CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Project title: Tianjin Shuangkou Landfill Gas Recovery and Gas Utilization Project
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A.2. Description of the project activity:

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The project site is Shuangkou landfill, located in Tianjin Municipality of China. It was the first modern sanitary landfill in Tianjin, designed and constructed in accordance with national standards, including impermeable liners and leachate collection and treatment systems. It was financed by a World Bank loan through the Tianjin Urban Development and Environment Project (IDA-23870).

The Shuangkou landfill occupies an area of 60 hectares and is approximately 35 kilometres away from Tianjin downtown area. It was designed with total waste disposal capability of 8.5 million cubic meters, or 7.39 million metric tons. Constructed in 1999 and put into operation in April 2001, it began to accept an average of 800~1000 tons household waste per day. By the end of year 2005 almost 1.6 million tons household waste have been landfilled there. The waste mainly comes from 4 districts and 1 transfer station of Tianjin.

Developed by the Tianjin Clean Energy and Environmental Engineering Co., Ltd. (hereafter called TCEE), the main objective of this project is to collect landfill gas (LFG), consisting primarily of methane, and to generate electricity by installing LFG collection system, electricity generation system and flaring system on site. It is estimated that the maximum installed generation capacity will reach 5MW during the project operation period. The generators will combust the methane in the LFG to produce electricity for sale to the public grid. Excess LFG, as well as all gas collected during periods when electricity is not generated, will be flared.

As a result, this project will reduce greenhouse gas emissions generated from the landfill by a total of approximately 1,647,473 tonnes of carbon dioxide equivalent (tCO_2e) during the 10-year crediting period, from 2008 to 2017. The project will also produce a total of around 251,235 MWh electricity during this period of time, 95% of which will be sent to the grid while the remaining 5% will be used on-site.

Implementation of this project will not only bring local and national environmental benefits, but also showcase a CDM project for LFG recovery and electricity generation in Tianjin Municipality. The project will successfully promote the sustainable development in the following aspects:

・**Greenhouse gas emission reduction**
Without the project, methane, which has the Global Warming Potential of 21 times than that of carbon dioxide based on the IPCC default value, and is the main content of LFG produced from the landfill, will continue to emit through several installed gas venting wells to the atmosphere without any treatment or recovery. With the project activities, methane in LFG will be recovered and utilized so that the direct emission will be reduced, resulting in a positive impact on global climate.

・**Landfill safety**

If the methane concentration in the air rises up to 5~15% by volume, the risk of explosion is very high. In China, sometimes landfill explosion happen due to unsuccessful venting of landfill gas. At present, several venting pipes and wells have been installed in order to avoid the accumulation of LFG in the waste layer and to minimize the risk of explosion at Shuangkou landfill site.

・**Energy potential**
Methane is an ideal clean fuel. Considering each cubic meter of methane generates about 36000kJ of heat, LFG recovery and utilization will contribute greatly to the energy supply for Tianjin.

・**Creation of employment**
The project will be designed, constructed and operated using local resources, supported by international experts. Consequently, employment opportunities will be created during both the project construction and operation period.

・**Demonstration**
Up to now, many developing countries, like Brazil, South Africa and Costa Rica, have accumulated experience on recovery and utilization of landfill gas as CDM projects. China is also making great efforts to promote domestic LFG utilization projects. One of them, Nanjing Tianjingwa landfill site, has succeeded in registering as a CDM project in December 2005. With overseas and domestic experiences, Shuangkou Landfill Gas Recovery and Gas Utilization Project is expected to proceed successfully, aiming at improving landfill gas utilization, saving energy and protecting the environment. It will be the first CDM project carried out in Tianjin so that it plays a demonstrative role for future CDM projects development in Tianjin.

A.3. Project participants:

Name of Party involved(*) ((Host) indicates a host Party)	Private and/or public entity(ies) project participants(*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
People's Republic of China (Host)	Tianjin Clean Energy and Environmental Engineering Co., Ltd.	No
Spain	International Bank for Reconstruction and Development ("World Bank") as Trustee of the Spanish Carbon Fund	No

The participants involved in this project are:

・**People's Republic of China**
Host country

・**Tianjin Clean Energy and Environmental Engineering Co., Ltd. (TCEE)**
Shuangkou landfill is under the control of the Tianjin Solid Waste Treatment Centre, which is a division under the Tianjin Environmental Sanitation Commission.
TCEE is a newly formed company under the Tianjin Construction Commission, and authorized jointly by Construction Commission and Environmental Sanitation Commission to implement Shuangkou landfill

gas recovery and utilization project as the project developer and operator, and as the project emission reductions seller.

• **The Spanish Carbon Fund**
The Spanish Carbon Fund (SCF) is the carbon buyer of this project. International Bank for Reconstruction and Development ("World Bank"), as Trustee of the Spanish Carbon Fund, will sign an Emission Reduction Procurement Agreement with the project developer, TCEE.

The Spanish Carbon Fund (SCF) was created in 2005. With a capital base of US$202.7 million, the SCF will purchase greenhouse gas emission reductions from projects developed under the Kyoto Protocol to mitigate climate change. The SCF will promote renewable energy and energy efficiency projects in developing countries and countries with economies in transition.

Consulting company for the proposed project is:

• **Shanghai JEC Consultant Co., Ltd.**
Shanghai JEC is a Chinese & Japanese Joint Venture which has specialized in developing municipal solid waste management projects and CDM projects. Shanghai JEC is mainly involved in the preparation of the PDD for this project and is not the project participant.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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A.4.1.1. Host Party(ies):

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People's Republic of China

A.4.1.2. Region/State/Province etc.:

>>
Municipality of Tianjin

A.4.1.3. City/Town/Community etc:

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Shuangkou town, Bei Chen District, Tianjin Municipality

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

The project is located at Shuangkou landfill site in China's metropolis of Tianjin. Situated between 38.57-40.25 north latitude and 116.71-118.67 east longitude, Tianjin is by the Bohai Gulf and in the eastern part of North China Plain. Flat Land covers 94.2% of land area, and between 2.2 to 50 meters above sea level. Tianjin has a coastline of 113.4 kilometres long. Covering a jurisdiction area of 11,305 square kilometres, 186 kilometres from north to south and 101 kilometres from east to west, and with a population of more than 10.2 million (data of year 2004), it enjoys the semi-humid continental monsoon climate of warm temperate zone.

Shuangkou landfill is located in the Shuangkou town, west of Beichen District. The project location is shown below.

Fig.1 Map of Project Location – Shuangkou Landfill Site

A.4.2. Category(ies) of project activity:

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Sectoral scope 13: waste handling and disposal

Sectoral scope 1: energy industries (renewable-/non-renewable sources)

A.4.3. Technology to be employed by the project activity:

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Tianjin Shuangkou sanitary landfill started construction in the year 1999 and commenced operation in April 2001. The site was designed to receive daily 2,700 tons of municipal solid waste while currently average input is 800~1000 tons of waste per day. It mainly accepts overall wastes generated in such districts as Hongqiao, Heibei, Xiqing and Beichen, as well as part of waste generated in Heping district and Nankai district from Panlou transfer station. Up to now, around 1.6 million tons of wastes have been landfilled at the site. It is estimated that it will have a daily waste input of 1300 tons from year 2006 till the end of its service life.

The projected depth of waste, after reaching the final contour, will be approximately 34 metres with 32 metres above grade and 2 metres below grade. Total design capacity is 8.5 million cubic metres. At an approximate density of 0.8 tonne per cubic metre, this translates into about 6.8 million metric tons.

The project activities involve the reconstruction of the landfill and set-up of LFG recovery systems in its working cells, including such systems as LFG collection, pre-treatment, electricity generation and grid connection, flaring, monitoring and protection system, data recording and archiving.

- **Landfill covering**

In order to collect more landfill gas, the waste layers will be covered with more soil.

- **Gas collection system**

At present, a total of 42 gas venting wells are installed at the site in a rectangle form. The interval between two wells is 99 metres in long side and 88 meters in short side. These wells were constructed in 1000mm diameter with Φ200mm HDPE pipes inside.

The proposed project will consist of newly installed branch pipes, main pipes, and additional venting wells for LFG collection, as shown in the Feasibility Study of Shuangkou Landfill Gas Recovery and Utilization Project.

- **Gas pre-treatment system**

Before electricity generation and flaring, LFG collected needs to be pre-treated to remove its impurities and moisture, H_2S gas, etc., to prevent the generators and flaring system from corrosion. The proposed project recommends the following LFG pre-treatment system, as shown in Fig. 2.

