Kunming WuHua Municipal Solid Waste Incineration Power Plant

Environmental Audit Report

July 2014

Abbreviations

APC	Air Pollution Control
BAT	best available techniques
BEP	best environmental practices
CFB	circulating fluidized bed
Wuhua	Wuhua MSW Power Plant/ Wuhua MSW Incineration Plant
EA	environmental assessment
EHS Guidelines	World Bank Group Environmental, Health and Safety Guidelines
EPB	Environmental Protection Bureau
EMP	environmental management plan
FECO	foreign economic cooperation office, ministry of environmental protection
MEP	Ministry of Environmental Protection, PRC
MSW	municipal solid wastes
NIP	National Implementation Plan of China
POPs	Persistent Organic Pollutants
Stockholm Convention	SC
UMB	Urban Management Bureau

Content

1 Introduction

1.1 Background

China signed the Stockholm Convention on POPs in 2001 and the People's Congress ratified the Convention in 2004. The National Implementation Plan (NIP) was completed in 2007. The proposed project will catalyze and expedite the phase-in of *Best Available Techniques (BAT)/ Best Environmental Practices (BEP)*[1] in the MSW disposal sector that the NIP identified as a major source of PCDD/F release. The NIP identified MSW incineration as one of the key sources of PCDD/F release.

MSW management is a growing concern for China's cities. With China's rapid economic development, urbanization, and rising standards of living, the quantity of municipal solid wastes collected and transported has increased more than five-fold nationwide from about 31 million tons in 1980 to about 157 million tons in 2009 and is projected to reach 585 million tons in 2030. No country has ever experienced as large and rapid an increase in waste generation.

The role of incineration in MSW management has been increasing and will continue to increase due to a shortage of available land for landfills and the incinerators' potential ability to generate heat or electricity ("waste to energy"). A series of incentive policies are in place to encourage investment in MSW incinerators, including value added tax refunding, prioritized commercial bank loans, state subsidy (2%) for loan interest, and favorable feed-in prices for the electricity sale into the grid. Consequently, the number of MSW incinerators is expected to rise from 66 in 2009 to 200 in 2015, increasing the incineration capacity from 55.4 thousand tons to 140 thousand tons per day over the same time period.

China has a long road ahead in adopting the modern MSW management hierarchy, which most favors prevention, followed by -- in order or preference -- minimization (reduction), reuse, recycling, energy recovery, and least favors disposal. In China, present MSW management generally focuses narrowly on the traditional pattern of collection and disposal. Household waste is not separated at the source. Recyclable material collection and recycling is generally pursued by the for-profit private sector, which focuses on paper products, metals, plastics, and glass. However, residential waste collected and transported by municipal sanitation units for disposal at incineration or landfills still contains a considerable proportion of plastic bags, packaging materials, kitchen waste, and some metals. The high moisture content of the waste delivered to incinerators inhibits the combustion process, while plastics lead to dioxin precursors, both causing PCDD/F generation and release.

The project will implement selected NIP actions that should be completed by 2015 and fulfill the associated objectives. GEF supported activities will integrate PCDD/F reduction from MSW into China's efforts to modernize its MSW management system, by strengthening the policy and regulatory framework and the institutional capacity, demonstrating BAT/BEP applications, preparing a replication strategy and raising public awareness, and monitoring and evaluation of project results.

[1] Related to the Stockholm Convention.

In order to promote the BAT/BEP applications, an expert team was organized by Ministry of Environmental Protection (MEP) and World Bank. And 4 existing incinerators in Kunming city, capital of Yunnan Province, have been identified for the project BAT/BEP investment. These 4 pilot incinerators are DongJiao, KongGang, WuHua, and XiShan.

1.2 Project's Development Objective

The *project's development objective* is to build capacity and demonstrate best available techniques and best environmental practices in MSW incineration to support China to comply with the Stockholm Convention.

1.3 Project Design

The project includes two demonstration cities and central government departments. The project aims to demonstrate good practices in enhancing enforcement capacity of regulatory authorities, applying BAT/BEP systematically in selected incinerators, and disclosing information to the public. The project's aim is to demonstrate reduction of dioxin emission in MSW incineration, recognizing the increasing trend of MSW in China; rather than support incineration per se. Demonstration activities will take place in existing incinerators with the objective to gradually replicate them in some 140 other incinerators that are believed to be in operation in China.

In demonstration city **Kunming**, four MSW incinreators have been identified for possible financing. Technical evaluation and environmental audit carried out during project preparation found that all the plants are generally modern in design and well managed by experienced operators. All incinerators have the potential to meet releatively stringent dioxins emission standard. However, consistent compliance is subject to technical, operational and staff capacity constraints. Thus for each incinerator, enhancing pretreatment at garbage pits, instrumentation and automatic control system, and air pollution control system were proposed, depending specific issues of each incinerator. Further, the environmental audit also found that monitoring of operating parameters and emissions seem to be inadequate, and some monitoring data seem to be unreliable.

Therefore, a two-phase implementation approach will be taken considering the technical complexities associated with MSW incineration processes. During the first year of project implementation, each of the four incinerators will be subject to an intensive operational and environmental performance audit to collect and analyze comprehensive data on operating conditions and environmental emissions, and identify areas of improvement. Based on these fndings an operational improvement program that is consistent with BAT and BEP will be prepared for each incinerator. Incinerators that commit to implementing these programs and fulfill financial eligibility conditions will be supported during the remainder of the project, including through grant funding for necessary upgrades of equipment relevant for dioxin emission reduction. The four existing MSW incinerators may receive GEF funding to invest in enhanced equipment in order to implement operating improvement programs. It is anticipatd that at least three of the four incinerators will receive financial support to implement the operating improvement program.

1.4 EA Instrument

Given the fact that the four incinerators are existing plants, and the nature and scale of activities as mentioned above, the proper environmental assessment instrument is an Environmental Audit according to the Bank's safeguards policy OP4.01. The Environmental Audit has reviewed the overall environmental performance of the each incinerator in terms of regulatory compliance, incineration process, material management, emission compliance, safety and health management system, environmental management system, information disclosure. Based on the environmental audit, an environmental management plan (EMP) has been developed for each plant.

1.5 Public Consultation Approach

The project social assessment consultant and environmental assessment consultant worked together with incinerators to carry out public consultation during preparation. The FECO, incinerators and the Bank have agreed that the social assessment is a part of the EA and as such, provide for its public consultation part. Two round of public consultation were carried out during the project preparation, one at EA and SA work plan stage in May 2013, the other was after draft environmental audit, environmental management plan and social assessment plan were disclosed in March 2014.

2 Incinerator Profile

2.1 Basic information

Name: Kunming Wuhua Municipal Solid Waste Incineration Power Plant, hereinafter named as WuHua

Investor: Kunming Xinxingze Environmental Resources Industry Co., Ltd.

Address: one kilometer from the entrance to the Dapujikunlu Highway in Wuhua District of Kunming

2.2 Company Information

Kunming Xinxingze Environmental Resources Industry Co., Ltd. Owns and operates Kunming Wuhua Municipal Solid Waste Incineration Power Plant. It is the first municipal solid waste incineration and power generation plant in Yunnan Province. The plant area occupies 100 mu of land and involves the investment of 320 million Yuan. There are three incinerators and two generators (3×400t/h supporting boilers, 2×12MW steam turbine generator sets), providing the daily waste treatment capacity of 1000t and annual electricity generated of 160 million kwh. It's the project of cyclic economy encouraged by the state that disposes of the municipal solid waste following the principle of "recycle, reuse and reduce" to achieve the reuse of the waste resources.

2.3 Overview of Wuhua Incinerator

(1) Concessional agreement

The project company signed a concessional agreement (Build-Operate-Transfer) with Kunming Urban Management Bureau, under which the company runs the Wuhua incinerator, receive MSW tipping fee and feed-in tariff.

(2) Operation Facilities

3×400t/h CFB incinerators with 2×12MW steam turbine generators

(3) Design Capacity

The designed daily processing capacity of domestic waste is 1000t. The annual processing capacity is 365,000 t. The annual electricity generated is 160 million kwh.

(4) Staff members and Work System

Working days: 365d/a

Operation hours for incinerator: 7200h/a

Staff members: 77 staffs in 3 shifts

The organization structure is shown in Fig. 2-1.

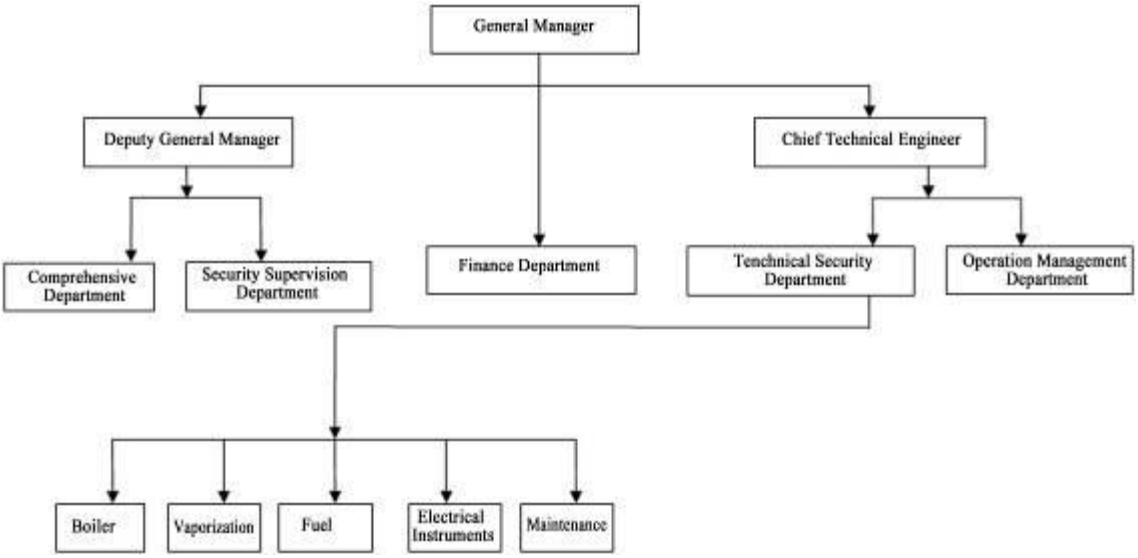


Figure 2-1 Organization Structure

3 Legal and Regulation Framework

3.1 Domestic Laws, Regulations, and Policies

Since China formally promulgated the Environmental Protection Law of the PRC (for Trail Implementation) in 1979, China successively promulgated multiple environmental protection laws and regulations like Law of the People's Republic of China on The Prevention and Control of Water Pollution, Law of the People's Republic of China on the Prevention and Control of Atmospheric Pollution and Marine Environment Protection Law of the People's Republic of China. An environmental protection legislation system consisting of comprehensive laws, pollution prevention laws, as well as resources and ecological protection laws has been established gradually. At present, the environment legal system with *Environmental Protection Law of the People's Republic of China* as the center and the *Constitution of the People's Republic of China* as the basis has been formed. In order to realistically intensify the urban domestic waste treatment, improve the reduction, recycling, and safety disposal level of urban domestic waste, and improve the urban living environment, multiple laws and regulations related to urban domestic waste treatment have been promulgated in China and corresponding control and prevention policies have been formulated.

The environmental protection laws and regulations related to the Project are as follows. See Table 3-1 for main provisions.

(1) Environmental Protection Law of the People's Republic of China (December 26, 1989);

(2) Law of the People's Republic of China on Prevention and Control of Environmental Noise Pollution (revised on October 29, 1996);

(3) Law of the People's Republic of China on Prevention and Control of Atmospheric Pollution (revised on April 29, 2000);

(4) Law of the People's Republic of China on the Prevention and Control of Environmental Pollution Caused by Solid Waste (revised on December 29, 2004);

(5) Law of the People's Republic of China on Prevention and Control of Water Pollution (implemented on June 1, 2008);

(6) Cleaner Production Promotion Law of the People's Republic of China (implemented on July 1, 2012);

(7) *National Hazardous Waste Inventory*, Decree 1, issued by the Ministry of Environmental Protection and National Development and Reform Commission of the People's Republic of China (implemented on August 1, 2008);

(8) Renewable Energy Law of the People's Republic of China (February 28, 2005);

(9) Circular Economy Promotion Law of the People's Republic of China (August 29, 2008);

(10) *Technological Policy for Treatment of Municipal Solid Wastes and Its Pollution Control*, issued by the Ministry of Construction, Ministry of Science and Technology, and State Environmental Protection Administration (CJ [2000] No. 120 Document);

(11) *Technical Guide for Domestic Waste Treatment*, issued by the Ministry of Housing and Urban-Rural Development, National Development and Reform Commission, and Ministry of Environmental Protection (April 22, 2010);

(12) Guidance on Strengthening Dioxin Pollution Prevention (HF [2010] No. 123 Document).

Table 3-1 Articles of Environmental Protection Laws Related to Domestic Waste Incineration in China

Name	Articles
Environmental Protection Law of the People's Republic of China	Article 10. Units that emission pollutants in areas where the local standards for the emission of pollutants have been established shall observe such local standards. Article 13. Units constructing projects that cause pollution to the environment must observe the state provisions concerning environmental protection for such construction projects. The environmental impact statement on a construction project must assess the pollution the project is likely to produce and its impact on the environment and stipulate the preventive and curative measures; the statement shall, after initial examination by the authorities in charge of the construction project, be submitted by specified procedure to the competent department of environmental protection administration for approval. The department of planning shall not ratify the design plan descriptions of the construction project until after the environmental impact statement on the construction project is approved. Article 24. Units that cause environmental pollution and other public hazards shall incorporate the work of environmental protection into their plans and establish a responsibility system for environmental protection, and must adopt effective measures to prevent and control the pollution and harms caused to the environment by waste gas, waste water, waste residues, dust, malodorous gases, radioactive substances, noise, vibration and electromagnetic radiation generated in the course of production, construction or other activities. Article 25. For the technological transformation of newly-built industrial enterprises and existing industrial enterprises, facilities and processes that effect a high rate of the utilization of resources and a low rate of the emission of pollutants shall be used, along with economical and rational technology for the comprehensive utilization of waste materials and the treatment of pollutants. Article 26. Installations for the prevention and control of pollution at a construction project must be designed, built and commissioned together with the principal part of the project. No permission shall be given for a construction project to be commissioned or used, until its installations for the prevention and control of pollution are examined and considered up to the standard by the competent department of environmental protection administration that examined and approved the environmental impact statement. Article 29. If an enterprise or institution has caused severe environmental pollution, it shall be required to eliminate and control the pollution within a certain period of time. Article 31. Any unit that, as a result of an accident or any other exigency, has caused or threatens to cause an accident of pollution, must promptly take measures to prevent and control the pollution hazards, make the situation known to such units and inhabitants as are likely to be endangered by such hazards, report the cases to the competent department of environmental protection administration of the locality and the departments concerned and accept their investigation and decision. Enterprises and institutions that are likely to cause severe pollution accidents shall adopt measures for effective prevention. Article 33. The production, storage, transportation, sale and use of toxic chemicals and materials containing radioactive substances must comply with the relevant state provisions so as to prevent environmental pollution.
Circular Economy Promotion Law of the People's Republic of China	Article 9. Enterprises and public institutions shall set up management systems and take measures to reduce the consumption of resources, reduce the production and emission of wastes and improve the reutilization and recycling level of wastes. Article 18. The administrative department of circular economy development under the State Council shall, together with the environmental protection department and other competent departments under the State Council, issue a catalogue of the encouraged, restricted and eliminated techniques, equipment, materials and products on a regular basis. It is prohibited to produce, import or sell any equipment, material or product listed in the eliminated category, and it is also prohibited to use any technique, equipment or material listed in the eliminated category. Article 31. Enterprises shall develop an interconnected water use system and a circulatory water use system so as to improve the repeated use of water. Enterprises shall use advanced technologies, techniques and equipment for the circulatory use of the waste water generated in the

	production process.
Cleaner Production Promotion Law of the People's Republic of China	Article 12. The nation shall implement a time-limited system for the elimination of obsolete or obsolescent production technologies, processes, equipment and products gravely hazardous to environments and wasteful of resources. Article 19. Enterprises in the course of technological upgrades shall adopt the following cleaner production measures: (I) Adopting toxin-free, non-hazardous or low-toxin and low-harm raw materials to replace toxic and hazardous raw materials; (II) Adopting processes and equipment with high resource utilization rates and little pollutant-generation to replace processes and equipment with high resource consumption and significant generation of pollutants; (III) Comprehensive use or recycling of materials such as waste products, waste water and heat generated from production procedures. (IV) Adopting pollution prevention and control technologies sufficient to permit the enterprises to comply with national or local pollution emission standards and total volume control quotas for pollutants. Article 28. Enterprises shall monitor resource consumption and generation of wastes during the course of production and provision of services, and conduct cleaner production audits with respect to production and service procedures according to need. Enterprises that exceed the national or local discharging standards or exceed the total volume control targets for pollutants set by the relevant local people's governments shall conduct cleaner production audits. Any enterprise using toxic and hazardous materials in production or discharging toxic and hazardous substances shall periodically conduct cleaner production audits, and report the audit results to the relevant administrative departments for environmental protection and the relevant departments for economic and trade under the local people's government at or above county level.
Law of the People's Republic of China on the Prevention and Control of Atmospheric Pollution	Article 8. The State adopts economic and technological policies and measures to facilitate the prevention and control of atmospheric pollution and comprehensive utilization. Article 11. New construction projects, expansion or reconstruction projects which emission atmospheric pollutants shall be governed by the State regulations concerning environmental protection for such projects. An environmental impact statement on construction projects shall include an assessment of the atmospheric pollution the project is likely to produce and its impact on the ecosystem, stipulate the preventive and curative measures. The statement shall be submitted, according to the specified procedure, to the administrative department of environmental protection concerned for examination and approval. When a construction project is to be put into operation or to use, its facilities for the prevention of atmospheric pollution must be checked and accepted by the administrative department of environmental protection. Construction projects that do not fulfill the requirements specified in the State regulations concerning environmental protection for such construction projects shall not be permitted to begin operation or to use. Article 12 Units that emission atmospheric pollutants must, pursuant to the provisions of the administrative department of environmental protection under the State Council, report to the local administrative department of environmental protection its existing emission and treatment facilities for pollutants and the categories, quantities and concentrations of pollutants emitted under normal operation conditions and submit to the same department relevant technical data concerning the prevention and control of atmospheric pollution. Units that emission pollutants as specified in the preceding paragraph shall report in due time about any substantial change in the category, quantity or concentration of the atmospheric pollutants emitted. Their atmospheric pollutant treatment facilities must ensure normal operations. Where the said facilities are to be dismantled or left idle, approval of the local administrative department of environmental protection under the people's government above the county level shall be obtained in advance. Article 13. Where atmospheric pollutants are emitted, the concentration of the said pollutants may not exceed the standards prescribed by the State and local authorities. Article 14. The State implements a system of collecting fees for discharging pollutants on the basis of the categories and quantities of the atmospheric pollutants emitted, and establishing reasonable standards for collecting the fees therefor according to the needs of strengthening prevention and control of atmospheric pollution and the State's economic and technological conditions. Article 19 Enterprises shall give priority to the adoption of clean production techniques that are instrumental to high efficient use of energy and to

