ fine chemical□ and biology and pharmacy have become the pillar industries. Daewoo Heavy Industry & Machinery Co., Ltd (DHI), Lycra Group, electron halftones etc. are fostered and developed as the skeleton enterprises. YETDZ is an extroversion and modern industrial new zone with perfect facilities, elegancy environment, logical industry structure and full of vital force and energy. It is one of the most ascendant areas for general environment of investment in North China.

YETDZ is growing fast in recent years until 2010. It develops towards to the west area and start to build Bajiao group. There are Hualu and west thermal power plants, which provide heat energy in the east of YETDZ. Considering the imminence demand for heat supply from the industry development for Bajiao group and citizens, the gap will become bigger. As the infrastructure for centralized heat supply of YETDZ, the Combined Heat and Power (CHP) Power Plant will affect the development of YETDZ if not built in advance.

In order to meet the development of YETDZ and Yantai harbor area (Bajiao group) and create favorable environment for investment, Shandong Luneng Development Group Co., Ltd and Yantai Hongyuan Electrical industry Co., Ltd plan to build one CHP power plant in the seaside of YETDZ. The FGD facilities will be installed simultaneously with the city co-generation units to reduce the air pollution.

2. Project Description

2.1 Project investment and location

The present phase of Yantai Bajiao Power Plant (YBPP) will install 2X300MW units; the annual consumption of 1.58million tons coal will be supplied by Shenfu Dongsheng Coal. The FGD facilities must be installed according to relative laws and regulations.

The FGD technology selected for the project is wet limestone-gypsum technology. The project is one seaside power plant and the site is within the Bajiao Group of YETDZ. The factory site and ash disposal area are in accord with the city planning. The sea area for water taking and drainage accords with the sea function planning and alongshore sea area environmental function-planning. This project utilizes the desalted seawater as the boiler water supply and industry water supply, treated sewage water as desulphurization process water, and seawater as circulating cooling water to save freshwater resource. It's congruous with the water-saving policy. The coal type is Shenfu Dongshen coal. $Q_{net,ar}$ 22100 kJ/kg S_{ar} 0.54% V_{daf} 33.42%.

The total investment of this FGD project is 124.4527 million RMB, including 10 million US Dollar World Bank loan (equivalent to 80 million RMB), the project launching fund is contributed by Shandong Luneng Development Co., Ltd and Shandong Yantai Hongyuan Industry Electrical industry Co., Ltd.

2.2 Social and natural conditions

Yantai is low hill area. The massif waves mildly and ravines intervein freely. The mountainous region is 36.32% of the total area, hill is 39.7%, plain is 20.78% and billabong is 2.90%. The low hill area is in the middle of the city and consists of Daze hill, Ai hill, Luo hill, Ya hill, Ci hill, Yuhuang hill, Kunyu hill, Zhaohu hill etc. The body is made most of granite with the altitude over 500m. The peak is Kunyu hill with the altitude of 922.8m. The hill area distributes the low hill area and the extents parts with altitude of 100 to 300m. It waves mildly and stretches meanderingly. The hillside is flat and the channel. The valley is shallow and wide with flood clashed substances fostered and thick soil layer. The plain area can be divided into peneplain, river-valley between hills, alluvial plain, basin alluvial plain among hills, alluvial plain in front of hills and seashore alluvial plain with altitude of 0 to 80m.

The plant is located in YETDZ which is one of the first batch of the national-level economic and technological development zones set up with the approval of the State Council in October, 1984. YETDZ is near to Yantai city in the east, Penglai city in the west, Fushan

zone in the south and Bohai basin in the north with latitude $37^{\circ}32'$ north and longitude $121^{\circ}14'$ east. The layout area of YETDZ is 228 sq.km.

The climate of Plant is a monsoonal and continental warm-temperate zone, cold in winter and lack of rain and snow, warm fast in spring with much wind and less rain, rainy and hot in summer with concentrated precipitation, and abundant sunlight in autumn with more fine and good weather. The average temperature is 12.4°C during a year, the max value is in July and the minimum is in Jan. The southwester is the dominant wind tendency and always changes seasonably.