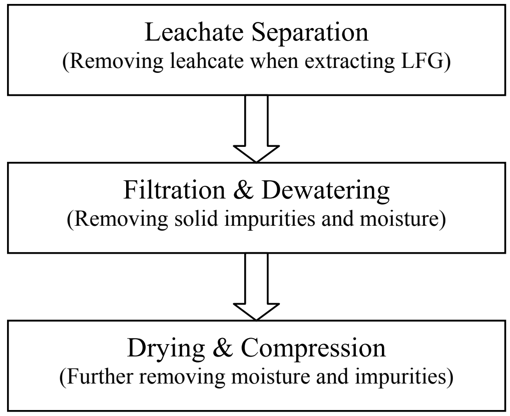

Fig.2 Landfill gas pre-treatment system

• **Electricity generation and grid connection system**
The electricity generated with LFG will be sold to the public grid. The electricity generators will be installed in different stages of the project, with maximum 5MW capacity.

• **Flaring system**
The LFG, which will not be used for electricity generation, will be flared. Once methane converts into carbon dioxide, the greenhouse effect caused by methane will be reduced substantially. The main works include the installation of auto-ignition flare platforms with the efficiency 97%.

• **Monitoring and protection system**
The monitoring and protection of the proposed project will be firmly based on the monitoring methodologies ACM0001 and AMS I.D.
This project provides monitoring and protection facilities for landfill gas pre-treatment, power generation and public grid connection.

• **Data recording and archiving system**
This system will be designed and operated in line with the requirements stated in monitoring methodologies ACM0001 and AMS I.D.

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

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The project is based on two complementary activities:
• Collection and combustion of landfill gas, thus converting its methane content into CO_2, reducing its greenhouse gas effect; and,
• Generation and supply of electricity to the regional grid, thus displacing a certain amount of fossil fuels used for electricity generation.

Through above activities, methane emissions from Shuangkou landfill will be mitigated both directly and indirectly.

If the project has not been carried out the emission reductions would not occur due to the following reasons.

Currently, China has three major legislations related to landfill in effect.
- *Technical code for municipal solid waste sanitary landfill (CJJ17-2004)*
- *Technical specification for operation and maintenance of municipal domestic refuse sanitary landfill (CJJ93-2003)*
- *Standard for pollution control on the landfill site for domestic waste (GB16889-1997)*

Among those legislations only CJJ17-2004 has mandatory requirements on the collection and flaring of landfill gas. When Shuangkou landfill was constructed in the year of 1999, the version CJJ17-1988, instead of CJJ17-2004, of *Technical code for municipal solid waste sanitary landfill* was available, in which neither flaring nor utilization of landfill gas was mandatory. Therefore, the current operation of Shuangkou landfill is strictly in compliance with the applicable Chinese regulation. In the absence of the CDM, it is quite certain that the proposed project would not be implemented so that landfill gas would continue to emit to the atmosphere without any flaring or utilization.

In these days, Chinese government encourages landfill operators to flare or recover landfill gas. However, the reality is that only few of them took some proper activities to do so due to no such legislative requirements. In fact, even the better managed landfills in China generally only install some venting wells for passively venting gas in order to avoid the risk of explosion. It is reported that currently less than 5% of recognisable landfill sites in China have landfill gas collection and flaring schemes and even less have gas utilization facilities[1].Therefore it is evident that emitting landfill gas into the atmosphere is the common practice in China.

In addition, implementation of the proposed project needs a high investment, high cost for operation and maintenance. Although this project has significant environmental benefits, because based on the financial analysis the net present value of this project without carbon revenue is not an economic attractive course of action. Without carbon revenue, the most economical and reasonable way for the landfill is to freely discharge landfill gas.

Therefore, no emission reduction would happen in the absence of the proposed project.

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

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Years	Annual estimation of emission reductions in tonnes of CO_2e
2008	66,176
2009	85,733
2010	111,157
2011	138,000
2012	171,126
2013	187,729
2014	200,925

[1] Source: CDM Umbrella Guidelines for MSW in China, by ERM, June 2004

2015	213,107
2016	230,688
2017	242,831
Total estimated reductions (tonnes of CO_2 e)	1,647,473
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	**164,747**

A.4.5. Public funding of the project activity:

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No public funding is used to support the Tianjin Shuangkou landfill gas recovery and utilization project activities.

SECTION B. Application of a baseline methodology

B.1. Title and reference of the approved baseline methodology applied to the project activity:

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ACM0001 Consolidated baseline methodology for landfill gas project activities (version 02, 30 September 2005), and
AMS-I.D. Renewable electricity generation for a grid.
(http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html)

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

>>
The project meets all the applicability criteria as set out in the methodologies.

ACM0001 is applicable to the following situations in regards to LFG activities where:
a) The captured gas is flared; or
b) The captured gas is used to produce energy (e.g. electricity/thermal energy), but no emission reductions are claimed for displacing or avoiding energy from other sources; or
c) The captured gas is used to produce energy (e.g. electricity/thermal energy), and emission reductions are claimed for displacing or avoiding energy from other sources.

As previously described, this project is based on two complementary activities, as follows;

- Collection and combustion of LFG, thus converting its methane content into CO_2, reducing its greenhouse gas effect; and,
- Generation and supply of electricity to the regional grid, thus displacing a certain amount of fossil fuels used for electricity generation.

The project activity accords to situation a) and c) above and is therefore applicable to ACM0001.

ACM0001 also mentioned that in this case a baseline methodology for electricity and/or thermal energy displaced shall be provided or an approved one used, including ACM0002 "Consolidated Methodology for Grid-Connected Power Generation from Renewable" If capacity of electricity generated is less than 15MW, and/or energy displaced is less than 54TJ(15GWh), small-scale methodologies can be used.

Because the maximum generation capacity of this project is 5MW, quite smaller than 15MW, simplified methodologies for small-scale projects will be used to calculate reductions for displacing electricity generation from other sources. The small-scale methodology to be used is Type I.D- Renewable electricity generation for a grid as the project will sell its generated electricity to the grid under its Power Purchase Agreement.

B.2. Description of how the methodology is applied in the context of the project activity:

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The project activity extracts landfill gas and combusts it in a flare or in the gas engines for electricity generation. The baseline scenario is the total atmospheric release of LFG.
The emission reductions will be calculated as follows:

ER_y=($MD_{project,y}$-$MD_{reg,y}$) ＊GWP_{ch4} ＋EG_y ＊$CEF_{electricity,y}$+ET_y ＊$CEF_{thermal,y}$

Where：

ER_y = Emission reduction in tCO_2 equivalents during a given year, tCO_2e
$MD_{project,y}$ = Amount of methane destroyed by the project activity in tCH_4 in the given year, tCH_4
$MD_{reg,y}$ = Amount of methane that would be destroyed in the baseline in tCH_4 in the given year, tCH_4
GWP_{ch4} = Approved Global Warming Potential of methane (21 tCO_2/tCH_4)
EG_y = Net quantity of electrical energy displaced during the given year, MWh
$CEF_{electricity,y}$ = CO_2 emissions intensity of the electrical energy displaced in the grid, tCO_2e/MWh
ET_y = Quantity of thermal energy displaced during the given year, TJ, which for this project 0
$CEF_{thermal,y}$ = CO_2 emissions intensity of the thermal energy displaced during the given year, tCO_2e/TJ, which for this project is irrelevant since ETy = 0

The above equation is that of the Consolidated Methodology for Landfill Project ACM0001

Besides, the electricity generated by the project activity will be connected to the public grid and the generation capacity is not over than 15MW, so that the Methodology for Small Scale Activities Type I.D-Renewable electricity generation for a grid is used here. In the methodology the carbon emission factor ($CEF_{electricity}$) is calculated according to option (b) under the Article 7, **the weighted average emissions (in kg CO_2equ/kWh) of the current generation mix**.

EF_y is counted using the weighted average emissions of the current generation mix as shown below:

$$EF_y\left(tCO_2 / MWh\right) = \frac{\sum_{i,j} F_{i,j,y} * COEF_{i,j}}{\sum_j GEN_{j,y}}$$

Where:

EF_y = Baseline emission factor in tCO_2/MWh
$F_{i,j,y}$ = Amount of fuel i (in GJ) consumed by power sources j in year y;
j = Power sources delivering electricity to the grid;
$COEF_{i,j}$ = Carbon coefficient of fuel i in tCO_2/GJ;
$GEN_{j,y}$ = Electricity delivered to the grid by fuel source j, MWh.