	reducing the emission of pollutants so as to decrease the generation of atmospheric pollutants. Article 20 Any entities that, as a result of an accident or any other sudden events, emissions or leaks toxic or harmful gases or radioactive substances, thereby causing or threatening to cause an accident of atmospheric pollution and jeopardize human health, shall promptly take emergency measures to prevent and control the atmospheric pollution hazards, make the situation known to entities and inhabitants that are likely to be endangered by such atmospheric pollution hazards, report the case to local administrative department for environmental protection, and accept the investigation carried out thereby. Under urgent circumstances of a severe atmospheric pollution that may jeopardize human health and safety, the local people's government shall make the matter known to local inhabitants without delay and shall take compulsory emergency measures, including the order in which the pollutant discharging entity concerned will be stopped from discharging the said pollutants. Article 30 Where any newly built or expanded thermal power plants and other large- or medium-sized enterprises that emission sulfur dioxide in the amount exceeding the prescribed standards for emission of pollutants or the quota of total quantity control, auxiliary facilities for desulphurization and dust removal must be installed or other measures for controlling the emission of sulfur dioxide or for dust removal must be adopted.In acid rain control areas or sulfur dioxide pollution control areas, if an existing enterprise emissions atmospheric pollutants in the amount exceeding the standards for emission of pollutants, such enterprise shall take relevant measures to control its pollutants in accordance with Article 48 hereof. Advance technologies in terms of desulphurization and dust removal are encouraged to be adopted in enterprises by the state. Enterprises shall take relevant measures to control the nitrogen oxide generated during incineration of fuels. Article 36 Entities that emission dust into the air must take relevant dust removal measures. The emission of toxic exhaust gases and dusts into the air shall be strictly restricted. If required, the gas or dust to be emitted must be purified without exceeding the prescribed standard for emission. Article 40 Entities that emission stink into the air must take relevant measures to prevent the neighboring residential areas from being polluted. Article 41 In populated areas and other areas that need special protection according to law, the incineration of asphalt, asphalt felt, rubber, plastics, leather, garbage and other materials that may produce toxic or harmful smoke or dust or stink shall be prohibited. Article 42 For transport, loading and unloading, and storage of substances that may diffuse toxic or harmful gases or dusts, sealing or other protective measures must be taken.
Law of the People's Republic of China on the Prevention and Control of Solid Waste Pollution	Article 3 The State shall, in preventing and controlling environmental pollution caused by solid wastes, implement the principles of reducing the emission and harm of solid wastes, fully and rationally utilizing solid wastes and making them hazardless through treatment so as to promote cleaner production and the development of recycling economy. The State shall adopt economic and technical policies and measures in favor of the comprehensive use of solid wastes, and fully recover and rationally utilize solid wastes. The State shall encourage and support the adoption of measures in respect of centralized treatment of solid wastes that are beneficial to the environmental protection and shall promote the development of industry responsible for prevention and control of environmental pollution caused by solid wastes. The people's governments at or above county level shall incorporate the prevention and control of environmental pollution caused by solid wastes into their environmental protection programs and adopt economic and technical policies and measures to facilitate the prevention and control of environmental pollution caused by solid wastes. When relevant departments of the State Council, the people's governments at or above county level and the relevant departments thereof formulate programs regarding urban-rural construction, land use, regional development and industrial development, they shall wholly take such factors into account as the reduction of emission and harm of solid wastes, and the promotion of comprehensive use and harmless treatment of solid wastes. The environmental protection administrative department of the State Council shall, pursuant to national environmental quality standards and national economic and technical conditions, formulate national technical standards on the prevention and control of environmental pollution caused by solid wastes in collaboration with relevant administrative departments of the State Council. The construction of projects which emission solid wastes and the construction of projects for storage, use and treatment of solid wastes shall be

	carried out upon the appraisal regarding their effects on environment and in compliance with relevant state regulations concerning the management of environmental protection in respect of construction projects. Article 17 Entities and individuals that collect, store, transport, utilize or dispose solid wastes shall take measures to prevent the scattering, run-off and leakage of solid wastes, as well as other measures against environmental pollution; no dumping, piling, discarding and dropping of waste solids is allowed without authorization. Article 22 No facilities or sites for centralized storage and treatment of industrial solid wastes or landfill of municipal solid wastes may be built in nature reserves, scenic resorts, conservation areas of drinking water and basic farmlands, and other areas requiring special protection that are prescribed by the State Council, relevant administrative departments of the State Council and the people's governments of provinces, autonomous regions and municipalities directly under the Central Government. Article 38 The people's governments at or above county level shall plan, as a whole, to build facilities for collecting, transporting and treating urban-rural municipal solid wastes, improve the ratio of utilization and harmless treatment of municipal solid wastes, promote industrial development for collection and treatment of municipal solid wastes, and progressively establish and perfect the social service system for preventing and controlling environmental pollution caused thereby. Article 41 The clearing, collection, transportation and treatment of urban municipal solid wastes shall be conducted in accordance with state provisions in respect of environmental protection and environmental sanitation so as to prevent environmental pollution. Article 44 The construction of facilities and sites for disposing municipal solid wastes shall comply with the standards in terms of environmental protection and environmental sanitation as prescribed by the administrative department for environmental protection sector of the State Council and the administrative department for construction sector of the State Council. Article 51 The administrative department for environmental protection sector of the State Council shall, jointly with other relevant departments of the State Council, formulate a national catalog of hazardous wastes and specify unified criteria, methods and signs for identifying and distinguishing hazardous wastes. Article 52 For containers and packages of hazardous wastes and the facilities and sites for collection, storage, transportation and treatment thereof, corresponding signs for identifying such hazardous wastes shall be set. Article 53 An entity discharging hazardous wastes shall, pursuant to state provisions, work out a plan for managing hazardous wastes, and declare the types, capacity, flow direction, storage, disposal and other relevant materials to the environmental protection departments of the local people's governments at or above county level. Article 55 An entity that emissions hazardous wastes shall dispose hazardous wastes according to relevant provisions of the State, and shall not dump or pile up such wastes without authorization; those that don't dispose hazardous wastes shall be ordered to correct themselves within the period specified by the administrative departments for environmental protection of the people's governments at or above county level; in case of failure to dispose within the time limit or failure of disposal to comply with relevant provisions of the State, a third party entity shall be designated to carry out such disposal as appointed by the administrative department for environmental protection of the people's governments at or above county level, and the expenses incurred therefrom shall be undertaken by the said entity that emissions hazardous wastes. Article 58 Hazardous wastes shall be collected and stored separately according to their different characteristics. It is forbidden to collect, store, transport and treat the hazardous wastes of incompatible natures and those not being undergone safety treatment. The protective measures complying with state standards regarding environmental protection shall be adopted for the storage of hazardous wastes whose storage period shall not exceed one year; where it is necessary to extent the said time limit, it shall submit to the original administrative department for environmental protection that approved the business license for approval, unless it is otherwise provided by laws and administrative regulations. It is forbidden to mix hazardous wastes with non-hazardous wastes during storage. Article 60 For transportation of hazardous wastes, relevant measures for prevention of environmental pollution must be taken and state

	regulations on transportation management of hazardous goods shall be observed.
National Catalogue of Hazardous Wastes	HW18: residues produced during incineration; 802-002-18 fly ash produced during incineration of municipal solid wastes
Technical Policy on Disposal of Urban Municipal Solid Wastes and Prevention and Control Technologies for Corresponding Pollution	1.5 Process management in respect of waste production shall be strengthened in order to reduce wastes at source in accordance with the principles of reduction, recycling and innocuity. For existing wastes, harmless treatment and recycling shall be initially carried out to prevent them from polluting the environment. 6.1 Incineration of wastes is applicable to wastes with the average low heating value higher than 5,000 kJ/kg and the economically developed areas that are in lack of sanitary landfill sites. 6.2 Currently, mature technologies regarding waste incineration based on grate incinerator shall be adopted while application of other types of incinerators shall be prudently selected. Application of incinerators that fail to comply with control standards are not allowed. 6.3 Wastes shall be fully burned in incinerators and flue gas shall remain in the afterburner under 850°C for more than 2 seconds. 6.4 Heat produced during waste incineration shall be recycled to the maximum extent so as to reduce thermal pollution. 6.5 Waste incineration shall be carried out in accordance with the requirements set forth in the Standard for Control of Pollution from Municipal Solid Waste Incineration, and flue gases, sewage, slags, fly ashes, stink, noises, etc. caused thereby shall be controlled and treatment in order to prevent them from polluting the environment. 6.6 Advanced and reliable technologies and equipment shall be adopted so as to strictly control the emission of flue gases produced during waste incineration. Semi-dry cloth-bag dust removing process can be adopted during treatment of flue gases. 6.7 Pre-treatment and separate treatment shall be carried out on leachate in waste storage pit and sewage produced during production which will be emitted after compliance with relevant standards. 6.8 Slags produced during waste incineration can be recycled or directly buried if they are proved to be the wastes out of the hazardous wastes. Slags and fly ashes belong to hazardous wastes must be disposed as hazardous wastes.
Technical Guideline for Treatment of Municipal Solid Wastes	3.2.1 Location of incineration plants for municipal solid wastes shall comply with the requirements of relevant state and industrial standards. 3.2.2 Design and construction of incineration plants for municipal solid wastes shall comply with the requirements set forth in the *Specification for Engineering Technologies in Incineration and Treatment of Municipal Solid Wastes* (CJJ90), the *Standard for Construction of Incineration and Treatment Projects for Municipal Solid Wastes*, the *Standard for Pollution Control in Incineration of Municipal Solid Wastes* (GB 18485) as well as relevant standards and various local standards. 3.2.3 Annual working days of incineration plants for municipal solid wastes shall be 365 days with the annual operating duration of each production line above 8,000 h. Designed service life of incineration system for municipal solid wastes shall not be shorter than 20 years. 3.2.4 Effective volume of municipal solid waste pit shall be determined in accordance with the rated incineration volume of municipal solid wastes in 5-7 days. Waste leachate collection facilities shall be installed in municipal solid waste pit. Finish materials used in inner wall and bottom of municipal solid waste pit shall satisfy the requirements including corrosion resistance, resistance to shock loading, seepage water prevention, etc. and the outer wall and bottom shall use non-absorbent finish. 3.2.5 Municipal solid wastes shall be fully incinerated in incinerators, detention time of flue gases in secondary combustion hearths under the temperature equal to or higher than 850°C shall not be shorter than 2 seconds, and the clinker ignition loss rate of incineration slags shall be controlled below 5%. 3.2.6 Bag-type dust catcher shall be installed in flue gas purification systems so as to remove the dust pollutants in incineration flue gases. Acidic pollutants including HCl, HF, sulphur oxide, nitrogen oxide, etc. shall be removed with dry method, semi-dry method, wet method or other combined

	processes. Suppression against production of nitrogen oxide shall be preferably considered during combustion control during incineration process of municipal solid wastes, and SNCR systems shall be installed or installation location therefore shall be remained. 3.2.7 During incineration of municipal solid wastes, effective measures shall be taken to control the emission of dioxins in flue gases, and the specific measures include: strict control towards the temperature, detention time and airflow disturbance conditions for flue gas incineration in the combustion hearth; reduction of detention time of flue gases in the temperature zone between 200°C-500°C; besides, spraying devices for absorbents such as activated charcoal powders shall be installed in order to remove the dioxins and heavy metals in flue gases. 3.2.8 For incineration incinerators with the capacity of 300 t/d or above, its chimney height shall not be shorter than 60 m; in case that there're buildings within the radius of 200 m around the chimney, height of the chimney shall be at least 3 m higher than that of the highest building. 3.2.9 Construction style and overall saturation of incineration plants of municipal solid wastes shall be in consistent with their surrounding environment. Style of Plants shall be simple, elegant and economical. Plane layout and spatial layout of plants shall comply with the requirements regarding processes and the installation, disassembly, replacement and maintenance of auxiliary equipment.
Directive Opinions Regarding Strengthening the Pollution Prevention and Control of Dioxins	(IV) Targets and missions Cutting and control measures shall be fully implemented in key industries such as iron ore sintering, electric arc incinerator steel smelting, secondary nonferrous metal recycling and waste incineration, review of clean production shall be further conducted, and advanced technologies and best practical processes and technologies regarding clean production shall be comprehensively promoted, in order to reduce the emission intensity of dioxins in each specific yield (capacity). Comparatively improved system for dioxin pollution prevention and control as well as long-term monitoring mechanism thereof shall be established till 2015 in order to reduce the dioxin emission intensity of key industries by 10% and to basically control the increasing trend of dioxin emission. (XI) Promotion regarding construction of high-standard waste incineration facilities The *Construction Plan of National Urban Municipal Solid Waste Treatment Facilities* and the *Construction Plan of Centralized Disposal Facilities of Hazardous Wastes and Medical Wastes*, elimination regarding waste incineration facilities with serious pollution and out-of-date processes shall be accelerated, and construction of high-standard centralized disposal facilities shall be promoted, in order to reduce the emission of dioxins. Operation management of waste incineration facilities shall be strengthened and the technical requirements of the *Standard for Pollution Control in Incineration of Municipal Solid Wastes* and the *Standard for Pollution Control in Incineration of Hazardous Wastes* shall be strictly followed. Mature technologies are preferably adopted in newly build incineration facilities while types of incineration incinerators that have not been proved in actual application at present shall be prudently adopted. Enterprise environment information disclosure system shall be established and the enterprises engaged in incineration of wastes shall publish its annual environment report to public. Online monitoring shall be applied in major process indexes and pollution factors such as sulfur oxides, nitrogen oxide, HCl, etc. and be connected to local environmental protection department. Emission of pollutants shall be sampled and tested once every quarter. LEDs shall be set conspicuously in plant areas displaying data such as incinerator temperature, detention time of flue gases, temperature of flue gas output, CO, etc. to public for convenience of social supervision.

3.2 Domestic Approvals

Wuhua Incinerator obtained all approvals that are needed for building and formal operation during 2006-2011

1. Project proposal

- Approval of Yunnan Development and Reform Commission for Kunming Municipal Solid Waste Incineration and Power Generation Project, YunFaGaiWaiZi [2006] No. 835, attachment 1:

2. Project EA

- Project EIA: Written decision of administrative license for approval of Yunnan Provincial Environmental Protection Bureau, YunHuanXuZhun [2006] No.51, attachment 3;

3. Project environmental acceptance

- Project environmental acceptance: The acceptance opinion on three synchronizations of Environmental Protection Department of Yunnan, YunHuanYan [2010] No.2 attachment.

The main contents of the domestic replies obtained by the enterprise are summarized in Table 3-2.

4. Total quantity control indexes

The total amount of pollutant emissions approved by by Kunming Environmental Protection Bureau include the following:

Dust: 89.6t/a

SO_2: 359.1t/a

COD:77t/a

Ammonia nitrogen: 5.4t/a

Table 3-2 Summary of Major Contents of Relevant National Official Replies

Name	Articles
Approval of Yunnan Development and Reform Commission for Kunming Municipal Solid Waste Incineration and Power Generation Project	(1) The construction scale of the Project constitutes of the annual waste processing capacity of 365,000 t and the installed gross capacity of 30MW. The construction contents of the Project include the construction of three incinerators with the daily processing capacity of 400t and the installation of two 15MW generator sets, as well as the construction of the supporting facilities. The construction site of the Project is located at the Heilinpu Town in the Wuhua District of Kunming City.
Written decision of administrative license for approval of Yunnan Provincial Environmental Protection Bureau	(1) The control of fume incineration shall be strengthened. The following measure shall be taken to strictly control the generation of dioxin. The sorting of waste shall be strengthened before incineration to minimize the chloric articles and metals of the waste into the incinerator, especially the chloric plastics and copper, whereby the generation of dioxin is controlled from the source. The measures to control the incineration conditions such as incinerator temperature, oxygen content and standing time shall be taken during the incineration. It shall be ensured that the fume is rapidly chilled within one second, so as to skip the temperature range of dioxin regeneration and further reduce the possible of dioxin generation. The measures including the injection of lime mortar and the arrangement of activated carbon absorption unit shall be taken after incineration to ensure the qualified emission of dioxin. (2) Equipment parameters and operating conditions of quench towers shall be strictly controlled for the avoidance of leachate emission. (3) Drainage system of the plant are shall strictly follow the design, construction and management of diverting wastewater from clean water and diverting the rainwater from sewage. Sewage treatment facilities shall be properly designed and constructed, and commissioning of processing conditions shall be paid attention to so as to ensure the operating effects of sewage treatment equipment and to ensure zero emission of sewage during dry season . Saving and comprehensive application of water shall be intensified, and effective measures shall be taken to make it possible to recycle the circulating cooling water and to reduce external emission on the basis that closed cycle of production wastewater is realized without external emission. (4) The fly ash is a type of dangerous waste. Before completing Kunming Dangerous Waste Disposal Center, the fly ash must be solidified and temporarily stored in the temporary storage facility built in the plant area for one year strictly following the *Standard for Pollution Control on Hazardous Waste Storage* (GB18597-2001). After completion of the Kunming Hazardous Waste Disposal Center, hazardous wastes shall be delivered to the Kunming Hazardous Waste Disposal Center for disposal together with the *Letter of Intent concerning Delegation of Disposal* signed between your company and Yunnan Dadi Fengyuan Environmental Protection Co., Ltd. If the fly ash can't be properly disposed of as per relevant national provisions after the Project is operated for one year after completion because Kunming Dangerous Waste Disposal Center isn't completed or is unable to receive the waste during the operation after completion, your company shall voluntarily stop the operation of the Project as per the *Letter of Undertaking for Fly Ash Disposal of Kunming Municipal Solid Waste Incineration and Power Generation Project* (KunXinSiZi (2006) No. 08). The slag shall be put into comprehensive use or properly disposed of as ordinary solid waste. (5) Noise control measures shall be strengthened and up-to-standard boundary noise shall be realized. (6) The Project shall allocate the area within 800m from the temporary storage site of fly ash for sanitary protection width. There is currently no residential area in the sanitary protection width. The local government shall make proper planning and control. No new civil facilities shall be built again in the sanitary protection width.

	(7) Proportion of coal mixed in the input shall be strictly controlled below 20% and the average low hating value of waste input shall be higher than 5,000 kJ/kg. (8) The indicator of pollutant emission quantity of the Project shall be solved by Kunming Environmental Protection Bureau within the range of municipal amount control indicator, including the dust of 89.6t/a, sulfur dioxide of 359.1t/a, COD of 77t/a and ammonia nitrogen of 5.4t/a. (9) Before putting the Project into trial operation, the online monitoring system of fume and dust, sulfur dioxide, oxynitride and hydrogen chloride must be installed.
The acceptance opinion on the three synchronizations of Environmental Protection Department of Yunnan	(1) The waste sorting works shall be further strengthened to prevent the chloric waste from entering the incinerator. The process shall be controlled strictly following the technical operation regulations to maximally control and reduce the generation of dioxin. The operation management and periodic maintenance of the environment protection facilities shall be strengthened and the operation log shall be established, so as to ensure the long-time steady operation and the steady and qualified emission of waste gas and the elimination of accidental emission. (2) The management of the fly ash collection, storage, solidification, handling and transport procedures etc. shall be strengthened strictly following the management requirement of dangerous waste, so as to ensure that the solidified fly ash complies with corresponding requirement of the *Standard for Pollution Control on the Landfill Site of Municipal Solid Waste* (GB16889-2008) and is timely sent to the subzone of the domestic waste landfill site for burial. (3) The environmental management of the waste storage house and raw coal yard in the plant area shall be strengthened to minimize the unorganized emission of stink and prevent the open stacking of raw coal. The planting of high and large trees shall be continued to enhance the greening in the plant area, fully exert the dust absorption and noise reduction effects of plants, reduce the noise in the plant boundary and beautify the environment of the plant area.

3.3 World Bank Safeguards Policies and Environment, Health and Safety (EHS) Guidelines

3.3.1 Compliance with WB safeguards policies

Table 3-3 shows the compliance analysis with the Bank's safeguard policies.

