

China GEF Thermal Power Efficiency Project

**Wuxiang Hexin Thermal Power
Plant**

**Energy-saving Retrofit Project
Environmental Management Plan**

Wuxiang Hexin Power Generation Co., Ltd.

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1. Introduction

1.1. The Purpose of EMP

The purpose of environmental management plan (EMP) is to formulate a series of technically and financially feasible and operational environmental countermeasures against the inevitable environmental impact during the project implementation progress, which can be adopted during the construction and operation period of project to minimize its negative social and environmental impact and solve the remaining environmental issues.

The function of EMP is to list the environmental countermeasures and monitoring measures adopted during the construction and operation period of project and to put forward the detailed action plan to avoid the negative impact of the project. The EMP is a bridge between environmental countermeasures and environmental measures ascertained in environmental impact evaluation report. Through the implementation of action plan in the EMP, the target of environmental countermeasures shall be achieved.

1.2. Project Background

Wuxiang Hexin Thermal Power Generation Co., Ltd. is located on the first terrace on the north bank of Niehe River in the southwest and around 2Km away from the town of Wuxiang County, Changzhi City, Shanxi Province. Wuxiang County is in the southeast of Shanxi Province and the northernmost part of Changzhi City. It is 130Km away from Taiyuan in the north and 110Km away from Changzhi City in the south. Moreover, it borders Licheng County and Zuoquan County in the east, Qi County in the west, Yushe County in the north, Qin County and Xiangyuan County in the south.

As an old revolutionary base area and national poverty-stricken county, Wuxiang has made great contributions to Chinese revolution. Wuxiang has more than 210,000 populations, covering an area of 1,610 square kilometers. There are mainly mountainous terrains, with barren lands; however, Wuxiang has enriched mineral resources, as one of key coal production counties in Shanxi, and its geological reserves of raw coal are 2.86 billion tons. There is Wumo Railway connecting with Taijiao Railway and Yangshe Railway, as well as No. 208 State Highway, Nanqin Highway and Yuchang Highway in Wuxiang County; meanwhile, Taichang

Expressway passes through Wuxiang County; therefore, Wuxiang enjoys convenient traffic conditions. There is Guanhe Reservoir in Wuxiang, with abundant water resources. Based on above mentioned superior conditions, there are enough basic conditions to build large-sized thermal power plant. In order to promote local economic development and take full advantages of coal and water resources, Wuxiang Hexin Thermal Power Plant has decided to build a coal-fired power plant, with total installed capacity of 2400MW. The current construction scale is 1200MW, including 2 sets of 600MW sub-critical direct air-cooling coal-fired generating units, with the total investment of RMB 5.31 billion RMB. The boilers, turbines and generating units are manufactured by Wuhan Boiler Co., Ltd., Harbin Turbine Co., Ltd. and Harbin Motor Co., Ltd. respectively. #1 and #2 generating units are put into commercialized operation on Oct. 7, 2006 and Jan. 7, 2007 respectively.

During recent years, due to slowed construction of power supply, plus fast increasing of electricity load, Shanxi's power grid cannot meet its demand, especially in southeastern and southern parts of Shanxi. The proposed project is located in middle eastern part of Shanxi, which is of great importance to mitigate electricity shortage in southeastern Shanxi, improve power grid structure of Shanxi, enhance power supply capacity and promote economic development of Shanxi.

China attaches great importance to energy-saving and emission reduction. NDRC issued *The Notification on Printing and Issuing Middle and Long-term Special Energy-saving Planning* in 2004, requiring that the energy-saving retrofit shall focus on thermal power plants, and coal consumption shall lower to 360gce/kwh in 2010 and 320gce/kwh in 2020. On May 23, 2007, the State Council published *The Notification on Issuing Comprehensive Work Plan of Energy Saving and Emission Reduction*, which has clearly indicated the grim situation of energy-saving and emission reduction and has put forward various work schemes, namely, 240 million tons of coal equivalent shall be saved during 11th FYP and 50 million tons of coal equivalent shall be saved in 2011.

Wuxiang Thermal Power Plant (WTPP) also pays enough attention to energy saving and emission reduction and has adopted new technologies and processes to lower energy consumption, e.g. in order to minimize auxiliary power utilization rate, WTPP has implemented energy-saving retrofit in circulating pumps, condensate pumps and fuel pumps; in order to reduce coal consumption, the rehabilitation project has been carried out in coal-powder separator.

1.2.1. Necessities of Retrofit

WTPP adopts 600MW direct air-cooling coal-fired generating units, which has been put into use for a long time in China. The air-cooling equipment and material were imported from foreign countries and manufactured by wholly-owned enterprise, at high prices. In order to control the construction investment, lower engineering cost and improve economic benefit of generating units, WTPP has held many times of air-cooling system argumentation; the experts in air-cooling sector have been invited to attend the meetings to select and optimize the air-cooling schemes.

Based on the then coal price (150-200RMB/t) and electricity cost (0.22RMB/KWh), the back pressure of generating units were designed; the heat dissipating area of air-cooling system was selected as 1.3796 million square meters (single unit). During recent years, due to rising coal price (nearly 680RMB/t and 800RMB/t tax included) and climate change, the generating units are operating at high backpressure and coal consumption, especially in summer time. According to principle of energy saving and consumption reduction, the current air-cooling system shall be retrofitted in order to decrease its operating backpressure during summer time and lower coal consumption and operating cost of generators.

1.2.2. Main Design Principle and Ascertainment of Scheme

In order to lower maximum-output backpressure during summer time, the heat dissipating capacity at cold end shall be enhanced. Based on existing project cases, the following measures can be adopted, namely, (i) increasing the heat dissipating area of current direct air-cooling system (hereinafter referred to as “Direct Air-cooling”), (ii) bypassing partial steam by adopting surface condensing indirect air-cooling (hereinafter referred to as “Indirect Air-cooling”), and (iii) bypassing partial steam by adopting wet peak cooling system.

In case of direct air-cooling, one row of heat dissipater can be added on either side of air cooling system or one unit of heat dissipater can be added on each row. Adding one unit at each row will conflict with 500KV distributor, which is not feasible; adding one row of heat dissipater on either side is feasible for #1 generating unit, but not for #2 unit, because #2 generating unit will be expanded; therefore, the direct air-cooling is not recommended.

In case of indirect air-cooling, related facilities and equipment such as condenser, circulating pump and indirect cooling tower shall be constructed and installed. The

indirect cooling tower has a diameter of 86m and height of 135m; the area of heat dissipater is about 316,242 square meters. Due to its complexity, large area and high investment, the indirect air-cooling system is not recommended.

In case of wet peak cooling system, the facilities and equipment such as condenser, circulating pump station and mechanical-draft cooling tower shall be constructed and installed. The northern site of Phase-I auxiliary machine cooling tower (formerly designed for Phase-II auxiliary machine cooling tower) can be utilized to construct mechanical-draft cooling tower. According to calculation and site layout, the circulating water amount shall be 2×6000 m³/h; the size shall be 38×23.2m; the total water consumption shall be 264m³/h. The increasing water consumption needs to be approved by related government authorities and will affect the water source of Phase-II project, but the peaking cooling system will be mainly used during 12:00 and 18:00 in summer time; in case of water shortage, the peak cooling system can be shutdown to ensure the necessary water supply; therefore, the wet peak cooling system is recommended.

See Table 1.2-1 for retrofit project of WTPP.

Table 1.2-1: Energy-saving Retrofit Project of WTPP

Project Name	Contents	Result	Implementation Period	Investment (10,000RMB)
Installation of Peak Cooling System on #1 & #2 Generating Unit	Each DN1800 Pipe is connected to either of 2 DN6000 exhaust pipes of #1 and #2 generating unit and then both DN1800 pipes are combined into a DN2400 pipe to connect with peak condenser (one set for one unit). There are expansion joints and electric butterfly valves on the pipes. During summer time with high backpressure, the electric butterfly valves are opened to ensure partial steam to be cooled in condenser, so that the pressure of direct air-cooling heat dissipater can be reduced and backpressure can be lowered. During spring, autumn and winter time, the valves are closed so that all of exhausted steam go can be cooled by direct air-cooling heat dissipater. The peak condenser can be cooled by newly installed mechanical-draft cooling tower and circulating water. The condensate of peak cooling system flows to exhaust device. The air extraction system is connected with master machine. The steam is designed to be extracted at a rate of 175t/h, requiring 6000t/h circulating cooling water and 2,100m ² condenser (T304). The peak cooling system is activated when ambient temperature is high than 25°C. Comparing with 32kpa of maximum-output backpressure before retrofit, the maximum-output backpressure after retrofit is 24kpa, 4kpa is reduced.	Reduction of coal consumption for power generation: 5g/kwh Annual tce saved: 13,560tce	March to December 2011	3807

Total	—	Annually 13,560tce can be saved	—	1422
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After implementation of retrofit project, annually increased benefit: RMB 4.0064million RMB, annually tce saved: 13,560t, annually dust, SO₂ and NO_x generation reduction: 5980t, 484t and 1215t; annually dust, SO₂ and NO_x emission reduction: 120t, 49t and 121t. The total investment of retrofit project is RMB 38.07 million RMB. It is proposed to apply for GEF grant to fund this project.