Based on the data available for most current year from China Electric Power Yearbook (2002, 2003, 2004), together with calorific values for fuel types and fuel oxidisation from the *IPCC GHG Gas Inventory Reference Manual (IPCC 1996)*, and the *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*, the details of EF_y calculation are shown in Annex 3 of this PDD.

The project will supply electricity to Tianjin power grid which interconnects with North China Grid covering Beijing, Tianjin, Hebei province, Shaanxi province and Inner Mongolia Autonomous Region. Compared with electricity importation and exportation of Tianjin power grid itself, there is no significant difference. Therefore, Tianjin power grid is chosen as the grid boundary for calculation of EF_y of this project.

Tianjin Power Grid Importation and Exportation 2001~2003

	Year 2001	Year 2002	Year 2003	Average
Power supply (GWh)	22,610	25,028	27,985	25,208
Power generation (GWh)	22,175	27,275	32,200	27,217
Import/export (%)	2	-8	-13	-7

Source: China Electric Yearbook 2002, 2003 and 2004

For the year 2001, the value of average emission factor was 0.7941 (tCO_2e/MWh), while the value for the year 2002 was 0.8194 (tCO_2e/MWh). The value for 2003 is not available due to lack of the statistics of fuel consumption of oil and gas fired plants in Tianjin.

From the perspective of conservativeness, the lower of the above two values is used in this project, namely, 0.7941 (tCO_2e/MWh) as the baseline grid emission rate.

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity:

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The determination of project scenario additionality is done using the CDM consolidated tool for demonstration of additionality, which follows the below steps:

Step 0.Preliminary screening based on the starting date of the project activity

The starting date of the project is scheduled to be 1st January 2008. Therefore, the proposed project is not that type of project starting before the date of registration and prior to the start of the crediting period.

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a. Define alternatives to the project activity:

Alternative 1: Business as usual

The current status is maintained. The LFG is neither collected nor utilized but left to emit into the atmosphere through venting wells.

Alternative 2: Flaring

The LFG generated from the site is collected and flared for environmental protection and safety. (not utilized for energy)

According to Measures for Operation and Management of Clean Development Mechanism Projects in China, Article 4 “The priority areas for CDM projects in China are energy efficiency improvement, development and utilization of new and renewable energy, and methane recovery and utilization.” The Chinese government is encouraging landfill gas utilization as a type of clean fuel instead of simply flaring so that the latter alternative is not suitable for landfill gas CDM projects in China. Therefore, without CDM, the scenario of flaring landfill gas for safety reason would not happen in China because it needs additional investment but cannot bring revenue. Meanwhile, even if taking CDM revenue into consideration, it seems that the Chinese government does not encourage flaring-only projects according to the Chinese CDM regulation. As a result, this scenario is not regarded as one of the alternatives to the proposed project.

Alternative 3: LFG recovery and utilization project (the proposed project)

The proposed project is implemented. The LFG generated from the Shuangkou landfill is collected, and sent to the generators for producing electricity which then will be supplied to the public grid. Excess LFG, which is not utilized for electricity generation, will be flared. In addition, when generators are maintained or overhauled periodically, LFG will be flared as a back-up.

Sub-step 1b. Enforcement of applicable laws and regulations

The baseline scenario or the proposed project scenario must meet the regulatory requirements of Chinese government. At present China has the following most recent relevant requirements concerning landfill gas:
• *Technical code for municipal solid waste sanitary landfill (CJJ17-2004)*
• *Technical specification for operation and maintenance of municipal domestic refuse sanitary landfill (CJJ93-2003)*
• *Standard for pollution control on the landfill site for domestic waste (GB16889-1997)*

Among them only Article 5.1.1 and Article 5.3.3 in *Technical specification for operation and maintenance of municipal domestic refuse sanitary landfill (CJJ93-2003)* and Article 8.0.1 and Article 8.0.6 in *Technical code for municipal solid waste sanitary landfill (CJJ17-2004)* are mandatory that any landfill operators in China must obey.

> In *Technical specification for operation and maintenance of municipal domestic refuse sanitary landfill (CJJ93-2003)*, Article 5.1.1 indicates that a gas venting system should be installed, operated and maintained at the landfill in compliance with the requirements for the landfill design, while Article 5.3.3 indicates that when methane of LFG is over than 1.25% the safety precautions should be taken immediately.
>
> In *Technical code for municipal solid waste sanitary landfill (CJJ17-2004)* Article 8.0.1 indicates that landfill gas venting facilities must be installed at the landfill site to avoid accidents of ignition and explosion due to gas accumulation and transferring. If the landfill gas cannot be recovered and utilized, it must be extracted and flared by flaring system. At the old landfills that fail to meet the standards for safe and stable operation, gas venting system and treatment facilities should be installed.
> Article 8.0.6 indicates that at landfill site, methane content is not allowed to exceed 5% in volume, while inside buildings on the site methane shall not to exceed 1.25% in volume.

In addition, Annex 3 of EB22 Report clarifies as follows:

> Article 6(b), National and/or sectoral policies or regulations that give comparative advantages to less emissions-intensive technologies over more emissions-intensive technologies (e.g. public subsidies to promote the diffusion of renewable energy or to finance energy efficiency programs). and
>
> Article 7(b), National and/or sectoral policies or regulations under paragraph 6(b) that have been implemented since the adoption by the COP of the CDM M&P (decision 17/CP.7, 11 November 2001) need not be taken into account in developing a baseline scenario (i.e. the baseline scenario

could refer to a hypothetical situation without the national and/or sectoral policies or regulations being in place).

Shuangkou landfill was constructed in 1999 when only *Technical code for municipal solid waste sanitary landfill (CJJ17-1988)* was available. It recommended that landfill gas should be flared if possible. Therefore, CJJ17-2004 is not applicable to the proposed project and the project is additional to the baseline scenario in view of Chinese legislative requirements.

Step 2: Investment analysis

Sub-step 2a. Determine appropriate analysis method

The project will have proceeds from power sales as well as from emission reduction credits, so Option I stated in *Tool for the Demonstration and Assessment of Additionality* (version 2) is not applicable.

Further, Option II is based on the comparison of returns of the project investment with the investment required for an alternative to the project. In this case, the alternative to the CDM project activity is simply not to install flaring and generation equipment at the site, as business-as-usual scenario. Therefore does not involve investment of comparable scale to the project.

As a result, Option III must be used, where the returns of the investment in the project activity is compared to benchmark returns that are available to any investors in the country. Here, the benchmark analysis is selected to be conducted as follows.

Sub-step 2b.- OptionⅢ. Apply benchmark analysis

Till now, China has several CDM LFG-to-energy projects which have been registered, or are under request for registration, validation or in preparation. The financial parameters of those projects are summarized below.

Project Name	IRR with CER	IRR without CER	Benchmark rate	Remarks
Nanjing Tianjingwa Landfill Gas to Electricity Project (registered)	26.58%	6.61%	12%	Benchmark rate of return on construction or similar risks involved projects
Meizhou Landfills Gas Recovery and Utilization as Energy (registered)	40.45%	negative	4.44%	Rate of return of 2005 Phase I China National Bonds as the minimum hurdle rate
Jinan Landfill (under validation)	31.7%	negative	12%	Benchmark rate of return on construction or similar risks involved projects

In addition to benchmark rate of return on the similar projects listed above, in 2006 the interest rate for a five-year term of local banks in China is 6.39% and for latest long-term government bond is 2.42%. With reference to *Interim Rules on Economic Assessment Electrical Engineering Retrofit Projects*, the financial benchmark rate of return of Chinese power industries accounts for 8% of the total investment IRR. This is the same case when it comes to the waste-to-energy plants in China. WTE projects require the minimum IRR of total investment is also 8%. But for the LFG-to-electricity projects in China, 12% is the chosen as the financial benchmark rate, see the table above. This also can be approved by the Tianziling LFG-to-electricity project in Hangzhou, the capital of Zhejiang province, which started to operate in 1998. It had the IRR of 12.5% and the financial benchmark 12%. Even it was the project with the little profit it was implemented as the first LFG-to-energy project in China. Till now it still plays its demonstrative role for other landfills.

Sub-step 2c. Calculation and comparison of financial indicators

The financial analysis for the proposed project is shown in the table below, without and with CERs taken into account. The calculated IRR value of the project without CERs would be 7.0%, which is quite lower than the financial benchmark 12% as mentioned above. Thus without CERs revenue, it is evident that this project will face substantial financial hurdles and would not be implemented.