Table 3-3 Compliance with the Bank's safeguard policies

Safeguard Policies	Applicability	Compliance
OP/BP 4.01 Environmental assessment	Yes	Category A project, full assessment, and environmental audit report and environmental management plan prepared. Public participation and information disclosure carried out.
OP/BP 4.04 Natural habitat	No	The Project does not involve any natural habitats
OP 4.09 Pest management	No	The project would incur neither purchase of any pesticide nor additional pesticide application. No action is required according to the Policy.
OP 4.37 Dam safety	No	There are no dams in the project area.
OP4.11 Physical cultural resources	No	Not any cultural heritage or other physical cultural resource has been found.
OP/BP4.36 Forest	No	This project will not result in material changes or deterioration of important forest areas or relevant natural habitats as defined in such policies.
OP/BP 4.12 Involuntary resettlement	No	This project will out activities in existing waste Incineration Power Plant, so no land acquisition and resettlement are involved.
OD 4.20 Indigenous Peoples	No	There're no indigenous residents living in the project area or no indigenous residents will be affected by the project.
OP 7.50 International Waterways	No	There are no international waterways in the project area.
OP/BP 7.60 Disputed area	No	There're no international waterways in the project area.

3.3.2 World Bank Group Environmental Health and Safety Guidelines

The World Bank Group Guidelines applicable to this project include the applicable guidelines of General Guidelines and sub-guidelines related to municipal solid waste incineration.

The EHS Guidelines contain performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them.

The applicability of the EHS Guidelines should be considered in the light of of the hazards and risks established for each project on the basis of the results of an environmental assessment in which site-specific variables, such as host country context, assimilative capacity of the environment, and other project factors, are taken into account. The applicability of specific technical recommendations should be based on the professional opinion of qualified and experienced persons. When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in these EHS Guidelines are appropriate, in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific

environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment.

The *Environment, Health and Safety Guidelines for Waste Management Facilities* includes measures and performance levels relevant to MSW incineration, including management of air emissions, ash and other residuals, water effluents, noise, and occupational health and safety, etc. These measures have been incorporated into the project EMP. The Waste Management Facilities guidelines also make reference to emissions standards for MSW incinerators from European Union and the United States for this sector. Detailed analysis of the two referenced standards and comparison with applicable Chinese standards, and actual emission levels are presented in this report..

3.4 Stockholm Convention BAT/BEP

The key relevant articles in Stockholm Convention and the BAT/BEP Guidelines on POPs are as the followings

(1) Best Environmental Practices

- Reducing the overall mass of wastes that have to be disposed of by any means serves to reduce both the releases and residues from incinerators. Diversion of biodegradables to composting and initiatives to reduce the amount of packaging materials entering the waste stream can significantly affect waste volumes. Responsibility for waste minimization lies only to a minor extent with the operator of a waste incineration plant. However, coordination and harmonization of relevant activities on different organizational levels (e.g. operator, local, regional or national level) is of major importance for protection of the environment as a whole.
- Kerbside or centralized sorting and collection of recyclable materials (for example, aluminum and other metals, glass, paper, recyclable plastics, and construction and demolition waste) also reduces waste volume, saves valuable resources and removes some non-combustibles. Responsibility for these activities must be coordinated between relevant levels.
- Operators must be able to accurately predict the heating value and other attributes of the waste being combusted in order to ensure that the design parameters of the incinerator are being met. This can be done using the results from a feed monitoring program of key contaminants and parameters where sampling and analysis frequencies and rigor would increase as feed variability increases.
- To achieve optimal prevention of formation, and capture, of chemicals listed in Annex C, proper care and control of both burn and exhaust parameters are necessary. In continuous feed units, the timing of waste introduction, control of burn conditions and post-burn management are important considerations
- These events are normally characterized by poor combustion, and consequently create the conditions for formation of chemicals listed in Annex C. For smaller, modular incinerators operating in batch mode, start-up and shutdown may be daily occurrences. Preheating the incinerator and initial co-firing with a clean fossil fuel will

allow efficient combustion temperatures to be reached more quickly. Wherever possible, however, continuous operation should be the practice of choice. Independent of the operation mode waste should be fed into the combustion system only when the required temperature (e.g. above 850℃) is reached. Upsets can be minimized through periodic inspection and preventive maintenance. Incinerator operators should not feed the waste during filter bypass ("dump stack") operations or during severe combustion upsets.

- Routine inspections by the operator and periodic inspections by the relevant authority of the furnace and air pollution control devices should be conducted to ensure system integrity and the proper performance of the incinerator and its components.
- High-efficiency combustion is facilitated by establishing a monitoring regime of key operating parameters, such as carbon monoxide (CO), volumetric flow rate, temperature and oxygen content.
- Carbon monoxide, oxygen in the flue gas, particulate matter, hydrogen chloride (HCl), sulphur dioxide (SO_2), nitrogen oxides (NOx), hydrogen fluoride (HF), airflows and temperatures, pressure drops, and pH in the flue gas should all be routinely monitored.
- Bottom and fly ash from the incinerator must be handled, transported and disposed of in an environmentally sound manner.
- Regular training of personnel is essential for good operation of waste incinerators. Creating and maintaining public goodwill towards a waste incineration project is critical to the success of the venture.

(2) Best Available Technicques

- Environmental concerning location is the most important for a new MSW incinerator.
- Proper management of time, temperature and turbulence (the "3 Ts"), as well as oxygen (airflow), by means of incinerator design and operation will help to ensure the above conditions. The type and order of treatment processes applied to the flue gases once they leave the incineration chamber is important, both for optimal operation of the devices and for the overall cost-effectiveness of the installation. Best available techniques involve applying the most suitable combination of flue gas cleaning systems, including the dust (particulate matter) removal techniques, acid gas removal techniques, fuel gas polishing techniques, NOx removal techniques, etc.

3.5 Comparison of Approved Domestic Standards with EHS Guidelines

The EHS Guidelines for Waste Management Facilities make reference to European Union[2] and the United States[3] air emission standards for MSW incineration. Table 3-4 presents a

[2] EU Directive 2000/76/EC, applicable to MSW and Hazardous Waste Incinerators

[3] US EPA Standards of Performance for Large Municipal Waste Combustors, 40 CFR Part 60 Subpart Eb

detailed comparison of current Chinese national-level standards with EU and US standards for air emissions for MSW incinerators.

For dioxins, the EU has adopted 0.1 ng TEQ/m3. The United State standard is about 0.2 ng TEQ/m3 (after unit conversion) for new MSW incinerators. A broader review of international and domestic dioxin emission standards show that Japan, Beijing, Shanghai, Hong Kong SAR, and Taiwan, China have also adopted 0.1 ng TEQ/m3; while the US standard for existing MSW incinerators is about 0.5 ng TEQ/m3.

Chinese national level regulations have two sets of standards for dioxins emission for MSW incinerator. The current national standard, i.e. Standard for Pollution Control on the MSW Incineration (GB18485-2001), was issued in 2001 and stipulated a dioxin emission standard of 1ng TEQ/m3. However, in 2008, MEP issued a document (No. 82, HuanFa [2008]) stipulating that new power generating MSW incinerators (also known as "Waste-to-Energy" or "WTE") must meet 0.1 ng TEQ/m3. Therefore, Konggang and Xishan incinerators whose EIAs were approved after the effectiveness of the 2008 MEP document have to meet 0.1 ng TEQ/m3, while Dongjiao and Wuhua incinerators are subject to the 1 ng TEQ/m3 emission limit. During appraisal of the project, MEP issued updated Standard for Pollution Control on the MSW Incineration (GB18485-2014). According to this updated standard, for dioxins the old standard GB18485-2001 will remain effective until December 31, 2015; while starting from Jan 1st, 2016, all existing MSW incinerators will have to meet 0.1 ng TEQ/m3.

The emission standards for conventional air pollutants vary over different sampling durations in a general sense. The Chinese national standard does not specify such durations. The updated GB18485-2014 stipulates such durations. The EHS guidelines partially specify such durations. To make the comparison more meaningful, Table 3-4 includes emission standards of the original EU and US standards that are not quoted by the EHS Guidelines. For example, EU 1-hr average TSP, NOx and SO2 are added. In addition, the US standards use different unit systems that have to be converted to be comparable with Chinese and EU standards.

It should be noted that in the case of EU and US standards, different parameters present different levels and they are associated with different sampling time. This may reflect differences in country context, assimilative capacity of the environment, and other technical factors such as sampling and monitoring methodologies and combustion techniques.

Table 3-4 Comparison of Chinese national standards with EU and US standards for air emissions of MSW incinerators

Parameter			National Standard, GB18485-2001	National Stanard, GB18485-2014	EHS Guidelines (expanded)		
Ref.	Pollutants	Time	mg/m3	mg/m3	EU mg/m3	USA	USA converted (mg/m3)
1	Total Suspended Particulates	1-hr average	80	30	30	20	20
		24-hr average		20	10	n/a	
2	Carbon Monoxide (CO)	1-hr average	150	100	50-150	50-150ppmv	62.5-187.5
		24-hr average		80			
3	Nitrogen Oxides (NOx)	1-hr average	400	300	400	n/a	n/a
		24-hr average		250	200-400	150ppmv	Not Convertible
4	Sulfur Dioxides (SO2)	1-hr average	260	100	200	30ppmv or 80% reduction, whichever is less strigent	85.7 or 80% reduction, whichever is less strigent
		24-hr average		80	50		
5	Hydrochloric Acid (HCl)	1-hr average	75	60	60	25ppm or 95% reduction, whichever is less strigent	40.7 or 95% reduction, whichever is less strigent
		24-hr average		50	10		
6	Mercury (Hg)	Test Average	0.2	0.05	0.05-0.1	0.05 mg/dscm or 80% reduction, whichever is less	0.05 or 80% reduction, whichever is less

						strigent	strigent
7	Lead (Pb)	Test Average	1.6	See below Ref. 11	See below Ref. 10	0.14	0.14
8	Cadmium (Cd)	Test Average	0.1	See below Ref. 9	0.05-0.1 (0.5-8 hr average)	0.01	0.01
9	Tl+Cd	Test Average	n/a	0.1			
10	Total Metals	/	n/a	n/a	0.5-1 (0.5-8 hr average)	n/a	n/a
11	Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V	Test Average	n/a	1.0	n/a	n/a	n/a
12	HF	/	n/a	n/a	1	n/a	n/a
13	Dioxins (incl. furans)	/	1 ng TEQ/m3; 0.1 ng TEQ/m3 for new incinerators built after 2008	0.1 ngTEQ/m3 Test average	0.1 ngTEQ/m3 (6-8 hr average)	13 （ng/m3)(total mass)	0.2 ng TEQ/m3
Note			Effective for existing MSW incinerator until December 31, 2015	To be effective for existing MSW incinerator on Jan 1st, 2016		7%o oxygen, dscm: milligrams per dry standard cubic meter	mg/m3=ppmv*compound molecular weight/22.4

4 Environmental and social Baselines

4.1 General Information

The city of Kunming is the capital of Yunan Province in southwest China. Kunming is located in the middle of Yunnan-Guizhou Plateau. Its overall topography is featured with high northern part and low southern part. Most of the city has an altitude between 1,500m and 2,800m. The city presents low latitude-plateau-monsoon weather feature and has an annual average temperature of 15 ^{o}C and an annual precipitation of 1,035mm.

Kunming has a total area of 21,473km^2, divided into 6 districts, 7 counties and a county level city. It has a population of 7.26 million. The urban area has a population of 5.3 million (2013). The city has a GDP of CNY301 billion and an average per capita GDP of CNY 41,458 in 2012. The city is also a critical transport hub in southwestern China by having the fifth largest airport in China, several national expressways, and intensive road networks connecting the remainder of the province.

Kunming has good ambient air quality compared to the rest of China. Based on Kunming Environmental Quality Reports during 2010-2012, pollutants monitored on a daily basis, including PM10, SO2, and NO2, all met applicable national ambient air quality standard. They also show a slightly improving trend over the period. In 2012, the monitored annual average PM10, SO2 and NO2 concentrations were 67, 34, and 36 ug/m3, respectively, while, the national Ambient Air Quality Standard (GB3098-2012, to be effective in Jan 1, 2016) stipulates standards of 70, 60 and 40 ug/m3 for the three air pollutants in Kunming City.

4.2 Location

Kunming Wuhu incinerator is located at the Puji Street Committee in the Wuhua District, northwestern Kunming City. It is in northwestern Kunming, about 10km from its urban area. See figure 4.1.

The plant area faces the No.108 national highway – the Kunlu Highway on the south and the Kunsha Road on the east. The Kunsha Road crosses the No.108 national highway on the east side of the plant area and is adjacent to the provincial highway – the class II highway from Kunming to Fumin. Therefore, the traffic is convenient.

4.3 Natural environment

4.3.1 Soil

The soil in the area is of complex and diverse types and clear vertical distribution, represented as crisscross distributed mountain plateau type horizontal zonal soil, vertical zonal soil and intrazonal soil. According to soil assessment and categorization, the whole zone is divided into 5 soil groups, 9 subgroups, 10 soil genera and 25 soil species.

According to the soil-forming conditions, the soil can be divided into the following 5 groups as per the forming process and soil features: red soil, purple soil, lime soil, paddy soil and bog soil. 9 subgroups include red soil, yellow red soil, red lime soil, submergic paddy soil, acidic purple

soil, lateral seepage paddy soil, hydromorphic paddy soil, gleyed paddy soil, and bog paddy

Figure 4-1 location of 4 candidate incinerators – Wuhua – northwestern Kunming

soil. 10 soil genera include red soil, red purple soil, lime red soil, basalt red soil, sand stone, shale red soil, red soaked soil, red soil paddy soil, alluvial paddy soil, and lake deposit paddy soil. 25 soil local types include red soil (developed from lime), astringent red soil (developed from lime), gravel soil, chicken dung soil, astringent red soil (developed from basalt), oil red soil, fragrant surface soil, acid white soil, red sand soil, purple goat liver soil, red soaked soil, red clay field, yellow clay field, white clay field, daub field, hill sand field, chicken dung soil field, oil sand soil field, sand clay field, river sand field, black clay field, cold-waterlogged field, ocean field, and red soil field (developed from basalt).

4.3.2 Climate

The incinerator is located in the geographical position of low latitude and high altitude. Subjected to the influence of the monsoon wind and altitude difference (the height difference of 846.5m), the stereophonic climate of distinct dry and wet weathers, winter without severe cold, summer without intense heat, cold rainy days and distinct upper, middle and lower layers, which is the low altitude plateau monsoon warm and cool climate. It is featured with all seasons like spring, warm in morning and cool at night, sunny in winter and spring, rainy in summer and autumn, and also has several small climate features such as regional small-scale "lakefront", "temperature inversion", "cold lake", etc. "Cold spell in later spring" generally occurred in March and April and the cryogenic freezing occurred in July and August are

hazardous climate that may endanger spring crops.

Annual average temperature is 14.7°C, January is the coldest month with the average temperature of 7.4°C, July is the hottest month with the average temperature of 21.05°C, and annual average temperature difference is 12~13°C. Annual sunshine duration is 2,470.3 h which is relatively sufficient, but it is not evenly distributed all over the year. In dry season, there're more sunny days than cloudy and foggy ones, average sunshine duration is 1,443.3 h, accounting for 58.9% of the whole year. Its summer is controlled by the southwest marine moisture, so there're more cloudy and foggy days despite of the hot temperature. However, its sunshine duration is generally 1,006.6 h only which is not that long as the dry season, accounting for 41.1% of the whole year. The month with the longest sunshine duration is March which reaches 285.1 h while the shortest month is September with only 103.7 h of sunshine.

Rainfall mostly comes from the southwest warm and wet airflow of the Bay of Bengal in Indian Ocean and its annual rainfall is between 800~1,200 mm. Rainfall is not evenly distributed in every season, and May to October is rainy season with average rainfall of 912.1 mm, accounting for 88.7% of annual rainfall. Among which, rainfall is centralized in June to August with average rainfall of 614.9 mm, accounting for 59.8% of annual rainfall. Rainfall in winter only accounts for 10~12% of annual rainfall. For two seasons including dry season and wet season, average rainfall difference between them over the years is 7~8 times and difference in number of rainy days is 3~4 times.

Average days with strong wind (17 m/s) amounts to 21 and no tornado and wind shear are observed. Average wind speed over the years is 2.7 m/s and the prevailing wind direction is from the northwest; average days of thunderstorm over the years is 64, total average cloud cover is 5.9 while average low cloud cover is 5.0.

Located in the middle of central Yunnan in Yunnan-Guizhou Plateau, droughts frequently happen in spring and summer due to the effects of low-latitude, high altitude and monsoons, however, droughts may also happen in winter and spring. In late spring and early summer, the climate will greatly change and temperature drops due to atmospheric circulation in the northern hemisphere, freezing or advection radiation frost may occur and also hail, frost and windstorm.

4.4 Socio-economic conditions

The Wuhua District governs nine street committees and two townships, including the Huashan Street committee, Huguo Street committee, Daguan Street committee, Longxiang Street committee, Fengning Street committee, Lianhua Street committee, Hongyun Street committee, Heilinpu Street committee, Puji Street committee, Shalang ethnictownship and Changkou township.

The gross regional product achieved in 2011 was 60.8 billion Yuan, up 13% over the same period of the last year. The expected social retail goods were 34.6 billion Yuan, up 22% over the same period of the last year. The expected total investment in fixed assets was 32.52

billion Yuan, up 30% over the same period of the last year. The general budget revenue of the local finance achieved was 2.542 billion Yuan, up 23.71% over the same period of the last year. The proportion of the three industries was adjusted to 0.3:56.2:43.5. The expected urban per capita disposable income was 22,951 Yuan, which was actually increased by 10.03%. The expected per capital net income of rural household was 8,821.60 Yuan, which was actually increased by 10.9%. The urban upgrading and reconstruction are accelerated. The urban environmental quality is continuously improved. The social undertakings development is accelerated. The support capability is continuously enhanced. The social environment is harmonious and stable.

4.5 Sensitive receptors and other facilities

To the south of the incinerator there are two environmental sensitive targets. One is Puji Community, the other is Dayangtian village, both are about 1km away from the incinerator. See Table 4-1 and Figure 4-2.

There are several industrial facilities in the vicinity of Wuhua Incinerator. In the immediate north of incinerator there is a feces treatment plant. There are several construction material plants near the Wuhua incinerator as well.

Table 4-1 Sensitive Object in Surrounding Environment of Plant

No.	name of village	Households	Location relative to the incinerator	distance (km)
1	DaYangTian village	500	southwest	1
2	PuJi Community	500	southeast	1

Figure 4-2 Wuhua incinerator and nearby village/community

5 Review of Operation Conditions

This chapter examined the design and operational aspects of Wuhua incinerator. Stockholm Convention BAT/BEP Guidelines and WBG EHS Guidelines are referenced and compared where applicable.

5.1 Basic Information

5.1.1 Facilities

The basic composition of the Wuhua incinerator is shown in Table 5-1. Figure 5-1 present the incineration plant layout.