1.3. Preparation Basis

1.3.1 Laws, Regulations and Policies

1.3.1. Law, Regulation and Policy Basis

(1) *Law of Environmental Protection of the People's Republic of China*, December 1989.

(2) *Law of the People's Republic of China on the Prevention and Control of Atmospheric Pollution*, amended in April 2004.

(3) *Rules for Implementation of the Law on the Prevention and Control of Water Pollution*, amended in March 2000.

(4) *Law of the People's Republic of China on Prevention and Control of Pollution from Environmental Noise*, November 1996.

(5) *Law of the People's Republic of China on the Prevention and Control of Environmental Pollution by Solid Wastes*, amended in December 2004.

(6) *Law of the People's Republic of China on Environmental Impact Assessment*, October 2002.

(7) *Cleaner Production Promotion Law of the People's Republic of China*, June 2002.

(8) *Regulations on the Administration of Construction Project Environmental Protection*, Decree No. 253 of the State Council of the People's Republic of China, November 1998.

(9) *Classified Directory for Environmental Protection Management of Construction Projects*, Decree No. 14 of State Environmental Protection Administration, January 2003.

(10) *Guiding Catalogue of Industrial Structure Adjustment (2005)*, Decree No. 40 of National Development and Reform Commission of the People's Republic of China, December 2005.

(11) *Provisional Measure of Public Participation in Environmental Impact Assessment*, HF [2006] No.28 of State Environmental Protection Administration, March 2006.

(12) *Notice on Strengthening the Management of Environmental Impact Assessment in Construction Projects with Loans from International Financial Organizations*, HJ[1993]No.324 of State Environmental Protection Administration, June 21st 1993.

(13) *Notice on Printing and Distributing of Medium and Long-term Special Plan of Energy Conservation*, FGHZ[2004]No.2505 of National Development and Reform Commission, November 25th 2004.

(14) *Decision on Implementing the Scientific Concept of Development and Stepping up Environmental Protection*, GF[2005]No.39 of the State Council, 2005.

(15) *Decision on Strengthening Energy Conservation*, GF[2006]No.28 of the State Council, August 6th 2006.

(16) *Notice on Printing and Distributing the Integrated Work Plan of Energy Conservation and Emission Reduction*, GF[2007]No.15 of the State Council, May 23rd 2007.

1.3.2. Relevant Regulations of World Bank

(1) World Bank OP/BP4.01 and its Appendixes (Environmental Assessment), January 1999.

(2) World Bank OP/(Environmental Assessment), January 1999.

(3) World Bank GP4.01 (Environmental Assessment), January 1999.

(4) World Bank OP/BP4.04 (Natural Habitats), September 1995.

(5) World Bank GP4.07 (Water Resources Management), December 2000.

(6) World Bank GP14.70 Involving Nongovernmental Organizations in Bank-supported Activities.

1.3.3 Engineering Design Materials

(1) *Feasibility Study Report on Peak Cooling Project for Air Cooling System of Wuxiang Hexin Thermal Power Plant*, Shanxi Electric Power Survey and Design

Institute, February 2011

(2) Related technical documents, May to October 2010

1.4. Execution Standard

1.4.1. Environmental Quality Standard

(1) Ambient Air Quality Standard: The project area is a region where rural and general industry are mixed, ambient air quality functional area is classified as Category II region, subject to the secondary standard of *Ambient Air Quality Standard* (GB3095-1996). Standard limits are shown in Table 1.4-1.

Table 1.4-1 Ambient Air Quality Standard Concentration Limits (mg/m³)

Pollutant	TSP	SO ₂	NO ₂	PM ₁₀
Annual average	0.20	0.06	0.08	0.10
Daily average	0.30	0.15	0.12	0.15
1-hour average	—	0.50	0.24	—

(2) Surface water: the surface water system near the project is the Nanchuan River which belongs to Ziya River water system of the Haihe River system. Surface water evaluation is subject to Class IV standard of *Environmental Quality Standards for Surface Water* (GB3838-2002), the standard limits are shown in Table 1.4-2.

Table 1.4-1 Environmental Quality Standards Limits for Surface Water (mg/L)

Pollutant	pH	Ammonia Nitrogen	COD _{Cr}	BOD ₅	Volatile Phenol
Standard Value	6~9	1.5	30	6	0.01
Pollutant	Cyanide	Fluoride	Sulfide	Petroleum	
Standard Value	0.2	1.5	0.5	0.5	

Note: pH is dimensionless

(3) Groundwater: The drinking water for local residents comes from local groundwater. According to groundwater classification requirements of the *Quality Standard for Ground Water* (GB/T14848-93), the groundwater, based human health

reference value, is mainly suitable for centralized domestic drinking water, and for industrial and agricultural water use, belongs to Class III water quality, so the groundwater quality in evaluation area is identified as Class III, and is subject to Class III standard of *Quality Standard for Ground Water* (GB/T14848-93). The standard limits are shown in Table 1.4-3.

Table 1.4-3 Environmental Quality Standards Limits for Ground Water (mg/L)

Item	pH Value	Total Hardness (CaCO ₃)	Sulfate	Fluoride	Total Coliforms (piece/L)
Standard Value	6.5 ~ 8.5	≤450	≤250	≤1.0	≤3.0
Item	Ammonia nitrogen	Nitrate	Nitrite	Cr ⁶⁺	Total bacterial count (Piece/ml)
Standard Value	≤0.2	≤20	≤0.02	≤0.05	≤100

(4) Ambient noise: The sound environment is subject to Class II Standard under *Standard of Environmental Noise of Urban Area* (GB3096-93), the standard values are shown in Table 1.4-4.

Table 1.4-4 Environment Noise Standard

Classification	Standard Value (dB(A))	
	Daytime	Nighttime
Class II	60	50

1.4.2 Pollutant Emission Standard

Noise from construction site is subject to the requirements on limited values during construction stage as stipulated in *Noise Limits for Construction Site* (GB12523-90), the standard values are shown in Table 1.4-5.

Table 1.4-5 Noise limits for Construction Site

Construction stage	Main Source of Noise	Noise Limit (dB (A))	
		Daytime	Nighttime
Structure	Vibrator, electric saw, etc	70	55
Decoration	Crane, lift, etc	65	55

① Air pollutant emission standard

Air pollutant emission is subject to the maximum allowable emission concentration in time interval III of coal-fired boiler as stipulated in *Emission Standard of Air Pollutants for Thermal Power Plants* (GB13223-2003), the standard values are shown in Table 1.4-6.

Table 1.4-6 Emission Standard of Air Pollutants for Thermal Power Plants

Type of Boiler	Pollutant	Maximum allowable emission concentration in time interval III(mg/m ³)
Coal-fired boiler	Smoke dust	50
	SO ₂	400
	NO _x	650

Note: 10% < V_{daf} < 20%

② Sewage discharge standard

Sewage discharge is subject to Class I standard of *Integrated Wastewater Discharge Standard* (GB8978 - 1996) (as shown in Table 4), the standard values are shown in Table 1.4-7.

Table 1.4-7 Integrated Wastewater Discharge Standard

Pollutant	Standard Value	Pollutant	Standard Value	Pollutant	Standard Value
PH	6 ~ 9	Petroleum	5	COD _{Cr}	100
Suspended matter	70	Fluoride	10		

③ Noise emission standard

The noise at plant boundary is subject to Class II Standard as stipulated in *Standard of Noise at Boundary of Industrial Enterprises* (GB12348-90), the standard

limits are shown in Table 1.4-8.