The polluted and wastewater emission in new developed area of YETDZ will be $8.89 \times 10^4 \text{m}^3/\text{d}$ in the near future of 2010, and $26 \times 10^4 \text{m}^3/\text{d}$ in the far future of 2020. As for the specially dry years, the polluted and waste water emission will be $8.44 \times 10^4 \text{m}^3/\text{d}$ in 2010 and $25.05 \times 10^4 \text{m}^3/\text{d}$ in 2020 with the 97% guarantee rate. Considering 65% of the total amount of water treated will be circulated, the planned water circulated for production will be $5.78 \times 10^4 \text{m}^3/\text{d}$ in 2010 and $16.9 \times 10^4 \text{m}^3/\text{d}$ in 2020. As for the specially dry years, the water circulated for production will be $5.49 \times 10^4 \text{m}^3/\text{d}$ in 2010 and $16.3 \times 10^4 \text{m}^3/\text{d}$ in 2020 with the 97% guarantee rate. According to “The pipeline engineer of infrastructure in new developed area of YETDZ (Preliminary Design)”, the use of water circulated is little, mainly used for civicism and virescence. There circulated water used will be $16.3 \times 10^4 \text{m}^3/\text{d}$ in 2020 of the far future, and $3.55 \times 10^4 \text{m}^3/\text{d}$ will be remained. The desulphurization of flue of YBPP project will use water from Sewerage Treatment Plant of YETDZ which is planned for construction with the amount of about $97 \text{m}^3/\text{h}$ ($2328 \text{m}^3/\text{d}$), only 4.1% of the water circulated for production in YETDZ in 2010 and 1.4% of that in 2020. The request for using the circulated water has been approved by EPB of YETDZ and is the first consumer of the circulated water. The amount from Sewerage Treatment Plant of YETDZ can meet the demand of YBPP project. The design water quality of Sewerage Treatment Plant of YETDZ is up to par—B criterion of first level (ammonia and nitrogen will implement the A criterion of first level) according to <<Wastes Emission Standards for Sewerage Treatment Plant in town>> (GB18918-2002). The treated sewage water quality for desulphurization water in the power plant need to meet the Second level of Standards and is lower than the design water quality from the Sewerage Treatment Plant of YETDZ, so it is satisfied for YBPP.

2.3 Desulphurization Project analysis

Compared with all the FGD technologies and considering the actual situation, wet limestone-gypsum technology is finally chosen for this project. This technology is the most mature and widely-used desulphurization technology by now; the removal efficiency can reach above 90%. It takes the cheap limestone or lime as sorbent and consists of sorbent manufacturing system, flue gas system, absorbing tower and gypsum dewatering system etc., the final product is gypsum. This technology also has advantages on high removal efficiency, simple operation, cheap sorbent and so on.

Water consumption of this desulphurization system is 97m³/h. It comes from treated sewage water from city sewage disposal works. The by-product of this technology is CaSO₄·2H₂O, which can be used for construction materials and cement retarder. YBPP Preparation Branch has signed gypsum supply agreements with clients to reuse this by-product as avoiding secondary pollution.

2.4 Environmental protection objects

The environmental protection objects around the project location are determined and evaluated according to the weather, hydrology, geology, landform condition, “three-waste residues” disposal and distributing characteristic of factories and residents around the plant, listed as follows:

- (1) There's no natural protection area and historical relics near YBPP.
- (2) Noise: residential area around the power plant□mainly **are denizen of Bajiao Village** in the south of the plant boundary about 190 meters away.□

3. Environmental Assessment Status

3.1 An EIA was prepared and approved by SEPA in April 2006. The EIA included the FGD unit. A public consultation for the EIA was conducted in September 2005.

4. Environmental Management (Mitigation) Plan

Phase	Item	Issue	Mitigating measures	Cost of mitigation	Responsibility	Start Date	End Date
Construction	Air	The impacts on air are from dust emission caused by earth digging, piling up and carrying	Arrange special place for piling up earth, and take preventive measures, such as spraying water, setting shields to minimize the adverse impact.	Minor	Contractor	April, 2008	April, 2009
	Water	Domestic water is a big waste source, the COD _{Cr} and BOD ₅ is 200mg/L and 100mg/L.	The domestic water will be led to the treatment plant instead of discharging directly. The treated water can be used for spraying to avoid dust emission. Thus, the wastewater impact is small.	Minor	Contractor	April, 2008	April, 2009
	Solid Waste	Construction waste and living junk are major solid wastes during construction period. They may affect the environment as flying dusts if not transported in time.	The solid waste can be cleaned up, stored on-site temporarily and collected by the municipal solid waste authorities	Minor	Contractor	April, 2008	April, 2009
	Noise	The noises from grab, bulldozer, road-roller, blender and crane etc. the noise level is 75~94 dB (A).	The straight-line distance is 190 m from the nearest village to the sites. The working time will be limited from 7:00 AM to 9:00 PM. If work must be done in the night local people will be given at least one-week notice.	Minor	Contractor	April, 2008	April, 2009
Operation	Air	Limestone dust at the storage silo	Storage area will be sealed	Minor	YBPP Operational Branch	October, 2008	Ongoing