Table 5-1 Wuhua's engineering information

Main works	Item	Unit capacity and number of equipment	Total capacity
	Incinerator	3×400t waste incinerators of circulating fluidized bed of different specific weights (two in operation and one on standby)	Actual value of 1000t/d (maximum 1500t/d)
	Steam turbine	2×12MW condensing type	12MW
	Generator	2×12MW	12MW
Auxiliary works	Waste transport	The waste is collected and transferred by the subordinate environmental protection office of the local environmental and sanitary management department.	
	Water supply system	The domestic water is the spring water nearby. The industrial water, firefighting water and chemical water are all from the water body at Tanglangchuan River.	
	Waste storage	A raw waste storage house 60m long and 18m wide and a product waste storage house of the same size are arranged, storing in total of 7,600 tons of waste to satisfy the waste consumption of the Project in one week. The waste storage house is of enclosed and micro negative pressure structure.	
	Coal-burning system	The coal shed is of 18m span, 6m column spacing and the total length of 30m, being capable of storing approximately 1,200t of coal to satisfy the coal consumption of 7 days.	
	Ash storehouse	A 500m3 ash storehouse is arranged for the Project to provide approximately five days of ash storage capacity for the Project.	
	Slag storehouse	Two 500m3 slag storehouses are arranged for the project to satisfy approximately four days of slag storage capacity for the project.	
	Chimney	A reinforced concrete chimney with the outlet inner diameter of 300m and height H=80m is provided.	
	Other matters	HCl, 10m3 NaOH storage tank, 100m3 lime powder silo. The volume of the storage tank of activated carbon is 6m3.	
Environmental protection engineering	Fume purification system: adopting the dry purification tower of fume plate + ejection of activated carbon + bag filter		
	Sewage treatment system: The leachate of waste and other production and domestic sewage are treated by the in-plant sewage treatment station and reused in the places such as make-up water of the ring cooling system after treatment, eliminating the external emission and reserving the back ejection system of waste leachate.		
Living facilities	Supporting domestic facilities cu has the comprehensive office canteen and shift change dormitory.		

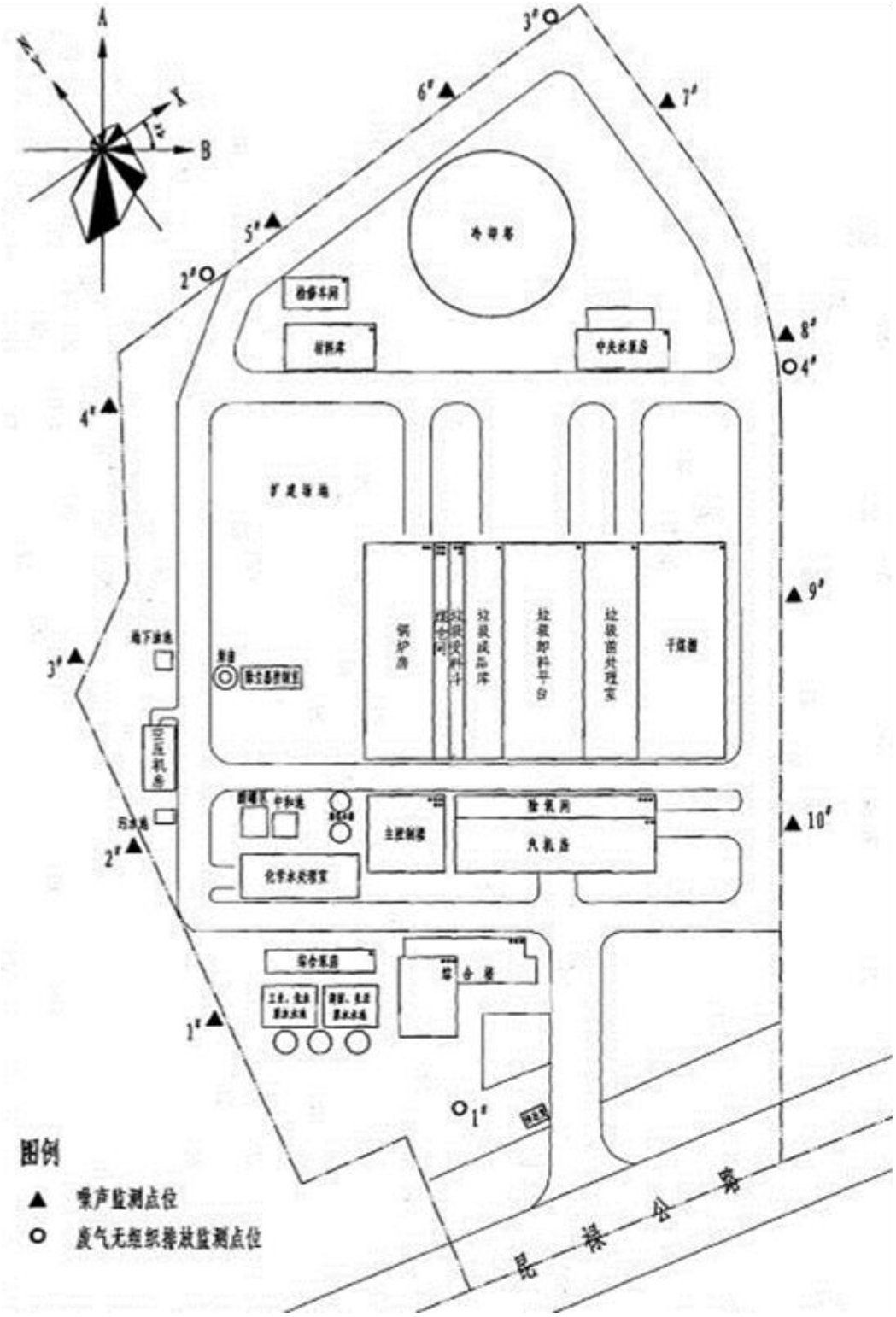


Figure 5-1a Wuhua Incinerator Layout

Figure 5-1b Wuhua Incinerator Satellite View

5.1.2 Economic and technical indicators

The economic indicators are shown in Table 5-2.

Table 5-2 Technical Index Table of Project

No.	Name	Unit	Quantity
1	Gross land area	m^2	66670
2	Gross floor area of building (structure)		16121
3	Plant road and square area	m^2	15540
4	Greening area		21562
5	Rate of green space	%	32.34
6	Length of fence wall of plant area	m	910

5.1.3 Operation information

Wuhua incineration plant started official operation in July 2008. In 2012, the incineration plant processed 374,180t household wastes and generated power 11609.0MW. In 2013, the incineration plant processed 419,671.96t and generated power 12533.0MW.

5.1.4 Service area

Service area includes mainly the municipal solid waste produced in the Wuhua District of Kunming City.

5.2 Process Analysis

Production processes can be divided into pre-treatment system of wastes, auxiliary coal-fired system, incineration system, domestic sewage treatment system, thermal system and power system. Process flow of the whole plant is shown in Figure 5-2.

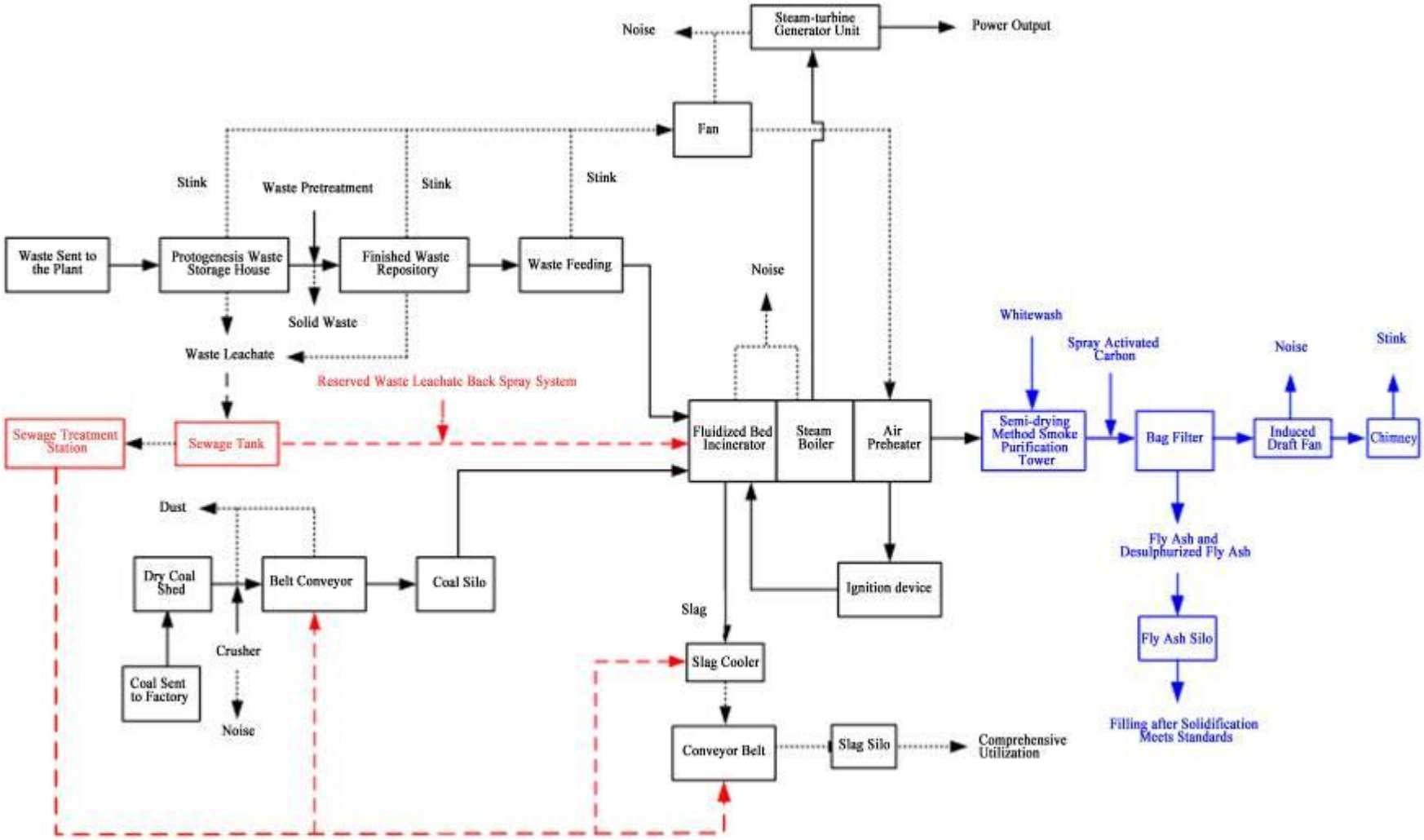


Figure 5-2 Process flow of Wuhua incineration plant

5.2.1 Pre-treatment system

The municipal solid waste is collected and transported to the high level platform in the incinerator plant using the special enclosed waste truck, metered by the electronic truck scale and unloaded in to the raw waste storage house. According to the personnel and object flow separation principle, the special enclosed waste truck enters the plant area from the north gate.

The raw waste storage house is 60m long and 15m wide, providing the storage capacity of 2,200 tons of waste. Two 3m3 bridge grab cranes are arranged in the storehouse. The waste is transferred to the waste pretreatment system using the grab, passes through the procedures such as crushing, de-ironing, bulk removal, sieving and manual sorting and then is transferred to the enclosed product waste storage house for storage.

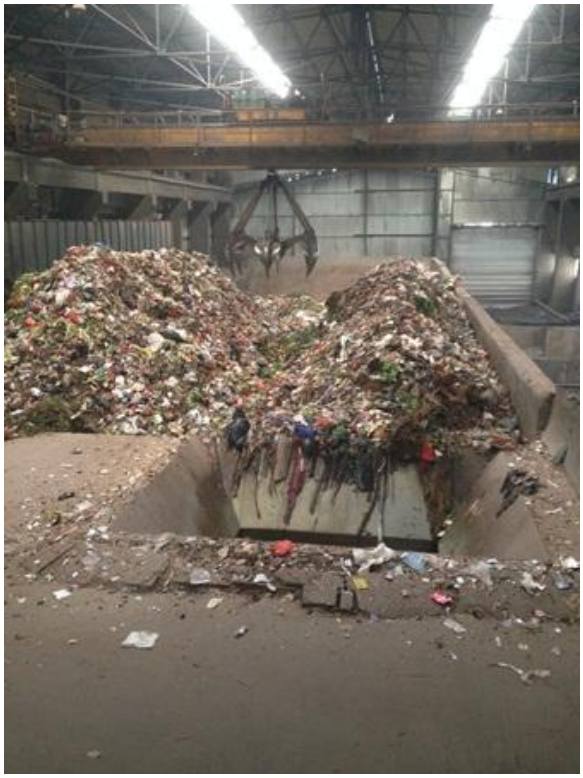
The product waste storage house is 63m long and 15m wide, providing the storage capacity of 2,200 tons of waste. The pretreated waste is moved into the 15m high level grab using the 3m3 hexapetalous grab and constantly sent into the incinerator hearth by the waste feeder.

To effectively control the odor generation of the waste during the courses of transfer, pretreatment and storage, the waste transporter, raw waste storage house, waste pretreatment room and product waste storage house are all of enclosed structure. Specifically, the seal at the waste emission outlet of the raw waste storage house is reinforced using air curtain and the air inlet of the primary fan of the incinerator is arranged in the product waste storage house. The primary fan extracts the odorous air in the waste storage house to the incinerator as the primary air for combustion. This puts the waste storage house in micro negative pressure condition and suppresses the outward spreading of the stink in the storehouse, so as to reduce the influence of the odor on the operation environment and air temperature in the plant area.

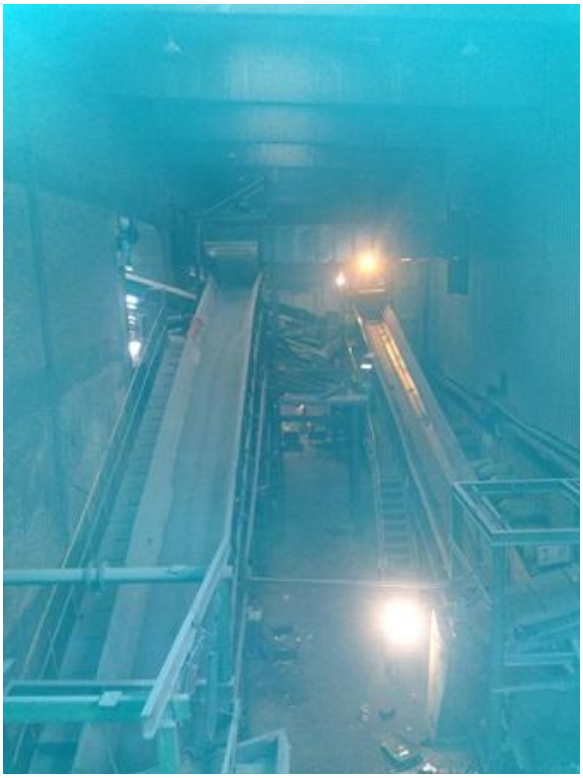
The municipal solid waste is generally divided into organic and inorganic wastes. The organic wastes generally constitute of the kitchen waste, waste paper, waste plastics and waste rubber, waste textile etc. The inorganic wastes generally include the metal, glass, ash etc.

With the improvement of the living standard of the urban residents and the popularity rate of natural gas in recent years, the composition of the municipal solid waste greatly varies, mainly represented as the continuous reduction of the uninflammable constituents such as the coal slag and the rising of the organic constituents and scrap. This gradually increases the heat value of the municipal solid waste and better facilities the incineration and power generation.

The enterprise received in total 419671.96 tons of domestic waste in 2013.



Shredder entrance



Sorted wastes conveyor

Figure 5-3 Pretreatment facilities in Wuhua

5.2.2 Auxiliary coal fuel system

The average heat value of raw domestic waste is approximately 4187kJ/kg and varies with seasons. To further improve the heat value, stabilize the operation of incinerator and reduce the generation and emission of the dioxin, technically a certain amount of fuel coal can be added as the auxiliary fuel.

The fuel coal used by the company is mainly provided by Yunnan Coal Supply and Marketing Company. The fuel coal used is the Guishan bituminous coal of the heat value of 22350kJ/kg.

The fuel coal is transported by external vehicle. No coal transport vehicle fleet is arranged by the company.

5.2.3 Incineration system

(1) Incinerator

Stockholm Convention Guidelines of BAT/BEP indicates the following articles that are relevant to CFB furnaces for MSW incineration.

- Fluidized bed technology requires municipal solid waste to be of a certain particle size range – this usually requires some degree of pretreatment and the selective

collection of the waste.

- Fluidized bed furnaces and spreader/stoker furnaces are well demonstrated for finely divided, consistent wastes such as refuse-derived fuel.

And for incinerating conditions, the Guidelines states

- Proper management of time, temperature and turbulence (the "3 Ts"), as well as oxygen (airflow), by means of incinerator design and operation will help to ensure the best combustion conditions.

Wuhua incineration plant uses fluidized bed furnace. And before MSW is incinerated, waste separation and removal of non-combustibles at the incinerator are carried out. A shredder has been installed in order to make the feedstock more homogenous.

By design the temperature in furnace is above 850℃ with over 2-second-residence time. In general, the practices in Wuhua incineration system are consistent with above BAT/BEP guidelines. However, highly humid waste may compromise the optimal combustion temperature, which is addressed through maintaining wastes in garbage pit for 3-5 days in order to dewater the wastes and increase caloric value. Further, based on international practices, the slime addition can be improved, and bag filter material can use Polytetrafluoroethene (PTFE) coated materials which is more effective in catching fine particles.

Specific combustion process and control of Wuhua furnace is described in below. See Table 5-3 for details of combustion conditions. Figure 5-4 shows its central control room.

Quartz sand is used as inactive fluidizing medium (also known as bed materials) in incinerators. When ignition, 0# diesel and auxiliary fired-coal are used to raise the temperature of bed materials to or above the stable combustion temperature, then wastes will be transported to the incinerators for normal incineration. Input of wastes and coal only accounts for 5% of the total material amount in the incinerator, therefore, input of wastes will not cause major fluctuation against the temperature of fluidized bed.

Hot wind from air preheater will cause strong turbulence and mixing of medium the fluidized bed, so temperature of wastes will be rapidly increased and the wastes will be rapidly burnt. For slags after incineration of wastes, they will be emitted from the slag emission port in the bottom of the incinerator hearth and the flue gas temperature at the output of incinerator hearth should be kept above 850°C; while for solid particles failed to be completely burnt in flue gases, they will be separated by two cyclone separators and will be sent to incinerator hearth for second incineration. High-temperature flue gases will successively pass the superheater, evaporation convection tubes, coal economizer and air preheater with the traction of draught fans, and the heat of the gases will be transferred to the water in each heated surfaces to turn the water into vapor with high temperature and high pressure, which will be sent to steam turbine generator units for power generation.

Figure 5-4 Central Control Room of Wuhua Incineration Plant

Table 5-3 Furnace Combustion Condition

No.	Item	Unit	Index
1	In-plant standing time of waste into incinerator	d	3-5
2	Waste volume into incinerator	t/h	16.6
3	Water content of waste into incinerator	%	35%
4	Dosage of auxiliary fuel	t/h	3.096
5	Oxygen content	%	8.2%
6	Primary air intake	m3/h	40000 m3/h
7	Secondary air intake	m3/h	38000 m3/h
8	Incinerator temperature	℃	850℃

The heat energy produced by waste incineration is converted into steam by the boiler and all of the steam produced by the boiler is used to drive the steam turbine generator set for power generation and the power generation system without waste heat. The fume from the boiler outlet is purified by the semi-dry spray and absorption tower and bag filter and before being emitted.

5.2.4 Air pollution control system

For air pollution control after the combustion unit, Wuhua applies a comprehensive air pollution control system including semi-dry scrubber+ activated carbon injection + electrostatic precipitator + bag filter, which is consistent with Stockholm Convention BAT/BEP guidelines.

Specific flue gas treatment processes in Wuhua are described as following.