Table 1.4-8 Standard of Noise at Boundary of Industrial Enterprises

Classification	Standard Value (dB(A))	
	Daytime	Nighttime
Class II	60	50

④ Solid waste storage standard

GB18599 - 2001: Solid waste disposal is subject to *Standard for Pollution*

GB18599-2001: *Control on the Storage and Disposal Site for General Industrial Solid Wastes*

2 Environmental Impact and Mitigation Measures

2.1 Major Environmental Impact and Mitigation Measures under Energy-saving

Retrofit Project

Table 2.1-1 shows major environmental impact and mitigation measures under energy-saving retrofit project during the construction and operation period.

2.2 Analysis of Positive Environmental Impact of Energy-saving and Emission Reduction

The energy-saving retrofit project, after being implemented, can achieve the annual benefit of RMB4.0064 million RMB each year, save about 13,560 tons of standard coal, reduce smoke dust, SO₂, and NO_x generation by 5,980, 486 and 1,215 tons respectively, and reduce the pollutant emissions by 120t/a, 49t/a, and 121t/a respectively; the total investment of the project is RMB38.07 million RMB. The World Bank GEF-funded project is proposed to be applied for under this energy-saving retrofit project. Specific energy saving effect is shown in Table 2.2-1.

Table 2.2-1 Summary of Energy-saving and Emission-reducing Effect of this Project

Name of Project	Amount of Saved Coal Equivalent	Economic Benefit (10,000RM B/a)	Reduction of Pollutant Generation (t/a)	Reduction of Pollutant Emission (t/a)
Peak cooler installation project for air-cooling systems of # 1, # 2 units	13560	400.64	Smoke dust: 5980 SO ₂ : 486 NO _x : 1215	Smoke dust: 121.50 SO ₂ : 49 NO _x : 1215

The production water of the power plant is supplied by Guanhe Reservoir, with designed water consumption: 648m³/h, actual water consumption: 358m³/h, annual water consumption: 3.13 million tons. The engineering water is mainly the supplementary circulating cooling water for auxiliary machine, with water circulation rate: 5,761m³/h, water circulation ratio: 93.8%, fresh water consumption: 358m³/h. All of the production water and sewage can be reused after treatment; therefore, there is no wastewater effluent outside.

The exhaust steam of turbine is directly cooled by air. The closed circulating water

supply system is adopted to supply cooling water to auxiliary machine. The dry ash removal and dry ash deposit are adopted to save water resource at the largest extent.

For this retrofit project, the facilities and equipment such as condenser, circulating pump station and mechanical-draft cooling tower shall be constructed and installed. The northern site of Phase-I auxiliary machine cooling tower (formerly designed for Phase-II auxiliary machine cooling tower) can be utilized to construct mechanical-draft cooling tower. According to calculation and site layout, the circulating water amount shall be $2 \times 6000 \text{ m}^3/\text{h}$; the size shall be $38 \times 23.2\text{m}$; the total water consumption shall be $264\text{m}^3/\text{h}$. The increasing water consumption needs to be approved by related government authorities and will affect the water source of Phase-II project, but the peaking cooling system will be mainly used during 12:00 and 18:00 in summer time; in case of water shortage, the peak cooling system can be shutdown to ensure the necessary water supply; therefore, this retrofit project will not impact the water consumption of individual sanitation, agriculture, leisure facilities and communities.

In summary, as shown in the analysis on the environmental impact in the construction period, the environmental impact in operation period, and the positive environmental impact of energy-saving and emission reduction, the project's positive environmental benefit is far greater than the negative environmental benefit, which is beneficial to the improvement of regional environment quality.

Table 2.1-1 Major Environmental Impact and Mitigation Measures under Energy-saving Retrofit Project

Stage	Environmental Factors	Project	Major Environmental Impacts	Mitigation Measures	Implementation Unit	Monitoring Unit
Construction Period	Ambient air	Peak cooler installation project for air-cooling systems of # 1, # 2 units	1. A small amount of dust generated during construction 2. A small amount of welding fume generated from cutting, welding and drilling operation during the construction process.	1. A small amount of dust is generated, should strengthen the construction management. 2. A small amount of welding fume is generated, can enhance the ventilation at construction site. 3. Construction personnel should wear qualified welding clothes, safety goggles, dust-proof masks and special gloves. 4. Construction equipment must be inspected qualified before use. 5. Equipment lifting must be in place under the unified command of professionals, must use qualified lifting equipment. 6. Closed-end management should be conducted at the construction area, irrelevant persons are not allowed to enter the construction area. 7. Construction waste processing is under the unified management.	Construction contractor	Wuxiang Power Plant and Changzhi Municipal Environmental Protection Bureau
	Water environment	Peak cooler installation project for air-cooling systems of # 1, # 2 units	A small amount of construction wastewater generated during construction	Construction waste water, after precipitation is used to mix materials in the construction process		
	Sound environment	Peak cooler installation project for air-cooling systems of # 1, # 2 units	Machinery equipment in construction process produces noise at 60 ~ 70B (A)	Construction amount is very small, low-noise equipment should be used during the construction, should make reasonable construction and reduce generation of construction noise		
	Solid waste	Peak cooler installation project for air-cooling systems of # 1, # 2 units	A small amount of construction waste generated during construction	Very small amount of construction waste and household waste of power plant are processed together.		

Table 2.1-1 (Continued)

Environmental Management Plan-Wuxiang Hexin Power Generation Co., Ltd.

Stage	Environmental Factors	Project	Major Environmental Impacts	Mitigation Measures	Implementation Unit	Monitoring Unit
Operation Period	Ambient air	Boiler fume	Major pollutants SO ₂ , dust, NO ₂ in flue gas emitted from coal-fired boiler	① Boiler adopts double-room five-electric-field electrostatic precipitator, with dust removal efficiency of 99% or more; dust emission concentration <50mg/m ³ . ② Boiler flue gas goes through desulfuration by using the limestone-gypsum wet process, with desulfuration efficiency of 90% or above, SO ₂ emission concentration <400mg/m ³ . ③ Oxynitride emission concentration is 650mg/m ³ . ④ Flue gas on-line monitoring device should be installed so as to facilitate supervision and management of exhaust gas pollution source and to reduce air pollution.	Wuxiang Power Plant	Changzhi Municipal Environmental Protection Bureau
		Coal dust (dust)	Unorganized emission of dust and coal dust during the storage and transportation of coal, ash and slag.	① Transport vehicles with overcanopy. ② Wind-shield and dust-suppression wall should be built around the coal fields, and water-spraying facilities should be provided. Such measures can reduce the dust at coal field by more than 70%. ③ The belt room of coal transmission room of main workshop should be installed with wet dust collector and spraying facilities, the coal bunker at coal bucket bay should use bag-type dust collector for dedusting. ④ Enhance greening in the plant, make the greening rate in the plant to reach more than 80%. ⑤ Conduct maintenance on DMC-160B-XT bag-type dust collector of the limestone unloading bank, to restore the dust-removal properties and ensure that emission standards are met.		
	Water environment	Waste water	Production wastewater mainly includes: circulation cooling water, wastewater from reverse osmosis water treatment system, acid/alkali-containing wastewater generated from preparation of chemical demineralized water, domestic water generated by employees, flue gas desulfurization wastewater, coal handling system, wastewater from coal yard, etc.	① Industrial wastewater mainly includes: recycled acid-alkaline wastewater generated from chemical water treatment system, backwash waste water drained from filter, resin-containing waste water from condensate water fine treatment system, waste water generated from boiler cleaning, water used to clean the ground of main workshop. The wastewater drained from the industrial production system within the plant enters the industrial wastewater treatment system, after the wastewater is treated, it will be retaken by the recovery pump to be used in desulfurization. ② The plant should be equipped with wastewater treatment system mainly used to collect and dispose the wash water from coal-transmission trestle and the water used in dust removal of coal transmission system. After wastewater is collected and transmitted to coal water clarification tank for treatment, and the treated water can be used repeatedly. ③ The desulfurization wastewater, after being treated, can be used for dry ash humidification. ④ Domestic wastewater, after being treated by domestic wastewater treatment system, will enter the recovery tank, and be delivered to the recovery water pump to be used for spraying coal yard. After these measures are taken, waste water is totally utilized in a comprehensive way, and is not drained outside.		