	Net Present Value (US$)	Discount Rate	IRR
Without CERs	negative	8%	7.0%
With CERs	6,239,438	8%	24.6%

Sub-step 2d. Sensitivity analysis

A sensitivity analysis was conducted by altering the parameters: electricity tariff, investment and operation & maintenance costs.

Positive impact

- Increase in the electricity tariff to be supplied to the grid by the proposed project
- Decrease in the project capital and O&M costs

Negative impact

- Decrease in the electricity tariff to be supplied to the grid by the proposed project
- Increase in the project capital and O&M costs

The above parameters were selected as being most likely to fluctuate over time. Financial analysis was performed altering each of these parameters by 10%, and assessing what the impact on the project IRR would be as shown in the table below.

<table>
<tr><th rowspan="2"></th><th rowspan="2"></th><th rowspan="2">% change</th><th colspan="2">IRR</th><th colspan="2">NPV (US$)
(Discount rate 8%)</th></tr>
<tr><th>With CER</th><th>Without CER</th><th>With CER</th><th>Without CER</th></tr>
<tr><td rowspan="2">Positive Impact</td><td>Increase in the electricity tariff to the grid</td><td>+10%</td><td>26.4%</td><td>9.7%</td><td>7,076,763</td><td>539,013</td></tr>
<tr><td>Decrease in the project capital and O&M costs</td><td>-10%</td><td>28.5%</td><td>9.6%</td><td>6,995,000</td><td>457,250</td></tr>
</table>

Negative Impact	Decrease in the electricity tariff to the grid	-10%	22.6%	4.2%	5,402,100	negative
	Increase in the project capital and O&M costs	+10%	21.3%	4.9%	5,483,863	negative

Figures in above table show that if there is an increase of electricity tariff or a decrease of investment and O&M cost by 10%, the project IRR would still be lower than the benchmark rate 12%, if without CERs considered.

Besides those parameters, the variation of the amount of electricity to be connected to the municipal grid will probably influence the project's financial attractiveness also. But in China, all CDM projects concerning electricity to the grid have not taken this parameter into account. In addition, several national law and regulations relevant to the renewable energy have been promulgated recently, such as *Renewable Energy Law of P.R.C.(2005).*, *Regulation on Electricity Generation by Renewable Energy (2005)*, etc., It is evident that Chinese government is making great efforts to encourage the nation to use renewable energy instead of conventional fossil fuel for its development. In the Regulation on Electricity Generation by Renewable Energy, it requires that the power companies should make proper design and retrofit of the municipal/provincial/regional grid in accordance with the their grid construction plans, to make it possible that all electricity generated by renewable energy, such as wind, solar, hydropower, biomass, etc. will be effectively connected to the grid. Thus, the electricity amount change is not considered in the sensitivity analysis of the proposed project.

Hence, above sensitivity analysis provides the valid argument that the financial attractiveness of the proposed project is robust to reasonable variations in the critical assumptions, and consistently supports that if without CER revenue the proposed project is not financially attractive.

Step 3. Barrier analysis

Sup-step 3a. Identify barriers that would prevent the implementation of type of the proposed project activity*:*

Step 3 is skipped because Step 2 is selected instead.

Step 4. Common Practise Analysis

The traditional and common solid waste disposal method in China is to simply deposit the waste on a designated (unused) area of land. When undertaken in an uncontrolled way, as is the case in many cities, the result is an "open dump". Open dumps give rise to a number of potential health and environmental problems including the spread of disease by flies, rats and other vectors, pollution of surface waters and, as the waste is frequently set on the fire, and air pollution.

Where municipal authorities (mainly in the cities) have developed sizable landfills, most of them vent any methane generated directly to the atmosphere. At present it is estimated that less than 5% of sizable landfill sites in China have landfill gas collection and flaring schemes and even less have gas utilization facilities. Most of the landfills have no leachate collection system, have inappropriate or no cover system, have limited or no compaction, have no gas control system, and have no waste screening systems in place.

The new legislation requires landfill operators to collect and if possible utilize landfill gas, and to flare landfill gas that cannot be used. However, the legislation is not adequately enforced and common practice demonstrates that landfills in the region, regardless of whether they are covered by the legislation or not, do not capture and flare or utilize their landfill gas.

According to the *National Action Plan for Recovery and Utilization of Landfill Gas (December 2001)*, it stated that:
At present, in China the municipal refuse is disposed using the technology of traditional landfill, without consideration of recovery and utilization of landfill gas. Almost all landfills do not have landfill gas recovery systems, except a few newly built landfills, and the landfill gas is emitted to the atmosphere openly……About 10 sanitary landfills have been set up in a few cities. However, there was no landfill gas recovery system in these sanitary landfills. In 1997, the first system of landfill gas recovery and utilization in China was built is Hangzhou Tianziling landfill, Zhejiang province, and the landfill gas is utilized for power generation. However, there is no mechanism and policy to guide the whole country to have landfill gas recovery and utilization systems. Therefore, it is still a blank paper for landfill management to establish landfill gas recovery and utilization systems.

Currently Tianjin has 5 landfills in operation. All of them have no gas recovery and utilization system, while just venting gas to the atmosphere through wells instead. These landfills are listed below:

Name of landfill	Operation start	Designed capacity (metric tons per day)	Current Status
Shuangkou landfill	April 2001	2700	No collection, flaring, recovery
Dahanzhuang landfill	December 2004	1000	No collection, flaring, recovery
Hangu landfill	May 2002	700	No collection, flaring, recovery
Dagang landfill	October 2003	400	No collection, flaring, recovery
Jixian county landfill	2005	200	No collection, flaring, recovery

Consequently, the proposed project to be implemented in Tianjin Shuangkou landfill site is clearly additional in terms of common practices of landfill gas management in China.

Step 5: Impact of CDM registration

Fully recognizing the serious problem of global warming especially caused by methane from landfills, Tianjin Construction Commission authorized Tianjin Clean Energy and Environmental Engineering Co, Ltd. as the project developer to recover and utilize the landfill gas from Shuangkou landfill, while taking CDM into consideration.

On the contrary, if without CDM, landfill gas from Shuangkou landfill will continue emitting as it usually does, although the Tianjin Construction Commission has the willing to improve the landfill environmental conditions, due to the barriers of financial support.

Further, as analyzed above (Step 2c), if the developer could be able to sell emission reduction credits derived from the project at a hypothetical price of 7 US dollars per tonne of CO_2e, the additional revenue generated by carbon sales would be adequate to proceed the project.

In sum, based on above analysis the proposed project, Tianjin Shuangkou Landfill Gas Recovery and Utilization Project is additional to the current baseline scenario.

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

>>

The following Fig.3 describes the project boundaries comprising all possible elements of the landfill gas collection, flaring and electricity generation systems, in conformity with methodologies ACM0001 and AMS I.D. which states that the project boundary is the site of the project activity where the gas is captured and destroyed/used.

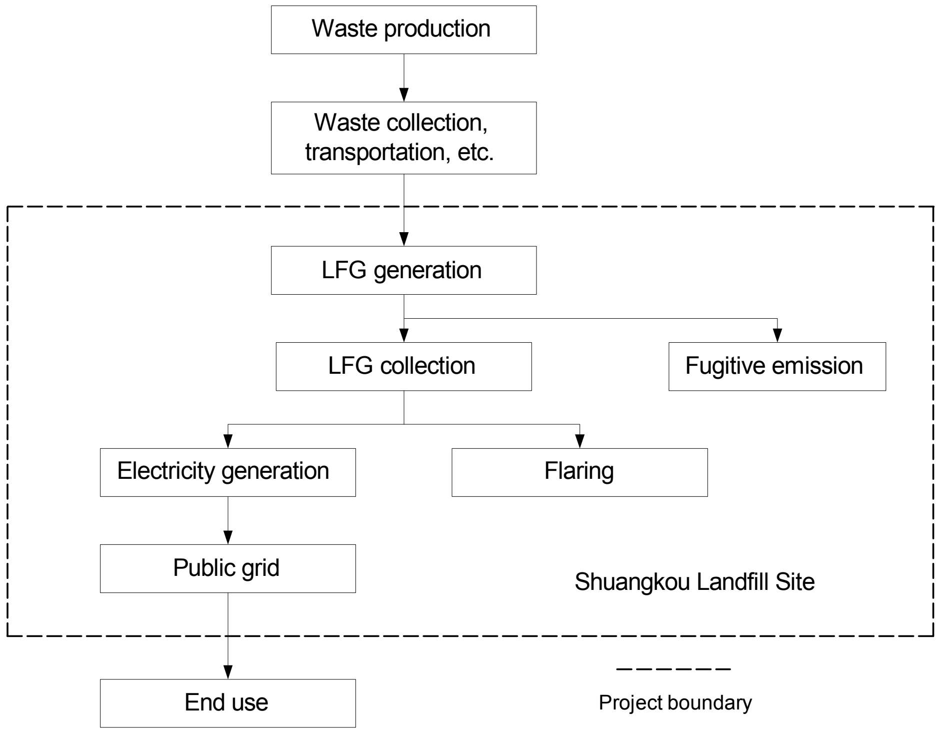

Fig.3 Boundary of Tianjin Shuangkou LFG recovery and utilization project

The project boundaries are chosen in a way that they describe not only the geographical boundaries, but also the competence boundaries of the project and the influence the project owner has to change the impacts of the project.