- High-temperature flue gas from boilers will first enter semi-dry reactor. Certain amount of activated carbon powders should be added at the inlet of reactor in order to absorb heavy metals and dioxins from flue gases.
- Large quantities of circulating dusts removed by $Ca(OH)_2$ and bag filter will enter the mixer at the bottom of the reactor, after humidification and fluidized mixing, they will enter reactor in which mass transfer and heat transfer reactions will happen between fluidized materials and acidic gases such as SO_2, HCl, etc. in the flue gas in order to remove most of them in the flue gas. The dry powder of absorbent $Ca(OH)_2$ is used during deacidification, its average particle size should be 200 meshes with the purity equal to or larger than 85%.
- After that, the flue gas will be leave the reactor from its top and enter bag filter. Fine dusts removed are sent to fluidized silo via air slider through which part of the dusts will be sent to the mixer via conveyor while part of the dusts will be overflowed to the dust (fly ash) transport system. Treated flue gases will be channeled to the stack by draught fans after they have passed the bag filter.
- End product fly ashes will be sent to fly ash process workshop where they are treated through chelating and solidification.

Figure 5-5 Wuhua Incinerator's Stack

5.2.5 Slag and fly ash management

According to Stockholm Convention BAT/BEP Guidelines, bottom ash, or slag, from incinerators designed and operated according to best available techniques (i.e., incinerators showing a good burnout behavior) tends to have a very low content of chemicals listed in Annex C of the convention, in the same order of magnitude as background concentrations in urban soils (i.e., <1–10 ng I-TEQ /kg ash). Boiler ash levels tend to be higher (20–500 ng I-TEQ /kg ash) but both are well below the average concentrations found in fly ash. Both the convention guidelines and WBG EHS guidelines suggest bottom ash and fly ash shall be managed separately. This is applied in Wuhua incinerator. In Wuhua, coarse grits are transported out of the plant for reuse. Fine slags are resent to the incinerator to supplement the bed materials.

One issue identified is that the bottom slag may contain large size objects despite presorting at garbage pit is already conducted. The large size objects may be stuck at the slag outlet. In this case, operator has to stop waste feed into the furnace, lower the temperature and remove the objects before restart normal incineration. This fire-pressing and restart cycle takes around an hour and obviously affect normal combustion process. If it takes place very frequently, emission control becomes more challenging. This issue was partially resolved by installing shredder and enhancing presorting process.

According to Stockholm Convention BAT/BEP Guidelines, fly ash is disposed of in dedicated landfills in many countries. However, pre-treatment is likely to be required for this to constitute BAT. Treatment and disposal options for solid residues from flue gas control systems include solidification or stabilization with Portland cement (or other pozzolanic materials), alone or with additives or a number of thermally based treatments, followed by appropriate disposal (based on anticipated releases from the treated residuals). Some residues with low levels of contamination may require no treatment before disposal in a landfill, based on an assessment of their contaminant release potential.

In Wuhua incinerator, fly ash management uses "chelating agent + cement solidification/stabilization". The process is as follows.

In ash silo, fly ashes and cements are automatically weighted and fed into the double-roller mixer according to required proportion to mix the materials; chelating agent solution is added according to required proportion at the same time. The several powder-like materials and liquid binders can be fully mixed before being fed into the shaping machine. Materials are fully kneaded and compacted in the kneading and shaping machine, and are molded via the mold in the header. Then the brick-like products are sent to the stockpile via belt-type conveyors for curing and stabilization over a period of time. Finally the solidified fly ashes are sent to landfill.

Overall this slag and fly ash management approach at Wuhua incinerator is in line with the Stockholm Convention BAT guidelines. Chapter 6 of the report discusses the leaching rest results of the solidified ash.

5.2.6 Leachate and wastewater management

Municipal solid wastes contain large amount of water, the leachate is seeped from the grids under the bottom of the front wall of waste storage pit and is collected in the sewage ditch arranged out of the waste storage pit, through which it will be temporarily stored in waste leachate pool. When the leachate in the tank reaches a certain amount, the leachate is injected back to the boiler. Other production and domestic wastewater is periodically collected in the sewage tank and then extracted to the sewage treatment plant for treatment using sewage truck.

5.3 Raw materials use, storage and transport

5.3.1 Raw materials use

Main raw material of Wuhua incineration plant is MSW. In 2012, the incineration plant processed 374,180t household wastes. In 2013, the incineration plant processed 419,671.96t.

Sources, application conditions and storage quantities of raw materials are shown in Table 5-4.

Table 5-4 Table for Consumption and Storage of Main Raw Materials

No.	Item	Consumption	Maximum storage capacity	Stored period	Sources
		t/d	t	day	
1	Waste	1000 (design)	3400	4	Wuhua District
2	Coal	176.5	4000	90	Xuanwei
3	Lime powder (desulfurizer)	2.4	30	6	Fuming
4	Quick lime (desulfurizer)	2.06	30	15	Fuming
5	Activated charcoal	0.42	6	10	Sichuan
6	0# diesel	0.26	10	30	Local
7	Scale inhibitor	0.1	2	20	Local
8	Cement	12	100	8	Local

5.3.2 Transport method of raw materials

Raw materials of this project are transported to the plant by vehicles. The domestic wastes are separately collected by the local sanitation department, transported to the enterprise using the special enclosed waste truck, metered by the electronic truck scale and unloaded into the raw waste storage house.

5.3.3 Turnaround method and system of raw materials in plant

Turnaround of raw materials inside the plant should follow various systems of the company, warehousing procedures shall be handled by warehouses upon delivery of materials and personnel use such materials should go through the product issuing procedures.

5.4 Diagnosis of Operation

Several issues of Wuhua incinerator operation have been identified and summarized in below.

5.4.1 Pretreatment issues

According to the operation records of Wuhua incineration plant, the feedstock is of low quality at around 4 MJ/kg, which can be increased to design specification at around 5-6 MJ/kg after reduction (removal of construction waste, leachate drainage) before it is fed to the furnaces. Often there are abnormal garbage objects in the feedstock, see Figure 5-6.

Figure 5-6 Abnormal objects sorted from raw waste in Wuhua incineration plant

5.4.2 Incinerator control issues

Generally speaking, CFB furnace has better mass and heat transfer process than mass burn furnace. However, this advantage can be significantly offset by non-homogenous raw garbage. Due to the poor quality of raw garbage and problems with pretreatment system, running the CFB furnaces in Wuhua in a steady manner is challenging. The incineration plant installed shredder and put in place other improvement measures in pretreatment system to deal with it since it had been put into formal operation. This had a major impact on system operations and substantially reduced down-time (lines have been running for a week in a row maximum).

In addition, control of combustion conditions in the furnace relies on monitoring of operating parameters such as temperatures at different combustion chambers, and also need to be considered together with conditions in downstream flue gas treatment system. For example, CO concentration after combustion chamber gives a good indicator of combustion completeness. CO concentration detection can be added and corresponding control strategy developed to better control furnace running. In addition, HCl monitoring has been absent for the last three years. Overall the instrumentation system is highly unreliable.

5.4.3 Flue gas treatment system issues

Wuhua's bag filter uses PPS material which barely meet basic dust removal requirement, but falls short of capturing very fine particles. Replacing it with PTFE coated filter and installing baghouse breakage detection device is much needed.

Lime and activated carbon mixing with flue gas seem inadequate as well. There is also no metering of dosage of lime and activated carbon.

6 Pollution Control and Emission Compliance

The previous chapter examined design and operating aspects of Wuhua incinerator, this chapter examined pollution control measures and emission levels based on monitoring data available. WBG EHS Guidelines, i.e. EU an US air emission standards and newly issued Chinese national standard for MSW incinerators are compared where applicable.

6.1 Air Pollution Control

6.1.1 Air pollution control processes

Air emissions from incineration include suspended solids (fly ash); acidic gas such as SO2, NOx, and HCl; heavy metals such as Hg, Pb, and Tl+Cd; organics such as dioxins and furans and incomplete combustion product CO. Other air pollutants in incinerator plant may include ordor generated at storage and transportation stage.

The Wuhua incinerator applies "semi-dry fume purification tower – activated carbon absorption tower - bag filter" to treat air emissions from incineration. Generally speaking, the semi-dry purification process is to remove acidic gas mainly; while activated carbon plus bagfilter target adsoption and capture of heavy metals and dioxins/furans. After baghouse, the fume gas is emitted into the atmosphere through an 80-m high chimney. See Figure 6-1.

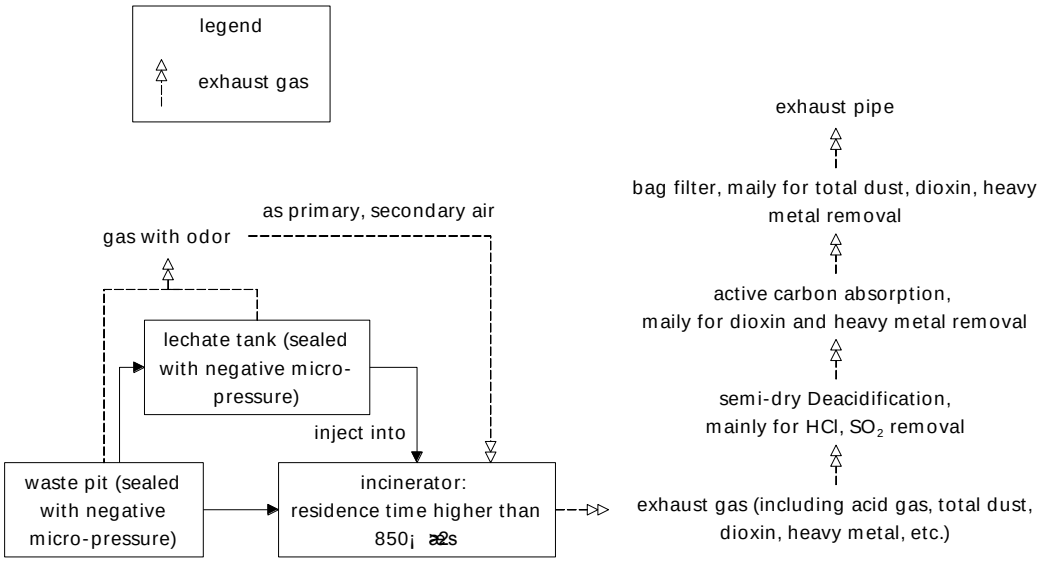


Figure 6-1 Generation and Treatment of Air Emissions in Wuhua Incinerator

In Wuhua Incinerator, the final air emissions are monitored at stack using the online monitoring system. The incinerator has standard online monitoring facilities to monitoring stack emissions. The online monitoring data, including SO2, NOx, CO, O2, TSP, and flow rate; are connected to the Environmental Surveillance Center of Yunnan Province and the Environmental Surveillance Center of Kunming City. Environmental protection bureau regularly check and maintain the sampling equipment to ensure the accuracy of the fume monitoring

data. Local environmental protection bureau carries out quarterly supervision monitoring to the incinerator. The quarterly grab samples were analyzed and compared with online monitoring data to ensure that the online monitoring facilities work properly.

1. Dioxin and heavy metal control

- Operating conditions control

In order to minimize the generation of dioxins during incineration, the incinerator temperature is controlled at 850℃~950℃. The oxygen content at the outlet of the incinerator hearth is controlled at 6~8%, and the fume standing time in the incinerator is larger than 2 seconds. Meanwhile, air distribution is staged to improve the flow structure in the incinerator.

- Rapid quenching

Drafted by the large power draught fan, the fume at 850℃~950℃ successively passes through the overheater, evaporative convection bank, coal economizer and air preheater, so as to rapidly decrease the fume temperature (The height of the fume pipe is within 28m. The fume flow speed is around 12m/s.) to approximately 170℃ to effectively control the generation of dioxin.

- Absorption by activated carbon

Activated carbon is added to the inlet of the fume treatment unit to trap a small volume of dioxin emitted from the fume. Then, the fume is sent into the semi-dry purification tower + activated carbon ejection + bag filter and finally emitted via the 80m chimney.

2. Acidic gases control

In Wuhua, semi-dry scrubbing through spraying slurry Ca(OH)2 (slaked lime) at the inlet of flue gas treatment system is applied in order to react with SO2, HCl etc. Products and remaining lime then are captured at bag house. Semi-dry scrubbing can remove more than 90% of the HCl in flue gas. In addition it can effectively remove organic pollutants and heavy metals. When coupled with bagfilters, the combined processes can remove more than 99% of heavy metals in flue gas. The other significant advantage of semi-dry scrubbing, compared to wet scrubbing, is that it uses less water and does not result in wastewater if well managed. Semi-dry scrubbing coupled with baghouse is the most commonly adopted techniques in China and internationally, and is recommended techniques by USEPA and EU.

3. NOx control

NOx can not be effectively removed through reacting with slaked lime at this stage. Commonly used techniques include combustion-related measures and/or selective catalytic reduction (SCR) or selective non-catalytic reduction (SNCR) systems that are either after the baghouse or directly in furnace. Neither NCR or SNCR is applied in Wuhua. The way to control NOx thus largely depends on control of combustion conditions, such as temperatures and O2 concentrations.

6.1.2 Air emission levels

Wuhua Incinerator was put into official operation in July 2008. Per domestic regulation on environmental monitoring and inspection, district environmental protection bureau carries out quarterly supervision monitoring through manual sampling; the incinerator owner commissioned licensed monitoring institute to sample and monitor dioxins once a year; and online monitoring of several air pollutants are in place as well.

Table 6-1 presents results and compliance analysis based on regular inspection monitoring made by local EPB, and dioxins monitoring by licensed monitoring institute during August 2010- January 2014. Compliance analysis based on these monitoring is summarized in below.

- Monitored air pollutants fully met currently applicable national standards (GB18485-2001). MEP issued amendment to this standard in May 2014, referenced GB18485-2014, which will be effective for existing MSW incinerators on January 1st, 2016. The new standard has considerably tightened emission limits for each pollutant, and is at the same level of the EU and US standards in general.
- Dioxins monitoring was conducted 12 times, of which 6 results are below 0.1 ng TEQ/m3. Highest value is 0.89.
- Total Suspended Solids, or TSP, monitoring was conducted 9 times, of while 6 results are above US standard (20 mg/m3). Tested maximum value is 79.9 mg/m3.
- Sulfur Dioxides, or SO2, monitoring was conducted 9 times. More than 50% of the results exceeded the new national, EU and US standard. A tested maximum value is 148 mg/m3, indicating acidic gas removal efficiency needs to be improved.
- Hydrocloric Acid, or HCl, monitoring was conducted 4 times. All the test results can meet the new national, EU and US standard.
- Nitrogen Oxides, or NOx, monitoring was conducted 9 times. Maximum concentration is 334 mg/m3, well above new national standard (250 mg/m3, 24-hr average; 300 mg/m3, 1-hr average), though below EU 1-hr average of 400 mg/m3. US standard uses ppmv unit and is not convertible because compound molecular weight is not fixed.
- Cadmium, or Cd, monitoring was conducted 9 times and have not been detected.
- Lead (Pb) and Mercury (Hg) monitoring was conducted 4 times and are all below the new national standard, EU and US standard.

Wuhua incineration plant is the oldest one among the four MSW incineration plant in Kunming City. Overall, its air emission levels of dioxins, TSP, SO2 and NOx are considerably higher than the other three.

Table 6-1 Wuhua Incinerator Air Emission Levels and Compliance Analysis

(Inspection Monitoring Results)

***Note**: Ministry of Environmental Protection (MEP) issued Standard for Pollution Control on the MSW Incineration (GB18485-2014) issued in May 2014. The existing 4 MSW incinerators will have to meet the new standard starting from January 1st, 2016, while the existing GB18485-2001 will remain effective until December 31, 2015.*

Pollutants	**Max. monitored concentrations**	**National Standard (GB18485-2001)**	**National Standard (GB18485-2014)**	**EHS EU**	**EHS USA**
Dioxins (TEQ/m3)	0.057-0.89	1.0	0.1`	0.1	0.2 ng
TSP (mg/m^3)	16-79.9	80	20(24-hr average) 30 (1-hr average)	10 (24-hr average) 30 (1-hr average)	20
SO_2 (mg/m^3)	24.1-148	260	80(24-hr average) 100 (1-hr average)	50(24-hr average) 200(1-hr average)	85.7 or 80% reduction, whichever is less strigent
NOx (mg/m^3)	140-334	400	250 (24-hr average) 300 (1-hr average)	200-400 (24-hr average) 400 (1-hr average)	150ppmv (24-hr average)
Pb (mg/m^3)	0.063-0.071	1.6	1.0 for (Sb+As+Pb+Cr+Co +Cu+Mn+Ni+V)	0.5-1(0.5-8 hr average) for total metals	0.14
Cd (mg/m^3)	ND	0.1	0.1 for (Tl+Cd)	0.05-0.1 (0.5-8 hr average)	0.01
Hg (mg/m^3)	0.031-0.05	0.2	0.2	0.05-0.1	0.05 or 80% reduction, whichever is less stringent
HCl (mg/m^3)	0.56-8.09	75	50 (24-hr average) 60 (1-hr average)	10 (24-hr average) 60 (1-hr average)	40.7 or 95% reduction, whichever is less stringent

Table 6-2 presents online monitoring results recorded since June 18th, 2012 until end of 2013. Online monitoring covered TSP, CO, NOx, SO2, O2 and flow rate of flue gas. Emissions levels of each parameter are generally low. However, it is also noted that some online monitoring data were either too high or too low. Its HCl online monitoring device was broken hence no monitoring data is available, indicating the maintenance and validation of this online monitoring equipment may not be adequate.

Table 6-2 WuHua's on-line monitoring results (started from Jun. 18th, 2012)

year	pollutant	unit	max	min
2012	TSP	mg/m^3	16.91	10.44
	CO		100.53	20.42
	NOx		222.76	0
	SO_2		174.68	0
	O_2	%	19.52	10.28
	volumetric flow rate	m^3/h	361570	193460
2013	total dust	mg/m^3	53.74	19.49
	CO		5.78	0
	NOx		121.67	46.46
	SO_2		251.09	94.88
	O_2	%	14.45	9.42
	volumetric flow rate	m^3/h	395748	316844

Figure 6-2Wuhua Incineratror's Online Monitoring for Air Emissions

According to domestic regulations, the environmental acceptance monitoring is the basis for granting formal operation, while inspection monitoring is the basis for EPB enforcement.

Online monitoring results are used by EPB for reference purpose

6.1.3 Control of odor and non-point source air pollutants

Odor and other air pollutants, including H2S, NH3 and TSP, arise from non-point sources such as garbage pit (bunker) at pretreatment unit.

To prevent the escaping of odor from the pretreatment unit, negative pressure is maintained in the space of the waste pit and leachate tank and the differential pressure is always maintained with the adjacent zone (ΔP=~20Pa). The air flow direction is: temporary waste storage house (unloading room) → waste pretreatment zone → waste storage house and not reversed.

To effectively control the odor produced during the waste transfer, pretreatment and stacking, the raw waste storage house, waste pretreatment room and product waste storage house are of enclosed structure and the seal at the waste emission port of the raw waste storage house is enhanced using air curtain. The air inlets of the primary and secondary fans of the boiler are arranged at the product waste storage house. The primary and secondary fans extract the odorous air in the waste storage house into the boiler as the primary and secondary air for combustion and to keep the waste storage house at micro negative pressure.

Additionally, Wuhua Incinerator applies odor removal system which is installed in the raw waste storage house of the waste pretreatment workshop to suppress the emission of odor.

Table 6-3 presents monitoring results of non-point source air emissions Wuhua incinerator.