Table 2.1-1 (Continued)

Environmental Management Plan-Wuxiang Hexin Power Generation Co., Ltd.

Operation Period	Sound environment	Noise	Boiler draught fan, blower, coal mill, feed pump, steam turbine, generator and exciter, the noise level is generally between 90 ~ 100dB (A)	Take a variety of measures such as noise elimination, sound insulation, vibration attenuation, etc., ensure the sound environment at Wuxiang Power Plant to comply with Class II and Class IV standard requirement in <i>Standard for Noise at Boundary of Industrial Enterprises</i> (GB12348-90).	Wuxiang Power Plant	Changzhi Municipal Environmental Protection Bureau
	Solid waste	Ash and clinker	Major solid wastes include pulverized fuel ash, slag and desulfurization gypsum	① Wuxiang Power Plant ash and slag removal system adopts dry ash removal system, and ash-slag separation way. ② Furnace clinker is directly transported by vehicle to the ash yard or is sold for comprehensive utilization. ③ The dry ash generated by dry ash handling system, after being separated, is sold for comprehensive utilization, or transported to the ash yard for storage. ④ Desulfurization gypsum is delivered to the ash yard or sold to act as cement additives for comprehensive utilization.		

3 Environmental Management Plan

Since Wuxiang Power Plant putting into operation in 2007, it has established a relatively complete environmental management system, and developed the *Environmental Management Standard*, enjoying a high level of environmental management. In order to facilitate environmental management of the whole plant, the environmental management under this energy-saving retrofit project is incorporated into the existing environmental management system.

3.1 Environmental Management Institution Establishment

(1) Wuxiang Power Plant has set up a leading group of environmental management, with sound environmental management institution.

In order to implement environmental management standards, standardize management means, clarify management responsibilities, requirements and procedures, make effective control of environmental pollution, ensure a variety of pollutants generated from the production process to be in line with national standards, Wuxiang Power Plant has set up a Environmental Protection Leading Group, the head of the group is the company's deputy general manager, deputy head of the group is assumed by the manager of HSE Department, and the group members are the persons-in-charge from the relevant departments. Environmental Protection Leading Group Office is set at the HSE Department. HSE Department assigns full-time environmental protection engineer to the group office, responsible for daily environmental management.

According to requirements of *Thermal Power Industry Environmental Monitoring Regulations* and *Thermal Power Plant Environmental Monitoring Technical Specifications*, Wuxiang Power Plant set up environmental monitoring station which is affiliated to the Power Generation Department, responsible for environmental monitoring within the plant.

(2) Environmental monitoring work is responsible for by perfect monitoring bodies, i.e. the Changzhi Municipal Environmental Protection Bureau, Changzhi Municipal Environmental Monitoring Station, and Wuxiang Power Plant.

Flue gas line monitoring devices are installed on boilers in Wuxiang Power Plant, and the monitoring is conducted in strict accordance with *Specifications for Continuous Emissions Monitoring of Flue Gas Emitted from Thermal Power Plants*

(HJ/T75-2001).

Wuxiang Power Plant developed *Rules for Implementation of Environmental Protection Technical Supervision* which provides detailed environmental monitoring plans.

Environmental management bodies during project construction period and operation period include: Shanxi Environmental Protection Bureau, Changzhi Municipal Environmental Protection Bureau, Environmental Project Office of the World Bank, Power Division of Shanxi Provincial Economic and Trade Commission.

There is no waste gas and wastewater produced during the project construction period, nor toxic gas or liquids produced, the construction noise is controlled at the minimum level, therefore, the environmental management bodies remain same during the construction period and operation period.

3.1.1 Environmental Management Institutions during Construction and Operation Period

Environmental Management Institutions during the construction and operation period include: Shanxi Environmental Protection Bureau, Changzhi Municipal Environmental Protection Bureau, the Environmental Project Office of the World Bank, Power Division of Shanxi Provincial Economic and Trade Commission, and so on. During the construction phase, Changzhi Municipal Environmental Protection Bureau follows the work instruction of Shanxi Environmental Protection Bureau, implements the regulations and standards concerning environmental management, monitors the construction units in terms of implementing environmental management plans, coordinates various departments to do a good job in environmental protection; Changzhi Municipal Environmental Protection Bureau is also responsible for the construction, final acceptance, operation inspection, supervision and management of environmental protection facilities under the project. The environmental management during the design and construction phase is jointly responsible by monitoring units, design units, the EIA units and construction units.

The daily environmental management work during the operation period is mainly responsible by Changzhi Municipal Environmental Protection Bureau. The responsibilities that the Bureau undertakes include: implement regulations and standards with regard to environmental protection, develop environmental protection regulations, and oversee the implementation of these regulations, understand the engineering environment, develop the environmental quality control objectives which

are easily assessed, propose control measures, and report the relevant issues to higher-level environmental protection departments, and the World Bank and other departments. Wuxiang Power Plant is responsible for carrying out specific work.

Meanwhile, in order to ensure the effectiveness and fairness of environmental management work, Wuxiang Power Plant should set up specific environmental management institution during the construction period, the institutional setting is shown in Table 3.1-1

Table 3.1-1 Environmental Management Institution Setting during Construction Period

Staffing	Number of Personnel
Team leader	1
Ambient air supervisor	1
Noise supervisor	1
Wastewater supervisor	1
Solid waste supervisor	1
Complaint hotline personnel	1
Total	6

3.1.2 Environmental Management Institutions during Construction and Operation Period

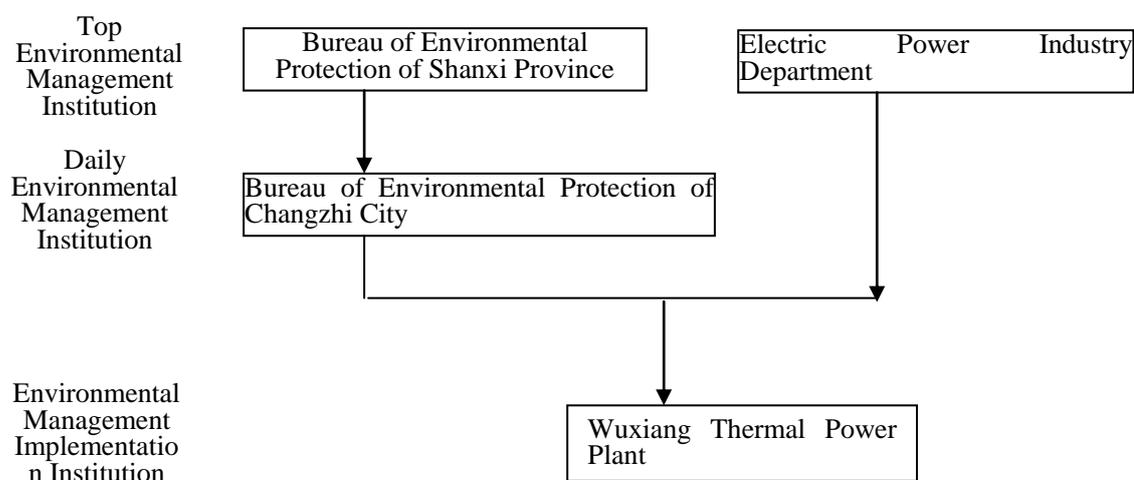


Figure 3.1-1 Schematic Diagram of Environmental Management Structure

According to power plant's environmental protection requirements, the company has established the Environmental Protection Leading Group, the head of the group is the company's deputy general manager, deputy head of the group is assumed by the manager of HSE Department, and the group member are the persons-in-charge from the relevant departments. Environmental Protection Leading Group Office is set at the HSE Department, responsible for the daily management of the plant. HSE Department assigns one technical supervisor to the office, and the other relevant departments assign part-time environmental protection personnel to the office.

According to requirements of *Thermal Power Industry Environmental Monitoring Regulations* and *Thermal Power Plant Environmental Monitoring Technical Specifications*, Wuxiang Power Plant set up environmental monitoring station which is affiliated to the Power Generation Department, and receives the technical guidance of the higher-level environmental monitoring stations. The monitoring station is equipped with technical personnel specializing in environmental protection, analytical chemistry and other professions, a total of six members including one station leader and two supervisors.