Phase	Item	Issue	Mitigating measures	Cost of mitigation	Responsibility	Start Date	End Date
	Water	<p>1. Wastewater from gypsum dewatering process, 12t/h. The pollutant: pH (pH=5~6), salt (fluoride, sulphite and sulphate etc.)</p> <p>2. Wastewater of washing FGD equipment when stopped.</p>	<p>1. The total 20t/h wastewater from 7# & 8# units will be treated together and reused for spraying after treatment.</p> <p>2. The wastewater after washing will be collected in drainage and delivered to FGD absorption tower by pumps.</p>	Minor	YBPP Operational Branch	October, 2008	Ongoing
	Solid waste	The SO ₂ and CaCO ₃ in flue gas will combined to CaSO ₄ ·2H ₂ O through chemical changes. The purity of the gypsum (CaSO ₄ ·2H ₂ O) >90%, fineness: 30~60um; Water content <10%. The amount is 4.5×10 ⁴ T/a (depends on the coal in the design)	The desulphurization gypsum will be sold to Shandong Yantai Dongyuan Cement Co., Ltd, Yufeng Lightweight Construction Material Co., Ltd in Fushan district of Yantai and Dehe Construction Material Co., Ltd in Muping district of Yantai. The total amount is 60,000 t, 5000 t and 5000 t according to the contracts. In order to avoid secondary pollution, close packaging is necessary.	Minor	YBPP Operational Branch	October, 2008	Ongoing
	Noise	Noise from the operation of blender, circulating pump and blower etc. level: □85 dB (A). The noise level of ball mill is 90~105 dB (A)	<p>Choosing the equipments with low noise (<85 dB[A]) and carrying out preventive measures:</p> <p>1. Design flue pipe to be as straight as possible to reduce noise;</p> <p>2. Planting shrubbery and arbor around the plant for sound absorption.</p> <p>The measures above could eliminate the noise level by 15~20dB (A).</p>	Minor	YBPP Operational Branch	October, 2008	Ongoing

5. Environmental Monitoring Plan

5.1 Environmental Monitoring Plan (Construction Phase)

Phase	Parameter	Site	Method and equipment type	Frequency	Monitoring cost/ Equipment cost	Responsibility	Start Date	End Date
Construction	Dust	Construction site	Visual	Weekly	Minor	YBPP	April, 2008	April, 2009
	Wastewater	Effluent goes to treatment plant, no measurements necessary						
	Waste solid	Temporary on-site disposal area	Observation	Monthly	Minor	YBPP	April, 2008	April, 2009
	Noise (equivalent continuous class-A)	Sensitive site within 150m of construction and buildings within 50m of piling place	Noise meter	Quarterly, or if there is a complaint	Minor	YBPP	April, 2008	April, 2009

5.2 Environmental Monitoring Plan (Operation Phase)

Phase	Parameter	Site	Method and equipment type	Frequency	Monitoring cost/ Equipment cost	Responsibility	Start Date	End Date
Operation	Air (dust)	Limestone storage area	Visual	Weekly	Minor	YBPP	Oct.2008	Operation
	Wastewater (pH, SS, Cl ⁻ , SO ₄ , fluoride)	Wastewater discharging outlet	PH meter, gravimetric and wet analysis	Quarterly	Minor	YBPP	Oct.2008	Operation
	Waste solid	No measurements necessary, gypsum will be sold						
	Noise (equivalent continuous class-A)	1m away from the boundary	Noise meter	Quarterly, or if there is a complaint	Minor	YBPP	Oct.2008	Operation

6. Institutional Arrangements

Data Collection for both construction and operation will be performed by Yantai Bajiao Power Plant.

Data Analysis for both construction and operation will be performed by Yantai Bajiao Power Plant special staff assigned for environment

Reporting and Recommendations for both construction and operation will be performed by Yantai Bajiao Power Plant special staff assigned for environment

Action/Decision Making for both construction and operation will be performed by Yantai Bajiao Power Plant General Manager

7. Public Participation

7.1 Purpose, Form and Contents

The investigation on the environment issues of YBPP was made in order to obtain the opinion and suggestion to this project from the public. Questionnaires were provided for the public to fill as show below. The major contents are four parts.

(1) Basic information of the informants

Including the age, education, occupation and duty.

(2) The environments near the sites

Including the major environment elements such as quality of air, sea water, surface water, underground water and noise that affect residents' living.

(3) Basic information about the planned project

Including the brief introduction of the project, effects on the residents around and the public attitudes towards the necessity of the project.

(4). Requirements and Advices on the environment issues of the planned project.

7.2 Basic information of the informants

For the public participation, 100 questionnaires were circularized and 95 were called back from the participants in September, 2005. To be more representative, the questionnaires were dispensed in the villages, towns near the sites, and organs around the YETDZ. The informants include workers, peasant, related cadres, deputies to the People's Congress, and commissioners to the National Committee of the CPPCC and teachers which represents citizens with different ages, education, professions.