Table 6-3 WuHua's non-point source monitoring results

pollutant	max concentration (mg/m^3)	approved standard(mg/m^3)	assessment
H_2S	0.003	0.06	meet the approved standard
NH_3	0.102	1.0	
TSP	0.19	1.5	

6.1.4 Control of Total Pollutant Amount

Apart from national standards for MSW emission, Wuhua incineration plant also needs to meet Total Pollutant Amount control targets approved by provincial environmental protection department. The targets are the ceiling for annual emission amount of certain pollutants. Table 6-4 shows that Dongjiao met these targets.

Table 6-4 WuHua's total pollutant control indexes

pollutant	exhausted totally (t/a)	approved index	assessment
SO_2	112.3	359.1	meet the requirements
TSP	19.1	89.6	

6.2 Wastewater management

Waste water pollution source(s) include: leachate generated in waste pit as well as process and domestic waste water.

- Leachate

Leachate is discharged to the two leachate collecting tank of the waste pit in a centralized

manner and injected back to the incinerator for incineration;

- ÀDomestic sewage

The incineration plant has no sewage treatment system. All domestic wastewater is discharged into septic tanks and sent to Kunming wastewater treatment plant by sewage transportation trucks.

- ÀRecirculation of Cooling Water

Most of the cooling water are recycled and reused in the cooling water system. A small amount of the cooling water, after neutralization and coagulation and filtering is used to water coal and slag yard. There is no discharge of cooling water.

6.3 Fly Ash and Other Solid Wastes

Main solid waste includes fly ash, slag and domestic waste. Domestic waste generated in the plant is incinerated together with other municipal solid waste. Fly ash is hazardous waste because it often adsorbs considerable amount of dioxins and heavy metals.

After being collected by bag filter, fly ash is pumped to an ash silo with a capacity of 1 × 500m3. Through stabilization workshop at a fixed time, it is added with cement, small stones and activated carbon for stabilization. After stabilization, it is transported and disposed of at a special section of Xijiao Landfill. It is required that ash spilling or leaking from the ash silo shall be avoided. At the same time, fly ash treatment records should be made appropriately.

Figure 6-2 shows how fly ahs is stabilized through cement solidification. Figure 6-3 shows fly ash that has been made into bricks with cement, stone and chelating agent in order to meet leaching levels for metals and salts.

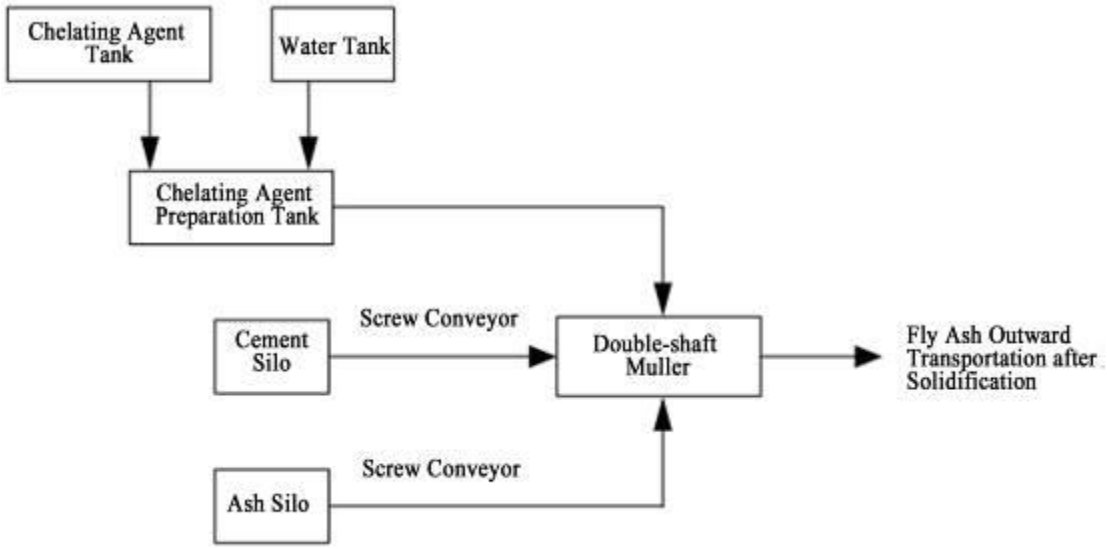


Figure 6-2 Fly ash stabilization process at Wuhua Incinerator

Figure 6-3 Stabilized fly ash

Bottom slag is non-hazardous waste and can be reused. Slag discharged through the slag cooler at the bottom of the incinerator, and then transported to slag pit by a slag conveyor with a volume of 1 × 500m3 for temporary storage. In order to reduce the dust during cleaning and transport of slag, the slag temporarily stored should be transported after it is treated thoroughly, and then transported by car to Yunnan Mucheng Building Materials Co., Ltd. at the back of the plant for producing brick.

The production and treatment of above solid wastes are listed in Table 6-5.

Table 6-5 Bottom slag management at Wuhua Incinerator

No.	Annual	Name	Output (t)	Utilization of General Solid Waste		
				Utilization (t/a)	Application and Means	Rate of utilization (%)
1	2012	Slag	20473.37	20473.37	Yunnan Mucheng Building Materials Co., Ltd. is responsible for the production of baking-free brick	100
2	2013	Slag	21486.16	21486.16		100

Table 6-6 Fly ash management at Wuhua Incinerator

No.	Annual	Hazardous Wastes Treatment					
		Name	Output (t/a)	Recovery (t/a)	Treatment (t/a)	Application	Removal Rate (%)
1	2012	Fly ash	375229.84	0	375229.84	Xijiao Waste Landfill Yard	100
2	2013		419671.96	0	419671.96		100

According to Article 6.3, the Standard for Pollution Control on the Landfill Site of MSW (GB16889-2008), the solidified fly ash cannot be landfilled unless the leaching test results meet the standard limits. The leaching test results of fly ash made in 2008, 2011, 2013 and 2014 are listed in Table 6-6. It is noted that data of 2008 was carried out by ZheJiang Monitoring Center.

Data of 2011 and 2013 were carried out by Jiangsu Levei Environemntal Testing Technology Institute Co. Ltd, while dioxin data of 2012 and 2014 was detected by TaiZhou Monitoring Station.

Table 6-7 Leaching test results of fly ash (mg/L)

	standard[4]	fly ash[5]				assessment
		2008	2011	2013	2014	
Hg	0.05	0.00069	0.00002	ND		meet the Standard for Pollution Control on the Landfill Site of MSW (GB16889-2008)
Cu	40	ND	0.0408	0.474		
Zn	100	ND	0.0029	0.264		
Pb	0.25	ND	0.017	0.201		
Cr^{6+}	0.15	ND	ND	0.116		
Be	0.02	ND	ND	ND		
Ba	25	3.51	0.262	1.74		
Ni	0.5	ND	0.00122	0.482		
As	0.3	ND	0.00201	0.00662		
T-Cr	4.5	0.06	0.115	ND		
Se	0.1	ND	0.00044	ND		
dioxin(ugTEQ/kg)	3.0	0.382	0.157/0.382		0.38	

According to the fly ash leaching test, the fly ash of Wuhua Incinerator is safe to be landfilled. It's noted that existing MSW incinerator emission standard (GB18485-2001) only stipulates that fly ash needed to treated as hazardous waste and does not give explicit requirement on the monitoring frequency of fly ash quality. The said Pollution Control on the Landfill Site of MSW (GB16889-2008) issued in 2008 allows landfill to receive stabilized fly ash as long as the fly ash meet quality standards.

6.4 Noise control

The main noise sources of the Project are noises produced by the crusher in the waste pretreatment system, by the crusher in the supported coal-fired system, by the incinerator induced draft fan in the incineration system, by the screening machine in the slag removal system as well as by the steam turbine generator, fan and boiler steam exhaust device in the thermodynamic and electric power systems.

The noise control measures include selection of low-noise equipment in terms of type selection, sound insulation of plant building, provision of damping pad and installation of silencer, etc.

According to the monitoring report, value of noise at boundary of industrial enterprises at day and night are respectively 50.9-70.0dB (A) and 51.5-68.6dB (A), with a maximum additional value of 10dB (A) in daytime and a maximum additional value of 13.6dB (A) at night, meeting the requirements of *Emission Standard For Industrial Enterprises Noise at Boundary* (GB12348-2008) for second category

It is also noted that theWuhua incineration plant is influenced by traffic noise from western 3rd ring-road, making the background noise level quite high.

[4] Table 1 of the Standard for Pollution Control on the Landfill Site of MSW (GB16889-2008)

[5] Data listed here are the max results.

7 Environmental, Health and Safety Management System

7.1 Environmental management system

Wuhua incineration plant has established an environmental protection standard system with standardized procedure documents of the Environmental Operation Control Procedure, the Identification, Assessment and Update Procedure for Environmental Factors and the Control Procedure for Emergency Preparation and Response, etc.

The incineration plant's environmental management codes also includes the Management Provisions for Solid Wastes, Exhaust Gases and Sewages, the Management Provisions for Fly Ash Solidification, the Emergency Plan for Environmental Accidents, the Network Chart of Environmental Protection Management, the Management Provisions on Environmental Protection, the Leading Group for Environmental Protection Affairs, and the Management Provision on Hazardous Wastes, etc.

On institutional and staffing, the incineration plant has 13 positions involved in safety, health and environmental protection, including one full-time staff. They work in a coordinated manner; and with clearly defined responsibilities. The management hierarchy includes three levels, i.e. senior management including general manager/deputy general manager, relevant division chiefs, and dedicated engineers. The plant's safety and environmental division is responsible for overseeing the implementation, the operational divisions is responsible for implementation of various codes and procedures, other relevant divisions provide necessary supports.

The Wuhua incineration plant fulfills its environmental, health and safety responsibilities through the following activities.

- Implementation of environmental law, regulation, and standard;
- Establishment and implementation of the pollution control and environmental management system;
- Organization of environmental monitoring, and maintenance of environmental files;
- Stipulation the training program to raise the staffs' skill;
- Treatment of the relationship with social communities coordinated by the environmental protection authorities;
- Formulating the emergency response plan, and participate in the emergency treatment for environmental issues;and
- Inspection and supervision of the implementation of environmental protection law and regulation.

Among them, the responsibilities for environmental monitoring include the following.

- To formulated annual plans on environmental monitoring and implementation plans as well as build up regulations and carry out the regulations;

- To complete the monitoring assignments regulated in the environmental monitoring plan related to project on schedule and compile reports according to related regulations and take charge of submitting reports;
- To actively participate in the investigation and treatment of accidents when sudden pollution accidents related to project occur;
- To take charge of the maintenance and inspection of monitoring devices to ensure normal monitoring;
- To organize and supervise the implementation of environmental monitoring plans.

7.2 Environmental safety assurance and emergency response

7.2.1 Pollution accident prevention and environmental management measures

The environmental emergency plan named as *Emergency Plan Collection of Yunnan Green Energy Co., Ltd.* has been stipulated according to the potential environment al accidents, in which the tasks of emergency response are specified, along with the relevant staffing and responsibilities; the pollution accidents are categorized in this Plan, and prepared with the corresponding procedures of treatment, including the rehearsal of such procedures. Feasibility is tested through the usual drills to improve the operability of the plans and to further improve the its content. Strengthen the company's leadership and operation of the technical staff training, operational workers must strictly operate in accordance with rules. Equipment management department should regularly and carefully check the fixtures, equipment and emergency facilities.

In accordance with the existing sources of risk and actual production situation, set leachate back spray devices, sewage collection tank, fly ash collection tank and harmless treatment in the plant, circulating and floating incinerator for semi-dry flue gas desulphurization, acid exclusion system and bag filter and other emergency measures. If a pollution incident occurs, responding in accordance with the measures described in the plan can effectively control the accidents.

7.2.2 Main risk factors

The main risk factors are including the chemicals and the production. The chemicals include the diesel for starting the incinerator, H_2S and NH_3 of MSW storage and treatment. While the main environmental risks during the production are the abnormal discharging of the pollutants, the explosion of the incinerator, etc.

7.2.3 Emergency response system

The Wuhua incineration plant has established its emergency directorate, after taking into account the specific needs of the plant, and has formed up its professional emergency response teams undertaking the tasks of field commanding, public disclosure and logistic support, accident investigation, rehabilitation and professional works. Additionally, it has prepared the environmental emergency plan for accidents of certain nature, type and impact scale, namely the *Emergency Plan Collection of Yun'nan Green Energy Co., Ltd.* (or the

Collection in short), including the following documents:

1. Safety accident emergency plan
2. emergency plan for the interruption of electricity
3. Environmental accident emergency plan
4. Emergency plan for acid and alkali leakage accident
5. Emergency plan for fire accidents
6. Emergency plan for electric shock
7. Emergency plan for air crush accident
8. Emergency plan for food poisonin$_g$
9. Emergency plan for traffic accidents
10. Emergency plan for loader traffic accident
11. Emergency plan for air tank explosion
12. Emergency plan for silo pump explosion
13. Emergency plan for pipe - broken accident
14. Emergency plan for Boiler pressure pipe explosion
15. Emergency plan for mechanical injury

Appendix I: Emergency Team Configuration

Appendix II: Accident Reporting Procedure

Appendix III: Frequently Dialed Phone Numbers for Emergency Rescue

Appendix IV: Contact Numbers of the Emergency Team

7.3 Personal protective equipment

The Company has completed an allocating system for labor protection equipment, taking into account the natures of different positions, delivering the protection gears like working suits, work boots, safety helms, gloves, earplugs, dust masks, anti-poison respirators and dust goggles, etc. In places where toxic and harmful gases are likely to be produced, forced ventilation equipment, toxic and harmful gas detecting instruments and emergency treatment equipment such as eye washers and shower are provided. Personal protective equipment shall be complete and the employees shall be able to use them correctly.

7.4 Environmental monitoring

(1) Online monitoring

- Flue gas

The flue gas monitoring equipment is installed in the chimney. The flue gas sampling mouth is

at the platform 32.5 m from the bottom of the 80-meter chimney.

The on-line monitoring system was established in 2012, and the data was connected with Environmental Protection Bureau of Yunnan Province and Kunming Environmental Protection Bureau by networking.

Monitoring items: SO2, HCl, CO, NOx, total dust, O2, temperature, flow rate, flow velocity.

(2) Commissioned environmental monitoring

- Flue gas

The company commissions a qualified environmental monitoring unit to collect sample and monitor its flue gas emissions and surrounding environment of the plant. The main contents are as follows:

Monitoring frequency: 4 times a year

Monitoring position: 80m from the bottom of flue gas chimney, platform, 32.5m from the bottom, and outlet of bag filter.

Monitoring items: Dioxin, SO2, HCl, NO_x, CO, total dust, heavy metal (Hg, Cd, Pb etc.).

- Non-point air pollutant sources

Monitoring frequency: 4 times a year

Monitoring position: the 4 direction points at the plant boundary;

Monitoring items: NH_3, H_2S, TSP and stench concentration

- Noise

Monitoring frequency: 4 times a year

Monitoring position: the 4 direction points at the plant boundary;

7.5 Environmental capacity building

In order to improve the enterprise's environmental capacity, the enterprise organizes environmental monitoring and control equipment manufacturers to provide training for us so that we can have a better understanding of the operation modes of environmental monitoring system and environmental control equipment as well as emergency treatment measures.

For the purposes of elevating the environmental emergency accident settlement capacity and strengthening the training of rescue team, the emergency headquarters shall start from the practical situation to carry out a simulation drilling at least once a year against sudden environmental accidents likely to be caused to the Company's hazardous objects.

7.6 Training budget

The budget for environmental management and monitoring in 2013 is listed in the regular expenditure of plant budget. Refer to Table 7-1.

Table 7-1 Environmental management and maintenance costs

No.	Item	Budget amount	Unit
1	Monitoring expenditure	15	RMB 10,000
2	Inspection and maintenance costs for environmental protection facilities	20	RMB 10,000
3	Costs for environmental protection materials	80	RMB 10,000
4	Training expenses	2	RMB 10,000
	Total	117	RMB 10,000

8 Information disclosure and public consultation

Information disclosure and public consultation is critical for the project design and implementation. During the GEF project preparation, the PMO, social and environmental assessment consultants and incinerator owners carried out public consultation. The chapter examined the public consultation prior to the building of candidate incinerators, during incinerator operation, and during the the GEF project preparation.

During preparation of the proposed GEF project, two rounds of public participations were conducted in accordance with World Bank OP4.01 Environmental Assessment, through a combination of opinion surveys and public meetings in project area. Local communities, villagers, and other affected people were consulted.

The first round of public participation for the project preparation was carried out in May, 2013; the second round was carried out in March 2014 after the draft full environmental audit and environmental management report had been disclosed on March 10.

Based on the results of the public consultation, a comprehensive public engagement plan to be carried out during project implementation has been developed and incorporated into the project design and EMP.

8.1 Public Consultation before Building Wuhua Incinerator

In 2005, during EA preparation of Wuhua Incinerator, the EA information disclosure and public consultation was carried out per domestic regulation. Information disclosed included the following.

a) Project information, such as site location, capacity, etc.

b) Potential environmental impact and pollution control measures

c) The EIA conclusions

8.2 Public consultation for environmental acceptance and incinerator operation

After trial operation, Wuhua undertook environmental acceptance monitoring carried out by the Yunnan Environmental Monitoring Center, and the acceptance information was posted on the website of the Yunnan Provincial Environmental Protection Department. This is a formal information disclosure mandated by administrative authorities based on monitoring results. Information disclosed included the following.

d) Environmental facilities and measures at the trial operation stage, such as incineration air pollution treatment, waste transport requirements, and noise, wastewater and solid waste treatment measures;

e) Monitoring results of key pollutants, such as fume concentration, dioxin levels, and SO_2, CO and NO_X levels;

f) Public opinions at the trial operation stage.

Since the Wuhua incinerator was put into operation, it has established a regular public engagement program which includes open the incinerator to the public such as school students.

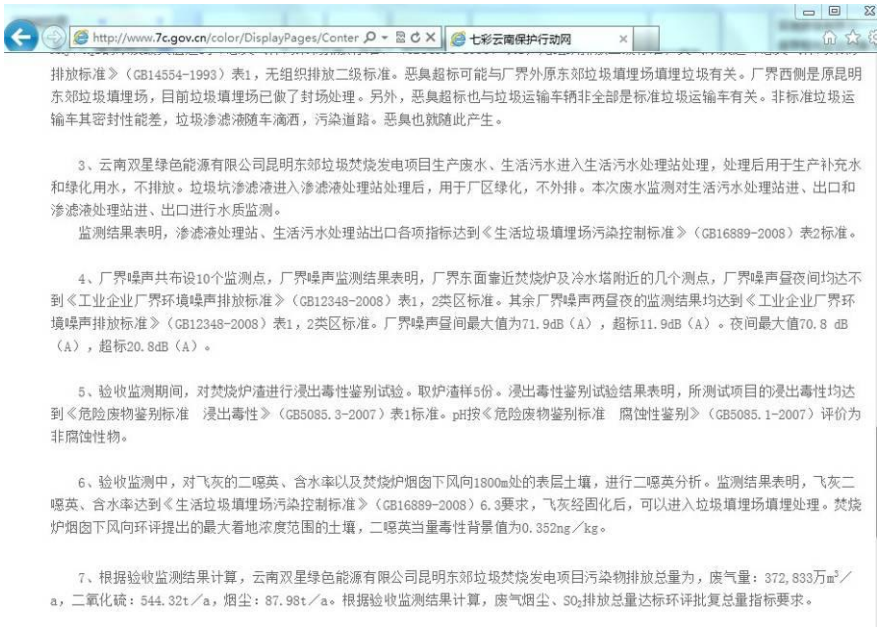


Figure 8-1 Environmental acceptance disclosure at website of YEPD

During the MSW incinerator operation, local environmental protection bureau, through its environmental monitoring stations, carried out regular inspection monitoring to the incinerator. Results are disclosed through government information release platform. The MSW incinerators engage specialized monitoring institute to conduct dioxins monitoring at least once a year because local environmental monitoring stations can not do dioxins monitoring. The dioxins monitoring results haven't been disclosed to the public yet.