Environmental Protection Network

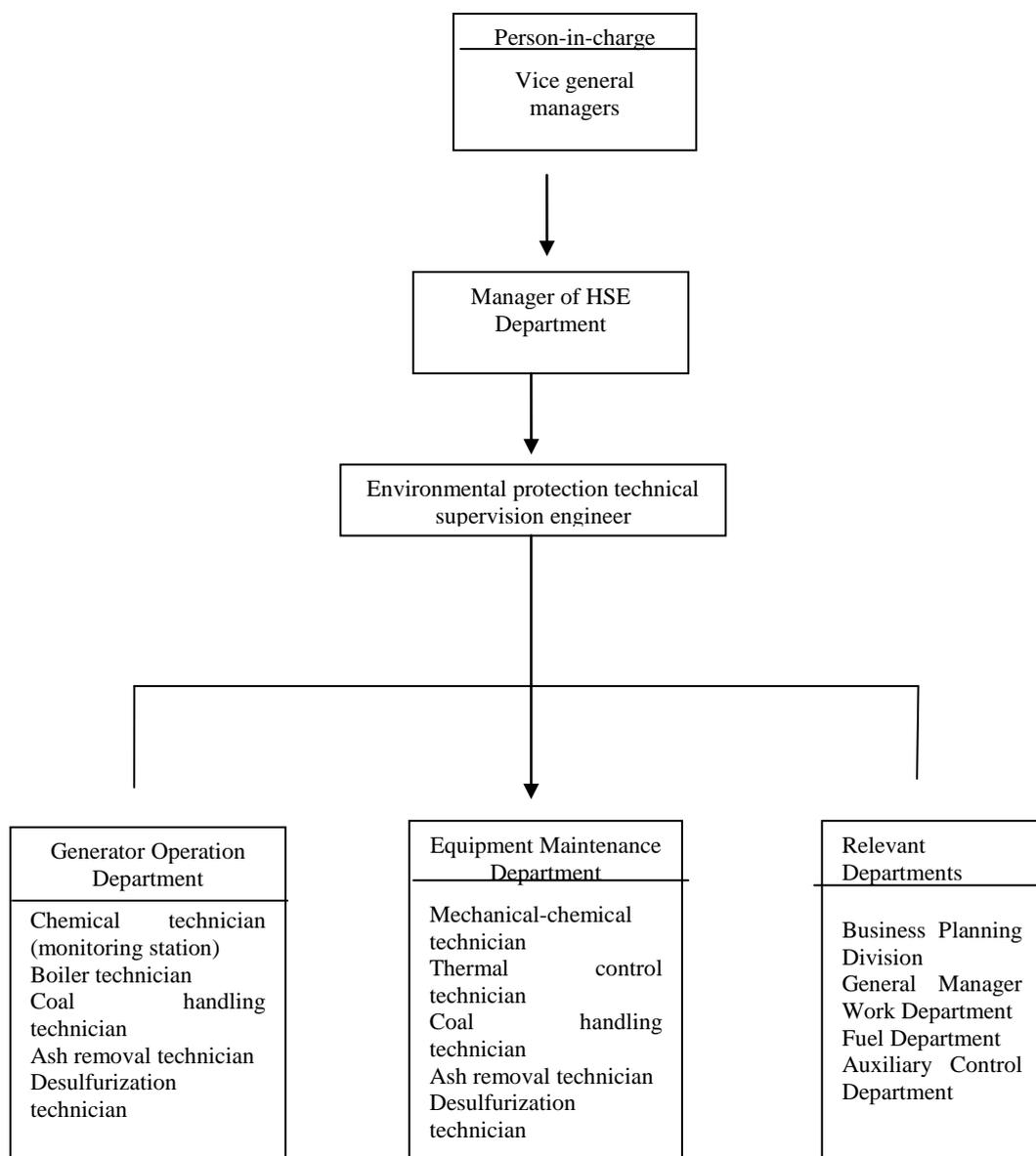


Figure 3.1-2 Schematic Diagram of Environmental Management Body of Wuxiang Power Plant

3.2 Environmental Management Duties and Authority

3.2.1 Construction Period

Environmental management group should develop a detailed management plan based on project construction plan, conduct regular inspection on this plan, and make necessary revision.

Group leader should submit reports to the project leaders to inform the inspection results of environmental management, and propose targeted solutions for potential environmental problems detected during the inspection.

Air, wastewater, noise and solid wastes supervisors should make tour inspection on the implementation of environmental precautions during the construction periods, arrange monitoring at fixed time and fixed points, and submit the inspection, monitoring results and on-site treatment opinions to the group leaders.

Hotline personnel are responsible for recording and sorting out the complaint telephones, reporting to the head, and informing the disposal results to the public.

3.2.2 Operating Period

The environmental management work in the operation period under the proposed project, should be responsible for by the Environmental Protection Leadership Team of Wuxiang Power Plant, the responsibilities and tasks of the members are as follows:

(1) Vice general manager: Vice general manager is the person in charge at the highest level, fully responsible for the whole plant's environmental protection work. He undertakes the environmental protection task assigned by higher authorities and local governments, and includes the environmental protection task into the targets during his term and economic contracts, and makes implementation.

(2)HSE Department manager: coordinate the relationship between the environmental protection dept, production construction dept, operation management dept and other relevant departments, review the annual plan and long-term planning concerning environmental protection, decide technical solutions and implementation measures for environmental control, and deal with major environmental pollution accidents or disputes.

(3) HSE Department: Responsible for the whole plant's daily environmental protection monitoring and management. Specific work include: supervise the operation of environmental protection facilities and do monitoring work, to grasp the whole plant's "three wastes" discharge, propose work plan for environmental protection, and make good summary on environmental protection; collect environmental protection data, conduct statistics and archiving, submit the environmental protection report regularly to higher authorities, do good job in payment of sewage drainage charges; participate in environmental protection design

review, environmental pre-acceptance, and final acceptance; organize the investigation and analysis of environmental pollution accident in factory and conduct environmental quality evaluation, organize and promote best practices and technology for environmental protection.

(4) Environmental monitoring station: affiliated to power generation department, responsible for environmental monitoring tasks within plant, implement *Thermal Power Plant Environmental Monitoring Technical Specifications*, and ensure monitoring quality. When the measurement results are abnormal, should promptly find out the cause and timely report the anomalies to the higher level; sort out and analyze monitoring data, and establish the environmental monitoring files; strengthen maintenance and calibration of environmental monitoring instruments and equipment, ensure normal monitoring; participate in the investigation of environmental contamination accidents occurred in the plant.

(5) Power Generation Department: do a good job in boiler burning investigation; responsible for operation of the oily waste water treatment facilities to ensure these facilities to meet emission standards; responsible for checking the operation of equipment vibration attenuation and noise reduction devices, identify problems and timely contact with the repair workshops; responsible for the normal operation of desulfurization systems; make a reasonable balance of water consumption and ensure 100% recycling and utilization of waste water.

(6) Electrical profession: responsible for the maintenance of oil-filled equipment in electrical workshop, with particular attention paid to the pollution caused by oil spill from transformer and other oil-filled equipment; strictly control excessive emissions in the maintenance period due to improper disposal of waste oil, waste liquid and waste solid.

(7) Thermal control profession: strictly control excessive emissions in the maintenance period due to improper disposal of waste oil, waste liquid and waste solid; responsible for desulfurization system DCS maintenance.

(8) Boiler profession: strict control excessive emissions in the maintenance period due to improper disposal of waste oil, waste liquid and waste solid; reduce the equipment noise to the allowable range; responsible for maintenance and repair of the oil system under the jurisdiction of boiler room, so as to prevent pollution caused by the oil spill from auxiliary machine, oil cooler and other equipment; responsible for repair and maintenance of the oily waste water treatment equipment; responsible for

the control of pulverizing system and flue gas system, reduce environmental pollution caused by coal leakage, powder leakage, air leak, ash leakage, smoke leakage.