The following table shows the detailed information of attended residents.

	Item	Number	Percentage□%□
Age	Under 18	0	0.0
	19□35	15	15.8
	36□60	70	73.7
	Above 60	10	10.5
Education	Junior high school and below	38	40.0
	Senior high school	42	44.2
	Junior college and above	15	15.8
Occupation	Peasant	13	13.6
	Worker	60	63.2
	Teacher	6	6.4
	Leader cadre	3	3.2
	General cadre	13	13.6
Remark	Deputy to the People's Congress□ commissioner to the National Committee of the CPPCC	5	5.3

7.3 Viewpoint collection of the Public Surveyed

The following table shows the details:

Viewpoint collection

Questions	Option	Number	Percentage (%)
1□How do you think about the ambient air quality near the projects site and YETDZ?	A. Good	63	66.3
	B. Slight pollution	23	24.2
	C. Medium pollution	2	2.1
	D. Severe pollution	7	7.4
2□How do you think about the water pollution of the rivers nearby the sites?	A. Good	56	58.9
	B. Slight	33	34.7
	C. Medium	2	2.1
	D. Heavy	5	5.3
3. How do you think about the groundwater pollution of the rivers nearby the sites?	A. Good	64	67.4
	B. Slight	16	16.8
	C. Medium	11	11.6
	D. Heavy	4	4.2
4□How do you think about the effect on the local environment of this project?	A. No effect	54	56.8
	B. Slight	28	29.5
	C. Medium	8	8.4
	D. Heavy	5	5.3
5□What kind of impact on environment do you care more caused by this project?	A. Sea water pollution	40	42.1
	B. Air pollution	47	49.5
	C. Noise pollution	6	6.3
	D. Others pollution	2	2.1
6□Do you think the environment protection measures can prevent pollution effectively?	A. Yes	58	61.0
	B. No	9	9.5
	C. Not always	28	29.5
7□Do you think this project will improve the atmosphere environment of YETDZ?	A. Yes	69	72.6
	B. No	6	6.3
	C. Not always	20	21.1
8□Depends on all the environment effects	A. Necessary	82	86.3

would be appeared, do you think it is necessary to start this project <input type="checkbox"/>	B. Unnecessary	3	3.2
	C. Disinterest	10	10.5

7.4 Analysis on the viewpoint of the Public

The survey analysis shows that the view on each issue is consistent. The public is active to participate and all of them have some knowledge on environmental impacts of this project. They also give some comments and advices to the project.

(1) 66.3% of all the attended persons think the air pollution in YETDZ is good and 24.2% think is slight pollution. That means the air quality is good in YETDZ.

(2) 58.9% think the water quality of the rivers nearby the sites is good and 34.7% think is slight pollution. That means the air quality is good near the sites.

(3) 67.4% think the groundwater quality nearby the sites is good and 16.8% think is slight pollution. That means the groundwater quality is good near the sites.

(4) 56.8% think there is no effect on the local environment, 29.5% think the effect is slight. 8.4% think is medium and 5.3% think is heavy.

That means the public think there is some impact on local environment..

(5) 42.1% cares more about seawater pollution, 49.5% cares more about air pollution and 6.3% cares more about noise pollution.

(6) 61% think the environment protection measures can prevent pollution effectively while 29.5% doesn't think so.

(7) 72.6% think this project will improve atmosphere environment of YETDZ while 21.1% doesn't think so.

(8) 86.3% support the project implementation and think it is necessary to start this project. 10.5% is disinterest. They care more about the compensation for the land occupied by the project. If they can get the compensation they will support the project. It is verified that the project entity has paid the occupation fees to YETDZ committee according to the national policies and of Shandong province. They can get the compensation from the project sites and ash disposal area in time.

Only 3.2% thinks it is unnecessary. They worry about the environment protection measures can't be implemented effectively and the construction of the plant may have impact on the environment. They were affected by the unsuccessful dust removal and desulphurization of

other plants. They think there must be black smoke from the chimney of the plant. In fact the planned project can achieve the environment standard and have little impact on the environment.

In general, 96.8% support the project after the compensation is put into effect.

The participants also raise some requirements and advices, for example, using labor force of villages around preferentially during the constructing and operation period; fulfilling the compensation in time, implementing the “three-simultaneity” policy when starting construction, enhancing the environment management, carrying out the protection measures, minimizing the negative effect of the environment, and give some favorable measures to the citizens nearby when it starts supplying heat.

We can see from above that the public supports the planned project. The construction entity should adopt the requirements and advices of the public and plan the construction and pollution treatment as a whole to harmonize the economy and environment development.