In addition, the MSW incinerators have implemented public outreach program, though at uneven levels. For example, Wuhua and Dongjiao incinerator periodically organized school students to visit the incineration plant. Konggang and Xishan are also open to the public on demand (see Figure 8-2).

School students visit incinerator

Villagers visit incinerator

Figure 8-2 Students and Local Community Visit Kunming MSW Incinerator

8.3 Public consultation during the GEF project preparation

During project preparation, two rounds of public consultations were conducted in accordance with World Bank OP 4.01. Social assessment was considered part of environmental assessment process, and the public consultations were carried out in an integrated manner to address the social and environmental concerns of the public. A combination of questionnaire surveys, focused group meetings, interviews and public meetings was carried out. The first round of public participation was carried out in May, 2013; the second round was carried out in March 2014 when the draft full environmental audit, environmental management plan and social assessment reports had been disclosed locally on March 10, 2014.

This section gives a complete picture of the public consultations carried for the four MSW incinerators. More detailed information on public consultation is included in the Social Assessment report of the project

8.3.1 First-round public consultation

In May, 2013, the project environmental and social assessment work plan, including the project information, incinerator information, such as combustion conditions, pollution control measures, and pollutant emission levels, etc. was disclosed. Public consutation were carried out concequently.

During this consultation, public awareness, knowledge and opinions on MSW incineration, incineration air emissions and their impacts, existing information disclosure mechanism were investigated. Public opinions on enhancing information disclosure and public engagement, and grieveance redress mechanism were addressed. The results of the first round public consultation are summarized in below. More details regarding consultation process and analysis can be found in the project social assessment report.

1. Public perception of and attitude to MSW Incineration

In summary, consulted people do not much about incineration as a method of MSW disposal. More than 50% of the people consulted indicated that they didn't know MSW incineration. 87.7% of the people consulted indicated that they didn't know what dioxins is about. 23.1% of the people consulted are against MSW incineration; 31% indicated they "understood" it; 26% said they supported MSW incineration. These percentages vary across different groups of age, gender, income levels, education levels, urban and rural people.

Based on these results, it is suggested that information disclosure and public participation shall be improved through the following measures.

- First, information disclosed on MSW incineration should include incineration method, knowledge of dioxins, and their impacts on human health, the environment and crops;
- Second, attention should be paid to needs of certain groups, such as demand and acceptability levels of women, old people, the poorly educated, low-income groups and MLS (Minimum Living Security) households;
- Third, publicity and education on the improvement of MSW incineration techniques and institutional capacity building should be conducted to mitigate opposition to MSW incineration.

2. Public awareness of air emissions from MSW incineration

Only 67% people consuted knew MSW would emit pollutants. People are more sensitive about the color, smell and precipitated dust. Of the air pollutants emitted from MSW incineration, 56.1% people consulted knew dust; 26.2% knew carbon dioxide; and 25.8% knew dioxins. Less than 20% of the people knew other pollutants such as NOx.

Overall it is found that the awareness of harmful MSW incineration emissions among people consulted is quite low, which is also an important reason why some residents repulse and detest MSW incineration. Therefore, during information disclosure on MSW incineration emissions, the following apsects shall be paid particular attention.

- First, it is necessary to conduct systematic publicity through formal and reliable channels, such as environmental protection authorities and community committees, covering types, impacts and emission standards of incineration gases, in order to correct prevailing rumors on MSW incineration;
- Second, the acceptability and capacity of women, old people, the poorly educated and low-income groups should be considered during publicity and education;
- Third, information should be preferably disclosed through formal channels, such as environmental protection, urban administration and sanitation authorities. Monitoring results of MSW incineration emissions should be disclosed in densely populated areas by means of brochure, leaflet, bulletin board, website, TV, broadcast, etc.
- Fourth, information on MSW incineration emissions should be advisably disclosed once a month, and dioxin emissions may be disclosed at the same frequency as monitoring.

3. Public opinions on information disclosure of MSW incinerators

The older the plant is, the fewer people knew about it when it was built. Wuhua was the first incinerator in Kunming, starting building in December 2006; only 5.2% of the people consulted knew the project. While, Konggang started building in 2011; 37.9% of the people consulted knew the project. This shows that over the past years information disclosure on MSW incineration has been improving. Overall, disclosed information of these MSW incinerators' siting, EIA, and current emission status seem to be inadequate. Dioxin test results of all the four incinerators haven't been disclosed to the public yet.

Peope consulted has a low satisfaction toward the current information disclosure status of the four MSW incinerators. 55.3% of the people consulted considered it unsatisfactory; 14.3% consider it satisfactory.

People consulted are more interested in to know the impacts directly relevant to their health and day-to-day life. 78.4% of the people consulted considered that health impacts of MSW incinerator shall be disclosed; 68.4% wanted the pollutant concentratons to be disclosed; 45% requested to know how fly ash is treated; and 27.2% wanted the incineration plants to build grievance redress channel.

According to existing information disclosure mechanism of the four MSW incinerators, it is concluded that:

- First, the 4 MSW incinerators should strengthen information disclosure on MSW incineration techniques, incineration gases and other MSW incineration emissions by means of LED panel and plant visit. The 4 MSW incinerators should install LED panel at their gates so that nearby residents can learn MSW incineration information readily. Plant visits may be organized by the MSW plants and community committees in order to improve residents' awareness and satisfaction level.
- Second, monitoring results of dioxins and other incineration gases should be posted at community committees or in densely populated areas.
- Third, local residents expect the MSW incinerators to disclose pollutant emissions, and their environmental and health impacts at the operation stage, and take measures to reduce the discharge of foul odor, dust, etc.

4. Willingness for Community Participation

Overall the people consulted have a low willingness to complain about the impacts of MSW incineration. Analysis show the low willingness is related compliant effect. Only 6.7% of the people consulted have filed grievance; 34.8% of them doesn't acknowledge the effect of their complaint; 60.9% doesn't think they have been responded or got results. Their experiences have affected others' willingness as well. In addition, the fact that people don't know about complaint channel have affected their willingness to complain.

22.5% of the people consulted have visited MSW incinerator. Of those people, 16.5% are against building MSW incinerator and 41.6% support building MSW incinerator. While, among

those people who have never visited a MSW incinerator, 24.9% oppose building MSW incineration plant and 21.5% support building MSW incinerator. Obviously, those people who have visited MSW incinerator are more positive to MSW incineration than those who haven't.

78.9% of the people consulted consider it necessary to build community environmental protection action group and 57.9% say they are willing to join it.

According to willingness survey on community participation, it is concluded that:

- First, the respondents' awareness of the information disclosure of the MSW incinerators is low, but this is being improved.

Second, a majority of the people are supportive of building community-based environmental protection action group.

8.3.2 Second-round Public Consultation

On March 10th, 2014, the draft full environmental audit, environmental management plan and social assessment reports were disclosed in the nearby villages of each MSW incinerator. Public consultations were carried out in late March through interviews and group meetings.

Group meeting at Wuhua

Group meeting at Xishan

Group meeting at Dongjiao

Group meeting at Konggang

Figure 8-2 Group Meetings during the Second Round Public Consultation

The second-round public consultation overall presents similar results to the first-round public consultation. During the consultation, incinerator operators also communicated with people consulted and responded their questions.

1. Public perception and attitude toward MSW incineration

People consulted acknowledged that proper MSW disposal is important and necessary. In terms of disposal approach, more than half of the people consulted acknowledged that incineration was an option. They also indicated that incinerator owners shall invest more on environmental protection, buy state-of-the-art equipment and made continuous improvement in order to protect the environment and follow sustainable development path. In response to this request, all incinerator operators committed to regularly upgrade equipment or purse advanced equipment, strengthen environmental protection and ensure emission compliance.

Lack of first-hand observations has an influence on the public perception on MSW incineration. People consulted visited Xishan incineration plant after a group meeting. After the visit, they expressed that the visit has substantially changed their impression of MSW incinerator. They said that they witnessed clean and orderly plant; they haven't smelled unpleasant odor. This suggested that the communication between incinerators and nearby communities was inadequate and people may have predetermined position toward incinerator.

2. Public awareness of environmental impacts of MSW incineration

Similar to the first-round consultation, people consulted are more sensitive about the color, smell and precipitated dust. Still, the public awareness and knowledge of MSW incineration emissions is low. People consulted near Dongjiao, Wuhua and Xishan incinerators indicated that their ambient environmental quality was affected by dust and odor. For example, community representatives suggested that they witnessed oil-dust on the tress near Dongjiao incinerator. Community representatives also suggested they could smell odor when meteorological conditions are not favorable. People consulted near Xishan and Wuhua incinerators expressed concern over health impacts of the MSW incinerators, and suggested Xishan and Wuhua incinerator owners would proactively provide free health check to nearby residents. In particular, a person consulted suggested that to entirely remove potential environmental issues associated with Wuhua incinerator, it should be relocated from the current place.

Incinerator operators consulted agreed to follow up on these issues raised, and conducted corrective actions as necessary. They also explained that given there are other industrial facilities located around these MSW incinerators, said environmental issues may not come from the incinerators. For example, next to Dongjiao incinerator there is a poultry processing plant that may produce odor; a closed landfill that still emits odor from time to time. Next to Xishan incinerator there is plastic processing plant that often emits odor as well. Wuhua incinerator operator indicated that prior to 2012, they received complaint about odor from local communities. As a response it installed odor removal facilities and added fully-closed cover to the garbage pit in 2012. Since then there was no complaint received officially. In terms of providing free health check to local communities, Wuhua and Xishan incinerator operators indicated that it was a public policy issue

that needs to be addressed with scientific study and consistent with government policies.

3. Willingness for community participation

People consulted expressed support to the public engagement program included in the project. All people consulted agreed that he incinerators shall establish a public observer mechanism and ensure the incinerator operation will be supervised by the public.

4. Other opinions

People consulted also expressed thanks to all the four incineration plant for providing employment opportunities to local communities. In particular, people consulted expressed overall support to Dongjiao incinerator. There was a landfill in operation near Dongjiao Incinerator and people nearby were seriously disturbed by odor and flies. After Dongjiao incinerator was put into operation, the landfill was closed. The incinerator operator planted trees on top of the landfill and the odor and fly problem has been alleviated. People consulted acknowledged the efforts made by Dongjiao incinerator operator on environmental protection over the years.

5. Conclusion

The results and pattern of the second-round consultation are similar to the first-round consultation. People consulted acknowledged incineration as an approach of MSW disposal is acceptable, while a portion of the people consulted were against MSW incinerator; some of them expressed concerns over the environmental and health impacts associated with MSW incineration emission. However, most people consulted expressed support to the project after learning the project purpose, approach and measures to be taken to improve incinerator operation, environmental performance, and public involvement.

8.4 Public Engagement Program

Based on the public consultation results, the following public engagement program has been designed and incorporated into the project. More details can be found in EMP and social assessment report.

- Information disclosure and public participation program including public disclosure of real-time incinerator emission and operating data, dioxin monitoring data, knowledge dissemination of MSW incineration and health impacts, MSW segregation and its linkage with incineration, interactions between incinerators and nearby communities, etc.
- Grievance redresses mechanism that includes telephone hotline, document filing and specialized complaint institution located at incinerators, community/village, environmental protection bureau, urban management bureau, etc.

9 Environmental Audit Conclusions and Recommendations

9.1 Procedural compliance of incinerator building and operation

The following procedure and documentation relevant to the building and operation of Wuhua incineration plant are reviewed:

- On April 26, 2006, the Environmental Protection Bureau of Yunnan Province granted the project's environmental administrative licenses [2006] No.51.
- On July 22, 2006, Yunnan Development and Reform Commission approved the text of the approved enterprise project with document of [2006] No. 835.
- On December 16, 2006, the project began its construction.
- In July 2007, Yunnan State Grid Company approved the grid-connection application submitted by the incineration power plant. (Document: "Yunnan Power Grid Corporation About Kunming municipal solid waste incineration plant expansion system approved" (YunDianJi [2006] 268))
- On December, 2007, the enterprise was put into trial operation.
- On August 5, 2008 acceptance of construction completion was issued.
- On February 1, 2010, Yunnan Environmental Protection Agency's environmental acceptance was issued (YunHuanYan [2010] No. 2).
- On January 15, 2011, the company attained "Waste Disposal Permit."
- On December 5, 2011, Yunnan Provincial Safe Production Supervision Bureau approved the project based on safety production regulation (Document: "Construction project safety facility" three simultaneous "Interim Measures for Supervision and Administration" (National Security Administration 36 orders)).

The project environmental approval, including EIA, environmental acceptable upon completion, conformed to the regulations and requirements of the state and Yunnan Province.

9.2 Compliance with domestic environmental protection requirements

9.2.1 Compliance analysis of enterprise and related management requirements

China has issued various policies and technical codes for the operating and environmental performance. The compliance of Wuhua incineration plant with these policies is shown in Table 9-1.

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Table 9-1 Compliance of Enterprise and Related Management Requirements

Name	Articles	Veritable records of enterprise operation	Evaluation conclusion
Policy on Disposal of Urban Municipal Solid Wastes and Prevention and Control Technologies for Corresponding Pollution	6.1 Incineration of wastes is applicable to wastes with the average low heating value higher than 5,000 kJ/kg and the economically developed areas that are in lack of sanitary landfill sites.	Through enhancing pretreatment (dewater, fermenting, etc), the heating value of MSW feed into furnace have been kept at lowest 5,024kJ/kg in average, which is higher than 5,000kJ/kg limited in the Policy.	All conform to the requirements.
	6.2 Currently, mature technologies regarding waste incineration based on grate incinerator shall be adopted while application of other types of incinerators shall be prudently selected. Application of incinerators that fail to comply with control standards are not allowed.	Wuhua adopts circulating fluidized bed incinerator which is still quite common in China. Its design and construction complies national conforms to relevant technical regulations on domestic garbage incineration. Its emissions conform to the national emission standard.	
	6.3 Wastes shall be fully burned in incinerators and flue gas shall remain in the afterburner under 850°C for more than 2 seconds.	Wuhua can meet the requirement as to keeping burning temperature for at least two seconds at 850℃ under normal operating conditions. However, downtime takes place from time to time.	
	6.4 Heat produced during waste incineration shall be recycled to the maximum extent so as to reduce thermal pollution.	The enterprise is provided with waste heat power generation system to recycle the heat energy as far as possible.	
	6.5 Waste incineration shall be carried out in accordance with the requirements set forth in the Standard for Control of Pollution from Municipal Solid Waste Incineration, and flue gases, sewage, slags, fly ashes, stink, noises, etc. caused thereby shall be controlled and treatment in order to prevent them from polluting the environment.	Based on the acceptance monitoring report of Three Simultaneities and inspection monitoring, various pollutants emitted by the enterprise can meet related standard requirements like *Standard for Pollution Control on the Municipal Solid Waste Incineration*.	
	6.6 Advanced and reliable technologies and equipment shall be adopted so as to strictly control the emission of flue gases produced during waste incineration. Semi-dry cloth-bag dust removing process can be adopted during treatment of flue gases.	Using semi-dry purification tower + activated carbon injection + bag filter	
	6.7 Collect waste water in storage pit and produced in production processes. Send it all back to the boiler to burn.	Collect waste water in storage pit and produced in production processes. Leachate is sent to the boiler to burn. Domestic wastewater sent to municipal wastewater treatment plant. Process wastewater reused.	
	6.8 Slags produced during waste incineration can be recycled or directly buried if they are proved to be the wastes out of the hazardous wastes.	Leaching toxicity of fly ash and fly ash solidified body, dioxins and water content should be in line	

	Slags and fly ashes belong to hazardous wastes must be disposed as hazardous wastes.	with 6.3 of *Standard for Pollution Control on the Landfill Site of Municipal Solid Waste* (GB16889-2008). Then it can be sent for landfill. After curing fly ash, it is transported to the Xijiao of Sanitary Landfill Disposal: sell slag for utilization; press and incinerate sludge.	
Circular on Strengthening the Management Towards Environmental Impact Assessment Carried out on Biomass Power Generation Projects	2. Technologies and equipment Incineration equipment shall comply with the major indexes and technical requirements regarding incineration equipment of solid wastes set forth in *Equipment for Environmental Industry Currently Encouraged by State (Product Catalog)* (Revised in 2007). (1) Except for power generation projects adopting fluidized bed incinerators in disposal of municipal solid wastes whose quality of traditional fuels mixed shall be controlled below 20% of the total quality of fuel input, other power generation projects adopting other fluidized bed incinerators in disposal of municipal solid wastes shall not mix coal. Recorders for feed of wastes and raw coal must be installed. (2) For those adopting advanced foreign mature technologies and equipment, auxiliary environmental technology shall be introduced at the same time, and the pollutant emission limit shall meet the requirements regarding design and operating parameters of auxiliary pollution control facilities so introduced. (3) For cities or regions with industrial thermal load and heating load, heat-supply units shall be preferred in power generation projects by burning municipal solid wastes in order to improve environmental benefits and social benefits.	As for the circulating fluid bed garbage incinerator, additive amount of coal was controlled at around 17.6% in 2012. There is no heat supply demand in Kunming and at the project site, so the enterprise built a set of waste heat power generation system.	All conform to the requirements.
	3. Pollutant control (1) Incineration equipment shall meet the "Technical Requirements of Incinerators" set forth in the *Standard for Control of Pollution from Municipal Solid Waste Incineration* (GB18485-2001); effective pollution control measures shall be taken so as to ensure that pollutants including sour gases i.e. SO_2, NOX, HCL, etc. and other conventional flue gases meet the requirements of Table 3 "Emission Limit of Air Pollutants Released by Incinerators" set forth in the *Standard for Control of Pollution from Municipal Solid Waste Incineration* (GB18485-2001); for the emission concentration of dioxins, relevant EU standards (currently 0.1 ngTEQ/m^3) shall be referred to and executed; for power generation projects that burn municipal solid wastes in large cities or other areas for which the NOx is specially controlled, necessary denitrification devices shall be installed, while for other areas, the	The enterprise's production sewage and household sewage are not discharged. The enterprise adopts the fully enclosed design for each process point prone to produce odor. The stink is collected and combusted in the incinerator and various types of pollutants provided by the combustion and its auxiliary facility can satisfy corresponding standard limits of emission. The production and operation conditions of the enterprise and the online monitoring of pollutant are connected to the management department. Automatic metering unit is provided for the	

	space for removal of NOX shall be remained; automatic and continuous monitoring devices for flue gases shall be installed; relevant requirements shall be put forward against auxiliary distinguishing measures for dioxins so that burning temperature, CO, oxygen level, etc. in the incinerators are monitored and the dose of activated charcoal is measured by interconnecting with local environmental departments. (2) Disposal measures for acid and alkaline wastewater, cooling sewage and other industrial wastewater shall be reasonable and feasible; back-spraying shall be preferred in treatment of waste leachate, and drainage shall meet the requirements of relevant state and local emission standards if back-spraying is not feasible, and emergent collecting pool of waste leachate with sufficient capacity shall be installed; sludge or concentrated solution shall be independently burned in plants without outbound transport for disposal. (3) Incineration slags and fly ashes collected by dust removal equipment shall be separately collected, stored, transported and disposed. Incineration slags are generally industrial solid wastes, therefore, relevant magnetic separators shall be installed in the projects in order to separate and recycle metals for comprehensive usage; also methods for storage and disposal in accordance with the requirements set forth in *Standard for Pollution Control of Storage and Disposal Sites of General Industrial Solid Wastes* (GB18599-2001) can be adopted; incineration fly ashes belong to hazardous wastes which shall be stored and disposed in accordance with the *Standard for Pollution Control in Storage of Hazardous Wastes* (GB18597-2001) and the *Standard for Pollution Control in Landfill of Hazardous Wastes* (GB18598-2001); comprehensive usage of incineration ashes shall be encouraged but the technologies adopted shall ensure full destruction of dioxins, effective fixation of heavy metals, and shall ensure that secondary pollution will not be caused during production and application of products. After implementation of the *Standard for Pollution Control in Landfill of Municipal Solid Wastes* (GB16889-2007), disposal of incineration slags and fly ashes shall be executed in accordance therewith. (4) Preventive and control measures for stink: closed design shall be adopted in waste unloading and transport systems as well as waste pits, the method of negative pressure shall be adopted in waste pits and waste transport systems, and disposal structures for waste leachate shall be capped and sealed. Under abnormal mode, effective odor control measures shall be adopted.	activated carbon.	
	6. Environmental protection distance	The enterprise executes the environmental	