Excluded from the project are the waste production, collection and waste transportation to the landfill, because this is outside of the responsibility of the project owner. The same for the public grid, the public grid and usage by the end user is not in the project boundaries, but the transmission line from the landfill site to the public grid is included. From the transmission line no emissions are to be expected. Furthermore, construction and operation of the transmission line should not result in significant environmental impacts. It is not clear at this moment whether the existing transmission line connecting the Shuangkou landfill and the municipal grid will be able to accommodate the future export of electricity from the project. While the transmission corridor already exists, minor land acquisition may become necessary to enhance the capacity of the existing poles. The need for land acquisition will be determined at the time of negotiation of the Power Purchase Agreement with the Power Bureau in the later half of 2006. Any land acquisition will have to be carried out in compliance with the World Bank's safeguard policies on resettlement.

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

>>

Date of completing the final draft of this baseline section (*DD/MM/YYYY*): 10 May 2006

Name of person/entity determining the baseline:

Company Name: Shanghai JEC Environmental Consultant Co., Ltd.
Address: 1748 Xinzha Road, Shanghai, China
Zip Code: 200040
Tel: +86-21-62172233
Fax: +86-21-62715179

Ms. Ou Yuanyang	oyy@shjec.cn
Ms. Beatrix Etzkorn	bea@shjec.cn
Mr. Peng Xiaoping	pengxp@shjec.cn
Ms. Ma Meifang	mamf@shjec.cn

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>

Operation starting date: 1 January 2008.

C.1.2. Expected operational lifetime of the project activity:

>>

10 years

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1.Starting date of the first crediting period:

>>

Not applicable

C.2.1.2.Length of the first crediting period:

>>

Not applicable

C.2.2. Fixed crediting period:

C.2.2.1.Starting date:

>>

It is expected that the project will start on 1 January 2008

C.2.2.2.Length:

>>

10 years

SECTION D. Application of a monitoring methodology and plan

D.1. Name and reference of approved monitoring methodology applied to the project activity:

>>

ACM0001 Consolidated monitoring methodology for landfill gas project activities. (Version 02, 30 September 2005)
AMS-I.D. Renewable electricity generation for a grid.
(http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html)

D.2. Justification of the choice of the methodology and why it is applicable to the project activity:

>>

According to CDM requirements, the section B.1.1 in this PDD demonstrates both baseline methodologies ACM0001 and AMS.I.D are applicable to this project. Therefore, ACM0001, the Consolidated Monitoring Methodology for LFG project, and AMS.I.D, Renewable electricity generation for a grid, are selected in pairs for this project.

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

Not applicable.

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

Not applicable.

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1. $LFG_{total,y}$	Total amount of landfill gas captured	m^3	m	continuous	100%	Electronic, till 2 years after last issuance of credits	Measured by flow meter. Data to be aggregated monthly and yearly.
2. $LFG_{electricity,y}$	Amount of landfill gas to generators	m^3	m	continuous	100%	Electronic, till 2 years after last issuance of credits	Measured by flow meter. Data to be aggregated monthly and yearly.
3. $LFG_{flared,y}$	Amount of landfill gas to flares	m^3	m	continuous	100%	Electronic, till 2 years after last issuance of credits	Measured by flow meter. Data to be aggregated monthly and yearly.
4. FE	Flare efficiency, determined by 1) the operation hours and 2) the methane content in the exhaust gas	%	m/c	Quarterly, monthly if unstable	n/a	Electronic, till 2 years after last issuance of credits	1) continuous measurement of operation time of flare (e.g. with temperature) 2) periodic measurement of methane content of flare exhaust gas.
5. $W_{CH4,y}$	Methane fraction in the landfill gas	m^3CH_4/m^3LFG	m	Continuous	100%	Electronic, till 2 years after last issuance of credits	Preferably measured by continuous gas quality analyzer

6. T	Temperature of the LFG	℃	m	Continuous	100%	Electronic, till 2 years after last issuance of credits	Measured to determine the density of methane D_{CH4}
7. P	Pressure of the LFG	Pa	m	Continuous	100%	Electronic, till 2 years after last issuance of credits	Measured to determine the density of methane D_{CH4}
8.	Total amount of electricity and/or other energy carriers used in the project for gas pumping and heat transport (not derived from the gas)	MWh	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable as the Project will use electricity generated from the landfill gas
9.	CO_2 emission intensity of the electricity carriers in ID 8	tCO_2/MWh	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable as the Project will use electricity generated from the landfill gas
10.	Regulatory requirements relating to LFG projects	Text	n/a	At the beginning of each crediting period	100%	Electronic, till 2 years after last issuance of credits	Required for any changes to the adjustment factor (AF) or directly baseline emission $MD_{reg,y}$
11. EG_y	Net electricity supplied to the grid	MWh	m	Hourly measured and monthly recording	100%	Electronic, till 2 years after last issuance of credits	This takes into account electricity use for the operation Double checked with receipts of sales

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

>>

According to the IPCC Good Practice Guidance the CO_2 emissions from landfill gas combustion are of biogenic origin and therefore are not considered as a GHG gas.

The only emission from the project is the electricity used for the operation of blowers, flare pumps and other auxiliary equipment. However, total electricity used for the project will be deducted from the amount of electricity produced by the project. Therefore, the emission reductions will only be claimed for the net electricity supplied to the grid. Project emissions are therefore accounted for in the formula for emission reductions in section D.2.4 below.

D.2.3. Treatment of leakage in the monitoring plan

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

No leakage is to be considered in this project according to the methodologies ACM0001 and AMS.I.D.

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

The emission reductions of the project will be calculated as follows:

$$ER_y=(MD_{project,y}-MD_{reg,y})*GWP_{ch4}+EG_y*CEF_{electricity,y}+ET_y*CEF_{thermal,y}$$

Where：

ER_y = Emission reduction in tCO_2e equivalent during year y
$MD_{project,y}$ = The methane destroyed by the project activity in tCH_4 in year y
$MD_{reg,y}$ = The methane that would be destroyed in the baseline in tCH_4 in year y
GWP_{ch4} = The approved Global Warming Potential of methane (21 tCO_2/tCH_4)

EG_y = The net quantity of electrical energy displaced during the year
$CEF_{electricity,y}$ = CO_2 emissions intensity of the electrical energy displaced in the grid
ET_y = Quantity of thermal energy displaced during the year, which for this project = 0
$CEF_{thermal,y}$ = CO_2 emissions intensity of the thermal energy displaced, which for this project is irrelevant since ETy = 0

As the methane in this project will not be used for heating purpose, this component will be excluded from the overall equation.

In correspondence with the above said methodology AMS.I.D, the Option (b) under Article 7, the weighted average emissions (in kg CO_2e/MWh) of the current generation mix, is chosen for calculation of carbon emission factor ($CEF_{electricity,\ y}$). This method is used as sufficient data for the calculation of the operation margin and build margin of the Tianjin grid is not available in China. The carbon emissions factor of the grid (EF_y) is therefore calculated according to the equation below.

EF_y is counted using the weighted average emissions of the current generation mix as shown below:

$$EF_y\left(tCO_2 / MWh\right) = \frac{\sum_{i,j} F_{i,j,y} * COEF_{i,j}}{\sum_j GEN_{j,y}}$$

Where:

EF_y = Baseline emission factor in tCO_2/MWh
$F_{i,j,y}$ = Amount of fuel *i* (in GJ) consumed by power sources *j* in year y;
j = Power sources delivering electricity to the grid;
$COEF_{i,j}$ = Carbon coefficient of fuel *i* in tCO_2/GJ;
$GEN_{j,y}$ = Electricity delivered to the grid by fuel source *j*, MWh.