(9) Boiler profession: strictly control excessive emissions in the maintenance period due to improper disposal of waste oil, waste liquid and waste solid; reduce the equipment noise to the allowable range;

(10) Auxiliary Control Department: in charge of the maintenance and repair of oil system under the jurisdiction of the company, prevent pollution caused by oil spill from auxiliary machine, oil cooler and other oil-filled equipment; responsible for the control of pulverizing system and flue gas system, reduce environmental pollution caused by coal leakage, powder leakage, air leak, ash leakage, smoke leakage; responsible for the repair and maintenance of the ash and slag removal systems to ensure them to be in good conditions; responsible for the repair and maintenance of mechanical, electrical part of desulfurization system, ensure the normal operation of desulfurization system; responsible for the ash removal and slag removal systems, establish the management system concerning the input rate of the electrostatic precipitator at electric field, efficiency of dust collection, and the related operation, strictly control the leakage of bag-type dust collector, ensure the concentration of dust emission to meet standards, prevent the environmental pollution caused by ash and slag.

(11) Coal handling profession: strictly control excessive emissions in the maintenance period due to improper disposal of waste oil, waste liquid and waste solid; responsible for maintenance and repair of environmental protection facilities. Especially, should ensure the normal operation of belt humidification device, water-excited dust collector, bag-type dust collector, coal yard sprinkler and other equipment; responsible for the management of the coal yard, spraying water at any time, so as to prevent the flying of pulverized coal in dry season and the occurrence of spontaneous combustion of coal pile.

(12) Chemistry profession: strictly control excessive emissions in the maintenance period due to improper disposal of waste oil, waste liquid and waste solid; responsible for normal operation of water treatment neutralization tank, fine processing neutralization tank, wastewater recycling pool and other facilities, and conduct water quality monitoring, ensure the waste water to be drained or recovered to meet standards; responsible for supervising analysis and test of fired coal quality, so as to ensure the ash and sulfur contents in coal to comply with environmental

protection requirements; responsible for the desulfurization system-related laboratory work, so as to ensure that the desulfurization efficiency is qualified. Responsible for normal maintenance and water quality monitoring of industrial waste water and domestic sewage, purification of wastewater for coal transmission facilities, and conduct water quality supervision, so as to ensure the normal operation of facilities.

(13) Property company: responsible for the supervision and management of domestic waste disposal, to ensure the waste to be buried and not to cause secondary pollution; responsible for the company's environmental greening planning and management, build the power plant into a garden-type plant.

(14) Fuel Department: responsible for supervision, management and maintenance of coal transmission and coal unloading facilities, establish the relevant system, eliminate environmental pollution due to coal leakage; responsible for the management of oil transportation and handling, establish the relevant system to prevent environmental pollution due to oil spills; responsible for the quality management of coal entering the plant, and ensure that the ash and sulfur in coal to comply with environmental protection requirements.

(15) Quanxin Company: responsible for ash and gypsum transportation and gray field operation and management, to prevent secondary pollution.

3.3 Environmental Management Plan

3.3.1 Project Initial Stage

The major environmental protection work in the project feasibility study stage is to conduct environmental impact assessment on the construction project, to prevent and mitigate potential adverse environmental impacts of the project. The EIA unit, design unit and construction unit discuss and prepare environmental management plans.

3.3.2 Construction Period

During the construction period, environmental protection is the responsibility of the contractor. In the whole process from construction, completion to repair of defects, the contractor should take all reasonable steps to protect the site and the surrounding environment in order to prevent the injury or damage to the public, in personal or financial aspects, de to pollution, noise or consequence arising from construction.

① Air environment control

a. Should be civilized during the construction period. According to construction plans, develop the measures against dust pollution, such as the addition of baffles, equipping watering vehicles and transportation vehicles with canvas.

b. Regularly check the operation sites.

c. Take administrative and financial penalties against the violation of operating requirements and failure to make timely rectification of the problems.

② Noise environment control

a. Replace high-noise construction process with advanced low-noise construction technology.

b. Make reasonable arrangement of construction schedule and construction time, so that the construction work will not affect the residents nearby.

③ Water environment control

The waste water during construction period mainly comes from the domestic sewage generated by construction workers and a small amount of construction waste water. The waste water generated from construction mainly contains suspended matters construction, after settlement, it can be used to mix construction materials.

④ Solid waste control

a. Construction waste is subject to unified disposal according to the regulations of local authorities, the small amount of garbage generated by construction workers and the domestic garbage generated by power plant staff are collected by the county sanitation department and buried at the designated landfill.

b. The metal waste replaced during the energy-saving retrofit process is stored in the power plant's waste warehouse, and then make rational use of waste.

⑤ Ecological environmental control

The energy-saving retrofit projects are carried out in the existing plant area, with small construction area, no new land is acquired, which does not involve environmental issues.

⑥ Social environment protection

The energy-saving retrofit project does not involve land acquisition and

emigration, and will not adversely affect the social environment

3.3.3 Operation Period

Key pollutants should be regularly monitored in the operating period, so as to meet the standards for pollutants discharge, and grasp the trend changes in environmental quality surrounding the plant.

① According to the environmental management audit requirements, the enterprise gradually straightens out the environmental management relationship of the whole plant, and conduct the enterprise environmental management work. At the same time, should regularly carry out environmental audit, and continuously improve enterprise environmental management.

② Establish, implement and monitor environmental management plan, develop the detailed monitoring and control system with regard to atmospheric pollutant, wastewater and other major pollutants, so as to ensure timely understanding and control of pollutant emissions and the impact on the surrounding environment.

③ Should strengthen the operation and management of environmental protection facilities, so as to ensure the normal operation and processing efficiency of environmental protection facilities, and ensure that the pollutant discharge standards are met.

④ Clarify environmental monitoring duties, establish and improve various rules and regulations of power plants: in accordance with national environmental standards, conduct daily monitoring on major pollution sources and pollutants of the enterprise, prepare the forms and reports regularly, regularly report the work to the competent authorities, and establish the archives; participate in pollution control services, carry out scientific research on environmental monitoring, and continuously improve the level of monitoring.

⑤ Strengthen safety environmental protection education on staff, implement labor protection measures, improve workers' safety and environmental awareness, and ensure employee safety and health.

⑥ Take a mature and effective risk prevention measures, establish emergency plans, strictly monitor the warning measures, prevent or reduce accidents, personal injury and environmental contamination.

⑦ Based on the industry characteristics and possible environmental impact, strengthen the exchanges with the community where the enterprise is in, release to the

public the corporate overview, energy-saving measures and pollutant emissions on a regular basis.

The project's Environmental Management Plan is as shown in Table 3.3-1

Table 3.3-1 Environmental Management Plan Table

Stage	Main Contents of Environmental Management
Project Initial Stage	(1) Coordinate with design units to develop good environmental management plans
Construction Stage	(1) Develop pollution prevention measures during construction period, and reflect the relevant content in the contract. (2) Construction unit and supervision unit monitor the implementation of pollution control measures during the construction process, and make promptly correction once problems are identified, so as to ensure that pollution prevention measures are well implemented. (3) Develop training programs, and conduct pre-job training on technical and production staff employed.
Production Operation Stage	(1) Strict implement environmental management systems, and ensure the normal operation of environmental management. (2) Monitor the environmental monitoring program, timely solve problems once found. (3) According to the new environmental policy, conduct timely training and education on relevant personnel, to ensure that enterprises can adapt to new situations and new requirements.

3.4 Contractor Management

During the project construction process, contractors will play a key role in environmental management, pollution control, prevention measures implementation and other aspects; therefore, the contractor should make the following requests.

(1) Choose the contractor with strength to ensure that environmental management plans are effectively implemented.

(2) Require the contractor and construction supervisors to receive training on relevant environmental protection and management before the construction.

(3) The environmental impact mitigation measures during the above-said construction period should be included in the contractor's bidding documents, and finally, included in construction contracts as the contract requirements towards the contractor for the project.

(4) Require the contractor to record its environmental activities and provide daily or weekly records on environmental performance. Project management office and

construction supervision team monitor and review these records.

(5) Contractor needs equip each sub-project with one full-time environmental personnel. These environmental staff must receive training according to training programs, so as to be competent in their work.

3.5 Environmental Management Recommendations

① According to the environmental management audit requirements, the enterprise gradually straightens out the environmental management relationship of the whole plant, and conduct the enterprise environmental management work. At the same time, should regularly carry out environmental audit, and continuously improve enterprise environmental management.

② Strictly implement the established environmental management plan and monitoring plan, ensure timely understanding and control of pollutant emissions and the impact on the surrounding environment.

③ Should strengthen the operation and management of environmental protection facilities, so as to ensure the normal operation and processing efficiency of environmental protection facilities, and ensure that the pollutant discharge standards are met.