	Reasonable environmental protection distance shall be put forward in accordance with the results calculated with source intensity of fugitive emission of odorous pollutants (NH_3, H_2S, methyl mercaptan, odor, etc.) under normal mode and appropriate consideration regarding the conclusions of environmental risk assessment, in order to set the control distance between the projects and the public facilities such as surrounding residential areas, schools, hospitals, etc. and to serve as the basis for planned control. Environmental protection distance of newly reconstructed and expanded projects shall not be lower than 300 m.	protection zone of 800m and there are no environment-sensitive targets within this zone.	
Technical Guideline for Treatment of Municipal Solid Wastes	3.2.3 Annual working days of incineration plants for municipal solid wastes shall be 365 days with the annual operating duration of each production line above 8,000 h. Designed service life of incineration system for municipal solid wastes shall not be shorter than 20 years.	The enterprise is operated at full capacity. Its designed life span is 23 years.	Compliance
	3.2.4 Effective volume of municipal solid waste pit shall be determined in accordance with the rated incineration volume of municipal solid wastes in 5-7 days. Waste leachate collection facilities shall be installed in municipal solid waste pit. Finish materials used in inner wall and bottom of municipal solid waste pit shall satisfy the requirements including corrosion resistance, resistance to shock loading, seepage water prevention, etc. and the outer wall and bottom shall use non-absorbent finish.	The effective volume of waste storage house can meet the rated living garbage incineration amount of seven days and its anti-seepage measures are complete and meet the requirements.	
	3.2.8 For incineration incinerators with the capacity of 300 t/d or above, its chimney height shall not be shorter than 60 m; in case that there're buildings within the radius of 200 m around the chimney, height of the chimney shall be at least 3 m higher than that of the highest building.	The incinerator chimney of the enterprise is 80m high, which is far higher than the buildings with a radius of 200m.	
Directive Opinions Regarding Strengthening the Pollution Prevention and Control of Dioxins	(IV) Targets and missions To reduce the dioxin emission strength per unit of production capacity (processing capacity), the reduction and control measures shall be fully implemented in the key industries such as iron ore sintering, steel melting using electric-arc incinerator, production of regenerative non-ferrous metal and waste incineration. Also, the review of clean production shall be deeply carried out. The advanced technology of clean production, the optimal feasible process and technology etc. shall be fully promoted. To 2015, perfect prevention and control system and long-acting supervision mechanism of dioxin will be established. The dioxin emission strength in the key industries will be reduced by 10% and the rising trend of dioxin emission will be basically controlled.	The enterprise planned to implement the examination and approval of clean production in 2015.	Enterprises have plans but dose not publishes cleaner production check and environmental audit report.
	(XI) Promotion regarding construction of high-standard waste incineration facilities The enterprise should strengthen management over the operation of waste incineration facilities and strictly implement the technical requirements in *Standard for Pollution Control on the Municipal Solid Waste*	The company did not publish annual environmental reports to the public.	

	Incineration and *Pollution Control Standard for Hazardous Wastes Incineration*. Mature technologies are preferably adopted in newly build incineration facilities while types of incineration incinerators that have not been proved in actual application at present shall be prudently adopted. Enterprise environment information disclosure system shall be established and the enterprises engaged in incineration of wastes shall publish its annual environment report to public. Online monitoring shall be applied in major process indexes and pollution factors such as sulfur oxides, nitrogen oxide, HCl, etc. and be connected to local environmental protection department. Emission of pollutants shall be sampled and tested once every quarter. LEDs shall be set conspicuously in plant areas displaying data such as incinerator temperature, detention time of flue gases, temperature of flue gas output, CO, etc. to public for convenience of social supervision.		

* The items listed in the table are the non-repeatable clauses.

9.2.2 Implementation of requirements in EIA approval

The comparison between enterprise operation and project EIA approval requirements is specifically shown in Table 9-2.

Table 9-2 Comparison Table of Various Environmental Impact Assessment Approval Requirements

Articles	Actual implementation	Evaluation conclusion
(1) The control of fume incineration shall be strengthened. The following measure shall be taken to strictly control the generation of dioxin. The sorting of waste shall be strengthened before incineration to minimize the chloric articles and metals of the waste into the incinerator, especially the chloric plastics and copper, whereby the generation of dioxin is controlled from the source. The measures to control the incineration conditions such as incinerator temperature, oxygen content and standing time shall be taken during the incineration. It shall be ensured that the fume is rapidly chilled within one second, so as to skip the temperature range of dioxin regeneration and further reduce the possible of dioxin generation. The measures including the injection of lime mortar and the arrangement of activated carbon absorption unit shall be taken after incineration to ensure the qualified emission of dioxin.	·A The enterprise should sort out the chlorine plastics and metals and especially the copper through the pretreatment of garbage to control the generation of HCl, CuO, CuCl2 and Dioxin precursors. ·A Flue gas 850 ℃ ~ 950 ℃ under high-power traction followed by induced draft fan super heater, evaporator convection tubes, economizer, air pre heater, a sharp decline in the temperature of the flue gas in the 2.3s to about 170 ℃. ·A The enterprise is equipped with lime and activated carbon injection processing system ·A From the monitoring results, the dioxin emission can reach the requirements standards.	The rapid cooling of flue gas cannot be generated across the temperature ranges of dioxin in 1 second. The rest are in line with the requirements
(2) Equipment parameters and operating conditions of quench towers shall be strictly controlled for the avoidance of leachate emission.	·A Flue gas of 850 ℃ ~ 950 ℃ under high-power traction followed by induced draft fan super heater, evaporator convection tubes, economizer, air pre heater, a sharp decline in the temperature of the flue gas in the 2.3s to about 170 ℃, can ensure full evaporation of the spray solution may not produce waste discharge.	Conformance to requirements.
(3) Drainage system of the plant are shall strictly follow the design, construction and management of diverting wastewater from clean water and diverting the rainwater from sewage. Sewage treatment facilities shall be properly designed and constructed, and commissioning of processing conditions shall be paid attention to so as to ensure the operating effects of sewage treatment equipment and to ensure zero emission of sewage during dry season . Saving and comprehensive application of water shall be intensified, and effective measures shall be taken to make it possible to recycle the circulating cooling water and to reduce external emission on the basis that closed cycle of production wastewater is realized without external emission.	·A Centralized waste leachate is discharged to the waste storage house two leachate collection tank, spray back to the incinerator to be burned; ·A All domestic wastewater is discharged into the sewage plant septic tanks, sewage car unified by extracting sent sewage treatment plant. ·A After circulating cooling water through the plant and sewage treatment pond for coal field, residue field, then after coagulation and filtration for clarification green irrigation, nothing more than rows.	Conformance to requirements.
(4) The fly ash is a type of dangerous waste. Before completing Kunming Dangerous Waste Disposal Center, the fly ash must be solidified and temporarily stored in the temporary storage facility built in the plant area for one year strictly following the *Standard for Pollution Control on Hazardous Waste Storage* (GB18597-2001). After completion of the Kunming Hazardous	·A Kunming hazardous waste disposal center has completed construction put into operation, according to the requirements of the Urban Management Bureau, according to the original treatment process fly ash. After curing, it was sent to Xijiao Sanitary Landfill plant.	Conformance to requirements.

Waste Disposal Center, hazardous wastes shall be delivered to the Kunming Hazardous Waste Disposal Center for disposal together with the *Letter of Intent concerning Delegation of Disposal* signed between your company and Yunnan Dadi Fengyuan Environmental Protection Co., Ltd. If the fly ash can't be properly disposed of as per relevant national provisions after the Project is operated for one year after completion because Kunming Dangerous Waste Disposal Center isn't completed or is unable to receive the waste during the operation after completion, your company shall voluntarily stop the operation of the Project as per the *Letter of Undertaking for Fly Ash Disposal of Kunming Municipal Solid Waste Incineration and Power Generation Project* (KunXinSiZi (2006) No. 08). The slag shall be put into comprehensive use or properly disposed of as ordinary solid waste.		
(5) Noise control measures shall be strengthened and up-to-standard boundary noise shall be realized.	Factory sector has exceeded standards of noise, mainly due to excessive traffic noise impact Xisanhuan	Not comply with standards
(6) The Project shall allocate the area within 800m from the temporary storage site of fly ash for sanitary protection width. There is currently no residential area in the sanitary protection width. The local government shall make proper planning and control. No new civil facilities shall be built again in the sanitary protection width.	·A No residential areas within 800m range.	Conformance to requirements.
(7) Proportion of coal mixed in the input shall be strictly controlled below 20% and the average low hating value of waste input shall be higher than 5,000 kJ/kg.	·A Add the amount of coal at around 17.6%, the average calorific value of waste low 5884kJ/kg.	Conformance to requirements.
(8) The indicator of pollutant emission quantity of the Project shall be solved by Kunming Environmental Protection Bureau within the range of municipal amount control indicator, including the dust of 89.6t/a, sulfur dioxide of 359.1t/a, COD of 77t/a and ammonia nitrogen of 5.4t/a.	·A According to the monitoring result ([2013] No.1-004), the annual exhaust emission is 19.1t/a, SO2 112.3t/a. ·A Wastewater is transported to municipal sewage treatment station.	Conformance to requirements.
(9) Before putting the Project into trial operation, the online monitoring system of fume and dust, sulfur dioxide, oxynitride and hydrogen chloride must be installed.	·A With incineration flue gas online monitoring facilities, monitoring item: SO2, HCl, CO, NOx, soot, O2, flue gas temperature, flow, velocity, concentration.	Conformance to requirements.

9.2.3 Analysis on the emission standard of pollutants

Chapter 6 of this report provides detailed analysis of pollutant emission compliance with relevant national and international standards. Inspection and online monitoring results available indicate the air emissions of Wuhua incinerator meet current national standard GB18485-2001 and has the potential to meet more stringent standard, i.e. newly issued GB18485-2014 and EU and US standard referenced in WBG EHS Guidelines.

1. Air emissions

According to the inspection monitoring results, the air emissions can fully meet the approved domestic standards, while TSP, SO2, and dioxin cannot fully meet the newly issued national standard GB18485-2014, and the most stringent emission levels as referenced by WBG EHS guidelines, i.e. either EU or USA standards. More than 50% of the TSP and SO2 monitoring results are higher than these stringent standards. Among the four incinerators, Wuhua is the oldest one, monitored maximum TSP, SO2 and dioxins concentrations in flue gas are also considerably higher than the other three incineration plants.

According to the on-line monitoring results, all the data can meet the approved domestic standards, while the TSP and SO2 cannot meet the most stringent limits of the new national standard and EHS standards. According to the EIA approval document, the on-line monitoring should cover HCl, but the device has been broken since 2012.

As discussed in chapter 6, the frequency and reliability of those inspection and online monitoring seem to be inadequate, thus an intensive operating and environmental performance audit program will be implemented in the first year of project implementation in order to develop a robust MSW operation improvement plan. This is incorporated into the EMP.

2. Waste water

Leachate are collected in two leachate tanks in the garbage pit, and injected into furnace for burning.

There is no wastewater treatment plant in the Wuhua incineration plant. Domestic wastewater are collected and transported to Kunming wastewater treatment plant for final disposal. Process wastewater is recycled in the plant.

3. Solid wastes

According to the fly ash leaching test, the fly ash of Wuhua incineration plant is safe to be landfilled. The said Pollution Control on the Landfill Site of MSW (GB16889-2008) issued in 2008 allows landfill to receive stabilized fly ash as long as the stabilized fly ash meet quality standards . Other solid wastes, such as slag (bottom ash) are managed separately from fly ash and are reused. These practices meet national regulations and are consistent with WGB EHS Guidelines and Stockholm Convention BAT/BEP.

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4. Noise

According to the monitoring report (from Yunnan Environmental Monitoring Center in 2008), value of noise at boundary of industrial enterprises at day and night are respectively 50.9-70.0dB (A) and 51.5-68.6dB (A), with a maximum additional value of 10dB (A) in daytime and a maximum additional value of 13.6dB (A) at night, meeting the requirements of Emission Standard For Industrial Enterprises Noise at Boundary (GB12348-2008) for second category. It is noted the noise levels at the boundary of the Wuhua incineration plant is greatly influenced by traffic noise from western 3rd ring-road.

9.3 Compliance with the World Bank's related policies

Compliance analysis of Wuhua's operation with WBG EHS Guidelines is shown Table 9-3.

Table 9-3 Compliance analysis of enterprise operation and the World Bank EHS Guidelines

Name	Articles	Veritable records of enterprise operation	Evaluation conclusion
EHS Guideline on Waste Management Facilities	(1) Exhaust gas ● The wastes are separated and classified to avoid the incineration of metals and metalloid wastes that are volatile in combustion and these substances are very difficult to be controlled by air emission technology after being volatile (like mercury and arsenic); ● If appropriate, the waste gas is utilized by boiler for power generation and heat supply; ● Based on the required emission level, the basic nitric oxide control measures (related to combustion), selective catalytic reduction (SCR) or selective non-catalytic reduction (SNCR) system is used; ● The waste gas treatment system is used to control acid gas, particulate matter and other air pollutants; ● The formation of Dioxin and furan is reduced in the following ways: ensure that the particle control system doesn't operate between 200℃ and 400℃; confirm and control the composition of wastes; carry out basic control (related to combustion); use the operating conditions for limiting the formation of Dioxin and furan and its precursors; and control the waste gas; ● The technology for transforming wastes into energy sources or anaerobic digestion is applied to help offset the emissions produced by power generation from fossil fuels.	● The enterprise uses the working procedures for the wastes emitted into the incinerator like manual sorting and magnetic separation, thereby substantially reducing the wastes that may produce hazardous substance from entering into the incinerator. ● The enterprise has built a waste heat power generation system to use the energy sources effectively. ● Based on the monitoring results, the enterprise's NOx can meet related standard requirements of the state and the World Bank. ● The standing time in the section above 850 degrees of the enterprise is longer than 2s. Also, measures such as transit acceleration are taken during the temperature zone of secondary production to reduce the regeneration of dioxin.	Overall compliance with the requirements.
	(2) Ash and other residues. ● The wastes should be retained in the combustion room in incinerator design (like reducing the interval of grate bars and using the rotary or statically rotary incinerator for the slightly liquid wastes), appropriate high temperature conditions (including the ash combustion area) should be maintained and the waste disposal rate of incinerator should meet the requirements for full reaction and residence of wastes, so as to ensure that the content of total organic carbon (TOC) in ash residue is lower than 3% and reaches 1% to 2% under special circumstances. ● The flying dust and the bottom ash of other waste gas treatment residues should be separately managed to avoid from polluting the bottom ash and affecting its recycling. ● Under the condition of economic feasibility, it is required to separate ferrous metals and non-ferrous metals from bottom ash for recycling;	● The company respectively treats fly ash and slag: After curing, fly ash is shipped to the Xijiao landfill plant: sell slag for utilization; the remaining should be pressed and incinerated and finally burnt. ● All of the disposals above comply with the domestic requirement of environmental management.	

	● The bottom ash should be subject to on-site or off-site treatment (like screening and extrusion) so as to reach the requirements for utilization or treatment at the treatment place (the size of metals and salt should conform to the environmental conditions of the utilization site in the process of screening); ● The bottom ash and residues should be managed according to the classification of harmful or harmless materials. The harmful ash should be managed and treated as harmful waste. The harmless ash can be treated at the MSW garbage landfill or can be recycled in the building material.		
	(3) Water emission. ● To prevent, reduce and control the sewage emission, the waste water produced from waste gas treatment should be treated; for example, the heavy metal is removed by filter condensation, sedimentation and filtration and neutralized.	● The enterprise has taken corresponding treatment process for different sources of waste water to ensure it can be reused at each section and for greening in the plant and the tail water isn't emitted as a whole.	
	(4) Noise. ● The main noise producing noise includes exhaust fan, chimney emission, cooling system (evaporative cooling and especially air cooling) as well as turbine engine. ● The measures for solving noise effect are stated in the *General EHS Guideline*. The suggestions and measures for preventing, reducing and controlling the incineration noise include that: silencer is used in the air cooler and chimney as required.	● The company takes measures to reduce noise and vibration.	

9.4 Audit Conclusion and Recommendations

Based on the operational review and environmental audit, the Wuhua incineration plant is well maintained, has fundamental control systems, qualified staff in place. It has also established a sound environmental management system, prepared environmental management manual that are incorporated into staff training and designation of responsibilities. The incinerator is also operated under the monitoring and inspection of relevant urban management and environmental protection bureaus. These conditions allow the incinerator for readily adaption of an operating and environmental performance enhancement program. There is also much room for operational improvement.

- Pretreatment process. Currently, raw household wastes need reduction (taking out lumpy waste bits such as construction waste, drainage of leachate) before being fed into the three incineration lines. The design is that two lines are in production, with the third line on standby. The feedstock is of low quality at around 4MJ/kg, which can be increased to design specification at around 5 MJ/kg after the reduction.
- Instrumentation and control system. Wuhua uses CFB incineration technology and applies in broad lines to overall plant configuration, PLC based process control system, flue gas treatment system and environmental monitoring system. Wuhua has installed shredder to make the incoming mixed waste more homogenous, which significantly help reduce down-time of furnaces. Still, instrumentation and control process control shall be improved, such as accurate temperature metering, and building CO concentration into control loop.
- Environmental monitoring devices. Online monitoring data are transmitted to central control room. HCl monitoring has not been functional since 2012.
- Wuhua incineration plant is the oldest one among the four MSW incinerators in Kunming, starting official operation in 2008. Its TSP, SO2, and dioxins emission levels are also the highest among the four.

Due to these operational issues, the air emissions, including dioxins, may fluctuate under abnormal operation such as frequent downtime or very poor feedstock. These would need a thorough review during the operating and environmental performance audit in the first year of project implementation. Potential improvement measures include the following.

- Enhance and better maintain pretreatment process and equipment.
- Investments in monitoring equipment for plant performance and environmental performance, and a certain level of integration of environmental performance monitoring and process control. These would be helpful for maintain optimal and flexible combustion conditions according to design parameters, quality of waste feedstock and emission levels.
- Enhance flue gas treatment system, such as installing lime and activated carbon injection metering device, bag breakage tester, replacing bag materials to PTFE coated filter. These would effectively help further reduce air emission levels.

- Public engagement and information disclosure shall be strengthened to engage the public as an important role in oversight.