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored		
Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.

D.2.2.1-1. $LFG_{total,y}$	Low	Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy.
D.2.2.1-2. $LFG_{electricity,y}$	Low	Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy.
D.2.2.1-3. $LFG_{flared,y}$	Low	Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy.
D.2.2.1-4. FE	Medium	Regular maintenance should ensure optimal operating of flares. Flare efficiency should be checked quarterly, with monthly checks if the efficiency shows significant deviations from previous values.
D.2.2.1-5. $W_{CH4,y}$	Low	The gas analyser should be subject to a regular maintenance and testing regime to ensure accuracy.
D.2.2.1-11 EG_y	Low	This data will be directly used for calculation of emission reductions. These data is the one most accurately measure, as this is measured both by the operator as well as by the grid company that will acquire the electricity generated by the project. The guarantee QC/QA, it will be double checked by receipts of electricity sales.

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

>>

TCEE, as the project developer and investor, will select a professional company (PC) specializing in the municipal solid waste management to construct and operate the proposed project. This company is also responsible for all monitoring activities to assure that all activities consistent with the Monitoring Plan. The project developer is responsible for supervising the project implementation conducted by the professional company.

The organizational structure for implementing the proposed project is shown as follows.

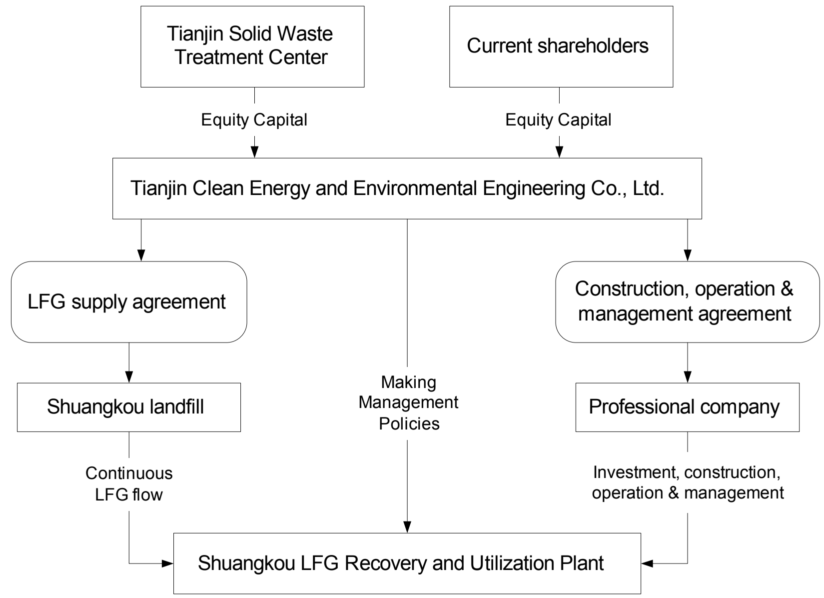

Fig.4 Organizational structure of the Project

D.5 Name of person/entity determining the monitoring methodology:

>>

Company Name: Shanghai JEC Environmental Consultant Co., Ltd.
Address: 1748 Xinzha Road, Shanghai, China
Zip Code: 200040
Tel: +86-21-62172233
Fax: +86-21-62715179

Ms. Ou Yuanyang oyy@shjec.cn
Ms. Beatrix Etzkorn bea@shjec.cn

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

>>
As stated before, the GHG emissions from the proposed project is the electricity used for flare pumps, blowers, etc. But based on the activities of the project, the electricity generated from landfill gas will provide for its own use, and will be deducted from the total electricity generation. So that the net electricity can be supplied to the grid and only this part of emission reductions will be claimed, as specified in the methodology ACM0001.

E.2. Estimated leakage:

>>
No leakage is to be considered in this project according to the ACM0001 methodology states.

E.3. The sum of E.1 and E.2 representing the project activity emissions:

>>
The sum of E.1 and E.2 is equal to 0 per year.

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

>>
Based on the proposed project, together with methodologies ACM0001 and AMS.I.D., the emissions reduction is calculated according to the following equation:

$$ER_y=(MD_{project,y}-MD_{reg,y})*GWP_{ch4+}EG_y*CEF_{electricity,y}$$

Where：

ER_y = Emission reduction in tCO_2e equivalent during year y
$Md_{project,y}$ = The methane destroyed by the project activity in tCH_4 in year y
$Md_{reg,y}$ = The methane that would be destroyed in the baseline in tCH_4 in year y
GWP_{ch4} = The approved Global Warming Potential of methane (21 tCO_2/tCH_4)
EG_y = The net quantity of electrical energy displaced during the year
$CEF_{electricity,y}$ = CO_2 emissions intensity of the electrical energy displaced in the grid

The methane that would be destroyed in baseline is calculated as follows.

$$Md_{reg,y} = Md_{project,y} * AF$$

Where:

AF = Adjustment Factor

In the ACM0001, it provides the guidance on how to estimate AF:
- In cases where a specific system for collection and destruction of methane is mandated by regulatory or contractual requirements, the ratio of the destruction efficiency of that system to the destruction efficiency of the system used in the project activity shall be used.

- In cases where a specific percentage of the "generated" amount of methane to be collected and destroyed is specified in the contract or mandated by regulation, this percentage divided by an assumed efficiency for the collection and destruction system used in the project activity shall be used.

The proposed project is none of above mentioned cases. Moreover, there is neither contractual requirement for this project nor local and national mandatory regulations which are applicable to Shuangkou landfill for the destruction of certain amount of methane from landfill, therefore, AF is set to be zero.

$$MD_{project,y} = MD_{flare,y} + MD_{electricity,y}$$

$$MD_{flare,y} = LFG_{flare,y} * W_{CH4,y} * D_{CH4} * FE$$

$$MD_{electricity,y} = LFG_{electricity,y} * W_{CH4,y} * D_{CH4}$$

Where：

$MD_{flare,y}$ = quantity of methane destroyed by flaring (tCH_4)
$LFG_{flare,y}$ = quantity of landfill gas flared during the year measured in cubic meters (m^3CH_4)
$W_{CH4,y}$ = average methane fraction of the landfill gas as measured during the year and expressed as a fraction (in m^3CH_4/m^3LFG)
D_{CH4} = the methane density expressed in tones of methane per cubic meter of methane (tCH_4/m^3CH_4)
FE = flare efficiency(the fraction of the methane destroyed)
$MD_{electricity,y}$ = quantity of methane destroyed by generation of electricity (tCH_4)
$LFG_{electricity,y}$ = quantity of landfill gas used for electricity generation during the year measured in cubic meters (m^3CH_4)

ACM0001 requires that a project proponent provides an ex ante estimate of emissions reductions. So the generation of methane ($Q_{y,k}$) is estimated with the following methane generation model, First Order Decay Model from the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories:

$$Q_{y,k} = k R_x L_0 e^{-k(T-x)}$$

Where:

$Q_{y,k}$ = the amount of methane generated in the current year (T) by the waste Rx
k = methane generation rate constant (1/yr)
R_x = the amount of waste disposed in year x (tonne)
L_0 = methane generation potential (m^3/tonne of refuse)
x = the year of waste input
T = current year

$Q_T = \Sigma Q_{y,k}$ (for x = initial year to T)

year	(1) Methane combustion by power generation (CH_4 m^3)	(2) Methane combustion by flaring (CH_4 m^3)	(3)=(1)+(2) Project methane directly destroyed (for conservativeness) (CH_4 m^3)	Project methane directly destroyed (CH_4 ton)	Direct LFG Emission Reductions (tCO_2e)
2008	3,330,000	565,071	3,895,071	2,792	58,632
2009	3,330,000	1,864,333	5,194,333	3,723	78,189
2010	5,937,430	553,447	6,490,877	4,653	97,706
2011	6,660,000	1,505,404	8,165,404	5,853	122,912
2012	9,140,700	852,034	9,992,734	7,163	150,419
2013	9,990,000	977,880	10,967,880	7,862	165,097
2014	9,990,000	1,854,534	11,844,534	8,490	178,293
2015	9,990,000	2,663,787	12,653,787	9,070	190,475
2016	12,322,196	1,148,591	13,470,787	9,656	202,773
2017	12,970,796	1,209,050	14,179,845	10,164	213,446
Total	83,661,122	13,194,131	96,855,253	69,426	1,457,943

As elaborated above, based on the approved methodology for small-scale projects AMS-I.D, the weighted average emissions (in kg CO_2e/kWh) of the current generation mix will be applied in the project. The emission factor is calculated as **0.7941tCO_2e/MWh** (see details in Annex 3 of this PDD).