④ Clarify environmental monitoring duties, establish and improve various rules and regulations of power plants: in accordance with national environmental standards, conduct daily monitoring on major pollution sources and pollutants of the enterprise, prepare the forms and reports regularly, regularly report the work to the competent authorities, and establish the archives; participate in pollution control services, carry out scientific research on environmental monitoring, and continuously improve the level of monitoring.

⑤ Strengthen safety environmental protection education on staff, implement labor protection measures, improve workers' safety and environmental awareness, and ensure employee safety and health.

⑥ Take a mature and effective risk prevention measures, establish emergency plans, strictly monitor the warning measures, prevent or reduce accidents, personal injury and environmental contamination.

⑦ Based on the industry characteristics and possible environmental impact, strengthen the exchanges with the community where the enterprise is in, release to the public the corporate overview, energy-saving measures and pollutant emissions on a

regular basis.

4 Environmental Monitoring Plan

4.1 Monitoring Purpose

Environmental monitoring is conducted in both the construction period and operation period, and its purpose is to fully and timely track the pollution dynamics of the proposed project, understand the environmental quality change, environmental influence range, and environmental quality trend in the region where the project construction is conducted, timely feeds information back to the departments in charge, and provide a scientific basis for environmental management under this project.

4.2 Monitoring Bodies

Wuxiang Power Plant environmental monitoring work is jointly carried out by Changzhi City Environmental Monitoring Station, and the monitoring station within the plant. Boiler flue gas emission is monitored by the flue gas automatic online monitoring system.

4.3 Monitoring Plan

4.3.1 Environmental Monitoring Plan during Construction

According to the pollution characteristics and actual situation during the construction period, establish certain monitoring system and ensure the system's implementation. Monitoring methods are subject to the existing standards and regulations promulgated by the state and the relevant ministries.

As for the energy-saving retrofit projects, the construction workload is very small, no waste water is discharged during construction. Environmental monitoring plan in construction phase is shown in Table 4.3-1.

4.3.2 Environmental Monitoring Plan during Operation Period

(1) Flue gas online monitoring

Two sets of M6000 type continuous emission monitoring systems (CEMS) are installed at the inlet and outlet of 2 boiler flue ducts of Wuxiang Power Plant. CEMS operates through network connection with the provincial and municipal environmental protection departments, and the monitoring alarm device is installed.

Monitoring should be conducted in strict accordance with the *Specifications for Continuous Emissions Monitoring of Flue Gas Emitted from Thermal Power Plants* (HJ/T75-2001).

(2) Routine monitoring conducted by Changzhi City Environmental Monitoring Station

In accordance with environmental protection requirements, Changzhi City Environmental Monitoring Station conducts on-site supervision and monitoring of the boiler flue gas emissions in each quarter.

(3) Routine monitoring conducted by Changzhi City Safety Supervision Administration

In accordance with the relevant requirements, Changzhi City Safety Supervision Administration monitors the company's working environment each year. Monitoring project has dust, noise, toxic and harmful gases.

(4) Monitoring program of in-plant environmental monitoring station

① Dust monitoring: In order to fully grasp the dust concentration within the plant, strengthen the scientific management of dust control measures, protect the workers' safety and health, and promote the production and development, Wuxiang Power Plant environmental monitoring station regularly conducts monitoring the dust at the places where boilers are in, and the fuel production sites and other places.

Monitoring items and frequency: monitoring is made on the dust and coal dust in the plant for once per quarter, the monitor is conducted for two days once, and in each of these two days, the monitor is made twice. Random inspection is made in dry season (strengthen the inspection in windy weather) .

② Wastewater monitoring: a monitoring point is set at the water outlet of wastewater treatment station.

Monitoring items: pH, suspended solid (SS), chemical oxygen demand (COD), arsenic (As), fluoride (F⁻), sulfide, hardness, oil and water amount.

Monitoring frequency: pH, SS and COD are monitored once every ten days, arsenic, fluoride, sulfide, hardness, oil and water amount are monitored once a month.

At the same time, monitoring on in-plant reuse water is conducted to ensure that reuse water to meet the recycling requirements. The monitoring on oil amount is

conducted twice each month at the outlet of oil-containing wastewater, water temperature is measured once per month at the outlet of circulation cooling water; pH, suspended solids and chemical oxygen demand are measured once per month at the outlet of domestic sewage station, suspended matters are measured once per month at the outlet of coal-transmission wastewater purification station.

③ Noise monitoring: monitoring should be conducted on the in-plant equipment noise, plant boundary noise, noise in living area, and work environmental noise once for every six months, the monitoring duration is 1 day, and the monitoring is conducted once in the daytime and once in the nighttime. The monitoring time is 10:00a.m (daytime) and 22:00 (nighttime).

④ Solid waste: make statistics of the name, generation and whereabouts of solid waste, statistics is made once a month.

Environmental monitoring plan during operational phase is shown in Table 4.3-2.

⑤ Mercury Monitoring of Smoke and Gas Emission: On November 11, 2010, under the requirement of the Ministry of Environmental Protection, Shanxi Environmental Protection Bureau issued The Notification on Implementing Mercury Pollution Control Pilot Work in Coal-fired Power Plants (Shanxi EP [2010] 383), and Wuxiang Hexin Power Plant was selected as pilot plant to implement mercury pollution control. In October 2011, the Mercury Continuous Emission Monitoring System (CEMS) will be installed in the plant so as to obtain the first-hand information on the emission concentration of mercury and to determine whether to install mercury removal device or not.

⑥ NO_x Monitoring: The Plant has already implemented NO_x concentration monitoring. Changzhi Municipal Environmental Protection Bureau assigns related staff to carry out the on-site monitoring every quarter. In 2012, according to the requirement of Shanxi Provincial People's Government, the Plant will install the first set of denitrification device; meanwhile, the CEMS will be updated to realize more accurate and normalized smoke and gas emission monitoring.

4.4 Monitoring Instrument

Table 4.4-1 shows the instrument and equipment furnished to Wuxiang Power Plant environmental monitoring station according to requirements of environmental monitoring.

Table 4.4-1 List of Apparatus and Equipment Equipped to Monitoring Station

No.	Name of Apparatus	Quantity (set)	Amount (10,000 RMB)
1	Electronic analytical balance (0.1mg)	1	2.0
2	Electronic analytical balance (0.01mg)	1	4.0
3	pH meter	2	0.5
4	Spectrophotometer	1	0.5
5	UV spectrophotometer	1	1.5
6	Ionic-activity meter	1	0.4
7	COD Tester	1	1.0
8	Biochemical incubator	1	0.4
9	BOD ₅ Tester	1	1.2
10	Oil tester	1	0.5
11	Frequency electromagnetic field tester	1	1.0
12	Flue gas on-line monitoring device	1	168
13	Precision Sound Level Meter	2	0.7
14	Flow tester	1	0.3
15	Refrigerator	1	0.3
16	Computer	1	0.5
Total			182.8

4.5 Feedback of Monitoring Results

Conduct monitoring according to the monitoring items, points and frequency listed in Table 4.3-1. After monitoring is completed each time, timely sort out the monitoring data, and write monitoring report in the list form, and submit the reports to the environmental protection leadership group of the plant, and meanwhile submit the reports to environmental protection department of Changzhi City, so that the all levels of management of the power plant and the local environmental protection departments

can keep abreast of the sewage drainage in the whole plant and the implementation of environmental control measures, and timely detect problems and solve problems.