5% of the power generated by the project is considered for on-site use, such as by the landfill gas extraction system (pumps) and the generation system itself. The rest, 95% of the power, will be connected to the public grid.

Year	Power supplied to the grid (kWh)	CEF (tCO_2e/MWh)	Grid Electricity Displacement Emission Reductions (tCO_2e)
2008	9,500,000	0.7941	7,544
2009	9,500,000	0.7941	7,544
2010	16,938,615	0.7941	13,451
2011	19,000,000	0.7941	15,088
2012	26,077,071	0.7941	20,708
2013	28,500,000	0.7941	22,632
2014	28,500,000	0.7941	22,632
2015	28,500,000	0.7941	22,632
2016	35,153,412	0.7941	27,915
2017	37,003,772	0.7941	29,385
Total	238,672,870		189,530

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

Year	Direct LFG Emission Reductions (tCO_2e)	Grid Electricity Displacement Emission Reductions (tCO_2e)	Project Emission Reductions (tCO_2e)
2008	58,632	7,544	66,176

2009	78,189	7,544	85,733
2010	97,706	13,451	111,157
2011	122,912	15,088	138,000
2012	150,419	20,708	171,126
2013	165,097	22,632	187,729
2014	178,293	22,632	200,925
2015	190,475	22,632	213,107
2016	202,773	27,915	230,688
2017	213,446	29,385	242,831
Total	1,457,943	189,530	1,647,473

E.6. Table providing values obtained when applying formulae above:

>>

Year	Estimation of project activity emission reductions (tonnes of CO_2e)	Estimation of baseline emission reductions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of emission reductions (tonnes of CO_2e)
2008	66,176	0	0	66,176
2009	85,733	0	0	85,733
2010	111,157	0	0	111,157
2011	138,000	0	0	138,000
2012	171,126	0	0	171,126
2013	187,729	0	0	187,729
2014	200,925	0	0	200,925
2015	213,107	0	0	213,107
2016	230,688	0	0	230,688
2017	242,831	0	0	242,831
Total (t CO_2e)	1,647,473	0	0	1,647,473

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>
According to the procedures for applying for a construction project in China, Environmental Impact Assessment (EIA) is a must. The objective of the EIA is to identify the effects of the project activities on both the environmental and socio-economic aspects of the community located near Shuangkou landfill, and to provide proper measures and procedures to mitigate its possible negative impacts.

• **Environmental Impact**

Based on the national technical code for landfill construction (CJJ17-1988), Shuangkou landfill has not installed LFG collection and recovery system. Currently the existing landfill phases have bad impact on the environment, especially on the aspects of leachate pollution, air pollution, odour and littering.

Through uncontrolled emitting of LFG, uncontrolled gas accumulation in the solid waste disposal body, gas explosions and fire were common problems on the old landfill site, and were not only harmful to the environment, but also for the health of workers. In order to collect landfill gas as much as possible, the proposed project will retrofit the landfill with more soil cover and build the side dams. Thus, through the side dams the leaching will also be minimized. The littering of old waste will completely disappear and through the landfill gas collection the air pollution in terms of odor and hazardous components will be reduced to minimum.

In particular, the proposed project will make leachate problems minimized. At present, the leachate produced at the Shuangkou landfill is collected through perforated pipes installed at the bottom of each waste disposal cell and then circulated back to these cells. The proposed project will include collecting the leachate separated by condensing from the extracted LFG, then discharging to the adjusting tank for pre-treatment prior to being circulated to the landfill.

The proposed project will bring environmental benefits globally and locally. From the Shuangkou landfill project:

◇ Reducing the uncontrolled discharging of LFG, (including methane, carbon dioxide and more than 150 trace components)
◇ No contact of waste with open air meaning no contamination nor risk to public health
◇ Reducing the odor nuisance
◇ Reducing vermin
◇ Reducing spreading of litter.
◇ Speeding up the stabilization of the landfill
◇ Production of electrical power
◇ CER revenue from the project can be used for improving the landfill operation and maintenance

On the other side, LFG generators produce emissions, depending on the type of generator, operation and maintenance. Flaring generates trace amounts of organic and toxic emissions like mercury and dioxins. Compared with the environmental impact without the project, these emissions are minimal, and they will be minimized and controlled by high standards in monitoring and maintenance measurements.

There are 3 villages around Shuangkou landfill, with the closest distance of 1.2 kilometres that meets the national standard GB16889-1997 that specifies any municipal solid waste sanitary landfill must be built at least 500 meters away from the residential area. As a result, the proposed project will not have any adverse environmental impact on the villages. On the contrary, it will improve the local environmental quality.

• **Social Impact**

When constructing the proposed project, including building of a gas excavation system on the old site and re-development of the old landfill area, the job opportunities will be created. During the project implementation, the works for operation, maintenance and monitoring are necessary and will create new employment opportunities.

On the other side, to ensure that the maximum amount of CERs will be collected, the landfill workers and the management need to be trained in operating, maintaining and monitoring the landfill gas project with international standards.

Sanitary landfilling, the covering of old landfill sites and the utilization of LFG are not common practices, in China. Conducting this project and collecting CERs mean to take over a leading role in China and provide a good example for other municipalities. Tianjin takes an active role in developing a good practice for other parts of China, especially in Western China. Through various discussions, workshops and conferences, the results and the experience from implementing this project will be transferred to these municipalities.

• **Sustainable Development**

One regulation of the CDM rules is, that the proposed project has to be in line, comply with and support the Sustainable Development Idea of the host country, China and in particular with Tianjin. According to the 10th and 11th Five-year plans, following criteria have to be fulfilled:

◇ Provide environmental benefits
See above Environmental Impact
◇ Enhance the health of the public and workers
See above Environmental Impact and Social Impact
◇ Provide social benefits
See above Social Impact
◇ Provide external social benefits, like reduce the reliance on foreign technologies
The proposed project will use as far as possible local technologies, in cases, where no advanced local technology exist, the project developer has to use foreign technology. This is a great opportunity for Tianjin and China to learn from foreign technologies. The experience gained through conducting the proposed project will provide China with the opportunity, together with local manufacturers, to develop local products. Local products are in general cheaper than foreign products, therefore local products are more affordable and more Chinese municipalities will follow the example and collect landfill gas, which will lead again in increasing environmental and social benefits all over China.

The proposed project meets all requirements in line with the host country's idea of Sustainable Development and has great positive impacts both on the environment and social conditions.

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>>

No significant negative environmental impacts are expected to result from the project activity. On the contrary, the project will upgrade the local waste management practice to a higher standard and will lead to a significant reduction in local pollution along with a significant reduction in GHG emissions as described above.

For further information about the EIA, please contact the project developer (see Annex 1).

SECTION G. Stakeholders’ comments

>>

G.1. Brief description how comments by local stakeholders have been invited and compiled:

The investigation of stakeholder comments is mainly in the form of handing out questionnaires (see the below for the form), together with verbal investigation. The investigated area covers most areas of Shuangkou county, in particular, those located in Shuangkou village where the electricity generation plant is.

Spot Check Questionnaires for the Public on the Environment Impact Assessment of Tianjin Shuangkou LFG Recovery & Utilization Project

Name		Gender		Age	
Education		Vocation		Post Title	
Served company and living address					
Contact No.		Whether living in Shuangkou county			

Dear everybody,

Tianjin Shuangkou MSW sanitary landfill site is located at Shuangkou village, Beichen district, tianjin city, with a total capacity of 9 million cubic meters, a daily handling capacity of 2700 tons and a service life of 15 years. The landfill site has been in operation since 2001 and accepted the MSW from Tianjin city. Till now, already 1.5 million tons of MSW has been landfilled there. In order to reduce greenhouse effect and the negative impact caused by LFG emission on air quality and environment quality, Tianjin Clean Energy Environmental Engineering Co., Ltd. will invest RMB 19 million Yuan for this project.