Table 4.3-1 Environmental Monitoring Plan List of Wuxiang Power Plant in Construction Period

No.	Environmental Factor	Monitoring Site	Monitoring Item	Monitoring Frequency	Entrusting Unit	Monitoring Unit Supervision Unit	Cost (10,000RMB/year)
1	Ambient air	Near construction site and office area	TSP	once/month, two days once	Wuxiang Power Plant	Changzhi City Environmental Monitoring Station, Changzhi Municipal Environmental Protection Bureau	0.8
2	Noise	施工厂界、厂界 1m 外 1m away from the construction boundary and plant boundary	Leq	once/month, monitoring is made once in daytime and one in nighttime			0.1
3	Solid waste	Construction site	Name, generated amount and whereabouts of solid waste	Statistics is made one per month			0.1

Table 4.3-2 Environmental Monitoring Plan List of Wuxiang Power Plant in Operation Period

No.	Environmental Factor	Monitoring Site	Monitoring Item	Monitoring Frequency	Entrusting Unit	Monitoring Unit Supervision Unit	Cost (10,000RMB/year)
Monitored by Changzhi City Environmental Monitoring Station, Changzhi City Safety Supervision Bureau							
1	Exhaust gas	Chimney (gas duct)	SO ₂ , smoke dust, NO _x	Once/quarter, 1day once	Wuxiang Power Plant	Changzhi City Environmental Monitoring Station, Changzhi Municipal Environmental Protection Bureau	2.0
2	Dust, noise, toxic and harmful gas	Relevant locations in the plant	Dust, noise, harmful and toxic gas	Once/year, 1day once			1.0
3	Noise	1m away from factory boundary	Leq	Once/year, monitoring is made once in daytime and one in nighttime			0.1
Monitored by in-plant monitoring station							
1	Exhaust gas	Chimney (gas duct)	SO ₂ , smoke dust, NO _x	Continuous monitoring	Wuxiang Power Plant	In-plant Environmental Monitoring Station, Changzhi Municipal Environmental Protection Bureau	10.0
		One monitoring point are set in each place of coal yard, coal mill, coal feeder, belt conveyor respectively	Dust, coal dust	Once/quarter, two days once, monitoring is made twice in a day.			2.0
2	Waste Water	Water outlet The quality of reuse water is monitored	pH, SS, COD, oil, fluoride, sulfide, etc.	Twice/year, two days once, reuse water is monitored four times per month			2.0
3	Noise	1m away from the factory boundary, office area in plant area	Leq	Once/half a year, monitoring is made once in daytime and one in nighttime			0.2
4	Solid waste	Plant area	Name, generated amount and whereabouts of solid waste	Statistics is made once a month	0.5		

5 Environmental Protection Monitoring Plan

Table 5-1 Environmental Protection Monitoring Plan

Phase	Supervision Body	Supervision Content	Supervision Objective
Construction Period	Environmental Project Office of the World Bank, Changzhi Municipal Environmental Protection Bureau	<ol style="list-style-type: none"> 1. Review preliminary environmental protection design and EMP 2. Check the dust and noise pollution control measures, decide the construction time 3. Check the air pollutant emissions 4. Check the discharge of domestic wastewater and oily waste water at the construction site 	<ol style="list-style-type: none"> 1. Strict implement the "Three simultaneous" system. 2. Reduce the impact of construction on the surrounding environment, and implement the relevant environmental regulations and standards.
Operation Period	Environmental Project Office of the World Bank, Changzhi Municipal Environmental Protection Bureau	<ol style="list-style-type: none"> 1. Check the implementation of EMP during the operation period 2. Check the implementation of the monitoring plan 3. Check whether the environmental quality at the environmentally sensitive points meet the respective quality standards 	<ol style="list-style-type: none"> 1. Implement EMP 2. Implement the monitoring plan 3. Effectively protect the environment 4. Strengthen environmental management, effectively protect human health

6 Training on Environmental Protection Personnel

6.1 Training on Environmental Protection Personnel during Construction Period

The environmental management trainees include executives and technical staff from the construction unit, supervision unit and other institutions. Training content includes environmental management, review procedures, implementation standards and environmental protection measures and pollution control technologies under the project.

6.2 Training on Full-time, Part-time Environmental Protection Personnel during Operation Period

In order to ensure environmental management work to be carried out smoothly and effectively during the operation period, the knowledge and skills training should be offered to enterprise employees. The training not only need make all the employees aware of the importance of this project and the significance of the implementation, but also offer them different post trainings. Table 6.2-1 shows the training program for environmental protection personnel under this project.

Table 6.2-1 Training Program for Environmental Protection Personnel under this Project

No.	Item	Training Content	Training Time	Trainer	Training Fee
1	Peak cooler installation project for air-cooling systems of # 1, # 2 units	Visit peak cooler manufacturers to make study and survey	3-5 days	3 persons	15,000 RMB
		Visit mechanical draft cooling tower manufacturers to make study and survey	3-5 days		
		Visit the power plants which succeed in retrofit to make study and survey	3-5 days		
Total				3 persons	45,000 RMB

7 Budget for Environmental Management and Monitoring Program

Table 7.1-1 shows temporary budget and capital source for environmental management and monitoring program

Table 7.1-1 Tentative Budget and Funds Source Table for Environmental Management and Monitoring Program

Item		Whole-year Budget (10,000RMB)		Budget (10,000RMB)		Source of Fund
		Construction Period	Operatio n Period	Construction Period 1 Year	Operation Period 3 Years	
PMU Operation	Wage	1.0	12.0	1.0	36.0	PMC
	Office expenses	0.5	1.5	0.5	4.5	PMC
	Transport costs	0.5	1.0	0.5	3.0	PMC
	Total IESD operation	2.0	14.5	2.0	43.5	PMC
Water quality monitoring	Wage	—	3.0	—	9.0	—
	Office expenses	—	1.5	—	4.5	—
	Transport costs	—	1.0	—	3.0	—
	Total amount for IESD operation	—	5.5	—	16.5	—
Air quality and noise monitoring	Laboratory analysis	0.5	2.0	0.5	6.0	PMC
	Wage of sampling staff	0.5	0.5	0.5	1.5	PMC
	Transport costs	0.5	0.5	0.5	1.5	PMC
	Total amount (air, noise monitoring)	1.5	3.0	1.5	9.0	PMC
Heritage Conservation Monitoring	Routine monitoring	—	—	—	—	—
	Special study	—	—	—	—	—
	Total amount (Heritage Conservation Monitoring)	—	—	—	—	—
Supervision Engineer Budget (Environment al Monitoring)	Wage	1.0	5.0	1.0	15.0	CMSC
	Office expenses	0.5	1.0	0.5	3.0	CMSC
	Transport costs	0.5	1.0	0.5	3.0	CMSC
	Total amount for IESD operation	2.0	7.0	2.0	21.0	CMSC
Capacity Building	Provided (expected)	8	10	8	30	TAC
Total budget for Environmental Management Plan		13.5	40.0	13.5	120.0	

Note: (1) PMC: Project management cost

(2) CMSC: Construction management and supervision cost

(3) TAC: Technical assistance cost

(4) The project's construction period is 1 month

The budgeted EMP cost during the construction period is 135,000 RMB, the budgeted EMP cost during the three-year operation period is 1.2 million RMB, the total EMP cost is 1.335 million RMB.

8 Information Exchange, Aggregation and Reporting

8.1 Information Exchange

Environmental management requires necessary information exchange between different departments and different posts within the organizations, meanwhile the organizations need disclose relevant information to relevant parties and the public, etc.

Internal information exchange can be conducted in form of meetings, internal briefings and other means, but formal monthly meeting must be held once per month, and all the information exchange should be recorded and archived.

External information exchange should be conducted once every six months or one year, the information exchange with coordination units should be summarized and archived.

8.2 Record

For the purpose of effective operation of environmental management system, organizations must establish a perfect recording system, and keep the records in the following aspects:

- (1) Legal and regulatory requirements
- (2) License
- (3) Environmental factors and their environmental impact
- (4) Training
- (5) Inspection, checking and maintenance activities
- (6) Monitoring data
- (7) Effectiveness of correction and preventive measures
- (8) Information on relevant parties
- (9) Approval
- (10) Review

In addition, necessary control should be made on the above records, including the records-related identification, collection, cataloging, archiving, storage, management, maintenance, inquiry, retention period, disposal, etc.

8.3 Report

During the project implementation process, contractor, monitoring stations and

Project Management Office should record the project progress, Environmental Management plan (EMP) implementation, environmental quality monitoring results, etc., and report the records to relevant departments. The report contents mainly include the following three parts:

(1) Monitoring stations and contractor conduct detailed records on EMP implementation, and promptly report the records to the Project Management Office.

(2) The project progress reports prepared by the Project Management Office (e.g. monthly, quarterly, annual reports, etc.) must include contents on EMP implementation, such as EMP implementation progress and enforcement effects.

(3) Annual EMP implementation report on the project must be completed and submitted to the World Bank before March 31 of the following year.

EMP execution report can include the following main elements:

- ① Training program implementation
- ② Project progress
- ③ Whether there are complaints from the public, in the event of complaint, record the main contents of complaints, solutions and public satisfaction
- ④ EMP implementation plan for next year