The project is Shuangkou Landfill Gas Recovery & Utilization Project, which collects LFG, the gas generated during the anaerobic decomposition of the household waste in landfill site, and utilize LFG for electricity generation. The proposed power plant will be located at the existing Shuangkou sanitary landfill, no need to occupy other land. The plant mainly consists of LFG collection system, compression system and power generation system, etc. The power generated by the collected LFG is expected to be 177,000 kilowatt. During the project crediting period, the GHG emission reductions are estimated to reach 7,290,000 tons of carbon dioxide equivalents, and consequently, the project will make a great contribution to the social and environmental benefit.

1. How do you think of the impact on your living quality from Shuangkou landfill site?
□ great (+ -) □ average (+ -) □ small (+ -) □ no impact □ not clear □ others

2. How do you think of the impact on air quality and environment quality from Shuangkou landfill gas?
□ great (+ -) □ average (+ -) □ small (+ -) □ no impact □ not clear □ others

3. How do you think this project’s influence on the improvement of living quality?
□ great (+ -) □ average (+ -) □ small (+ -) □ no impact □ not clear □ others

4. How do you think this project's influence on the improvement of air quality and environment quality? □ great (+ -) □ average (+ -) □ small (+ -) □ no impact □ not clear □ others
5. How do you think this project's influence on the economic development of Shuangkou country? □ great (+ -) □ average (+ -) □ small (+ -) □ no impact □ not clear □ others
6. What do you think of the project? □ extremely for □ for □ against □ extremely against □ of no concern
Other opinions and suggestions
Thank you very much for your participancy! Signature: Date:

Note: Except the blanks for name, address and vocation which should be filled out in details, please mark " √ " in those concerned items to show your attitude towards each question. If you choose "others", please give your explanations as well. Besides, you can also leave your words on attached paper to illustrate other situation. In case of any questions, please do not hesitate to present them to our staff.

G.2. Summary of the comments received:

The investigation result shows the public are of the same view of most of the questions. The summary of questionnaire results is as follows:

Questions raised in the questionnaire	Investigation result (%)				
	great	average	small	no impact	others
Q.1. How do you think of the impact on your living quality from Shuangkou landfill site?			33.3	66.7	
Q.2. How do you think of the impact on air quality and environment quality from Shuangkou landfill gas?			100		
Q.3. How do you think this project's influence on the improvement of living quality?		66.7	33.3		
Q.4. How do you think this project's influence on the improvement of air quality and environment quality?	100				
Q.5. How do you think this project's influence on the economic development of Shuangkou country?		50	50		
Q.6. What do you think of the project?	Extremely for	For	Against	Extremely against	Of no concern
	66.7	33.3			

The summary demonstrates that all the informants are for the implementation of this project. It is convinced that the project will effectively improve the air quality and environment quality within the surrounding area, which is consistent with the result of environment impact assessment.

G.3. Report on how due account was taken of any comments received:

The residents and local authorities are all very supportive of the proposed project, therefore, there is no need to modify the project due to the comments received.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Project Developer

Organization:	Tianjin Clean Energy and Environmental Engineering Co.,Ltd.
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Represented by:	
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Carbon Buyer

Organization:	International Bank for Reconstruction and Development
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City:	
State/Region:	Washington D.C.
Postfix/ZIP:	20433
Country:	United States of America
Telephone:	+1 202 473 0836
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E-Mail:	ibrd-carbonfinance@worldbank.org
URL:	www.carbonfinance.org
Represented by:	
Title:	Director
Salutation:	Mr.
Last Name:	Evans
Middle Name:	
First Name:	James
Department:	Carbon Finance Unit
Mobile:	
Direct FAX:	
Direct tel:	
Personal E-Mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding available in this project.

Annex 3

BASELINE INFORMATION

The lack of applicable legislation that enforces LFG capture and treatment and of financial attractiveness other than the incentive from the CDM, makes it clear that without the income from the selling of CERs, the proposed project would not be carried out and the current practice, emitting LFG through venting wells at Shuangkou landfill will continue. Based on the previous consideration, the current practice is the baseline scenario, including MSW collection, disposal in the landfill, compacting and daily cover, and the release of the LFG to the atmosphere through vent wells without treatment.

The proposed project includes collecting and utilizing LFG to produce electricity which will be supplied to the Tianjin public grid. In order to determine the baseline, the following parameters need to be decided at first.

- Waste disposal quantity
- Methane generation potential, Lo
- Methane generation rate, k
- Landfill coverage and collection efficiency
- Equipment performance
- Carbon emission factor of the grid connected

Waste disposal quantity

Year	Waste disposal quantity (ton)	Effect waste disposal quantity for LFG generation (ton)	Cumulated waste disposal quantity for LFG generation (ton)
2001	90,000	-	-
2002	292,000	-	-
2003	293,000	-	-
2004	272,000	272,000	272,000
2005	333,000	333,000	605,000
2006	470,000	470,000	1,075,000
2007	470,000	470,000	1,545,000
2008	470,000	470,000	2,015,000

2009	470,000	470,000	2,485,000
2010	470,000	470,000	2,955,000
2011	470,000	470,000	3,425,000
2012	470,000	470,000	3,895,000
2013	470,000	470,000	4,365,000
2014	470,000	470,000	4,835,000
2015	470,000	470,000	5,305,000
2016	470,000	470,000	5,775,000
2017	470,000	470,000	6,245,000
2018	470,000	470,000	6,715,000
Total	7,390,000		

Methane generation potential, Lo

According to the 1996 IPCC Guideline, the Degradable Organic Carbon is calculated with following formula,

DOC = 0.4* A + 0.17 * B + 0.15 * C + 0.30 * D

A: Paper and textiles
B: Garden and park waste, and other (non-food) organic putrescibles
C: Food waste
D: Wood and straw waste

In the 1996 IPCC Guideline, the default value of fraction of DOC of MSW was 0.09. With the quick economic development, Chinese household waste composition has changed a lot since 1996 so that this value is not suitable for determine the baseline of the proposed project. However, because of the lack of the adequate information of the composition of waste disposed at Shuangkou landfill at the time of preparing this document, the data from the similar cities such as Beijing, Shanghai, are employed.
In the Beijing Anding LFG flaring CDM project, the value of DOC is 0.1329, while for Shanghai, its DOC is set at 0.130 according to ERM's analysis. In view of the conservativeness, the value 0.130 will be chosen for Tianjin.

Methane emissions (Lo) (ton/year) = (MSW * MCF * DOC * DOC_F * F * 16/12 - R) * (1 - OX)

MSW: MSW disposed to the landfill site.

MCF: methane correction factor. Shuangkou landfill was constructed and is well managed in accordance with the Chinese legislations. Therefore, MCF is 1.0 stated in IPCC Guideline.
DOC_F: fraction DOC dissimilated, default value 0.77.
F: fraction of CH_4 in landfill gas, 50%.
R: recovered CH_4 (ton/year). The current practice is venting LFG directly to the atmosphere so it is zero.
OX: oxidation factor. Shuangkou landfill has the daily soil cover but in the conservative perspective, OX=0.1.

Therefore,
Lo = 1 * 1.0 *0.130 * 0.77 * 0.5 * 16/12 * (1- 0.1) = 0.06006 ton CH_4/ton MSW = 0.06006 / 0.0007168 = 83.8 m^3 CH_4/ton MSW
0.0007168: the methane density under standard conditions.

Methane generation rate, k

This value is based on the environment in which the MSW is disposed. Higher k values are associated with greater moisture in the MSW and other factors such as waste disposal practices, waste composition, the infiltration from surface and groundwater sources, precipitation, temperature, pH and nutrient availability, etc. IPCC Guideline set the range of k value 0.005 to 0.4 per year. EPA's *Turning a liability into an asset*: *A Landfill Gas-to-Energy Project Development Handbook* recommended the k value based on different conditions: wet climate 0.1~0.35, medium moisture climate 0.05~0.15, and dry climate 0.02~0.10. Tianjin has the dry climate and annual average precipitation ranges from 550mm to 650mm. But considering the waste disposed containing more than 55% water and Shuangkou landfill current circulation of the leachate back to the disposal area, moisture content in the landfill is much higher compared with that of other countries, especially the developed ones. Therefore, 0.08 is used as the k value of this project, which also is used in Anding LFG CDM project in Beijing, the city close to Tianjin. Besides, Anding landfill also circulates its leachate back to the waste disposal area.

Landfill coverage and collection efficiency

In order to collect more LFG, the landfill will be retrofitted and covered with more soils. It is expected the collection efficiency can be improved from 45% to 60% during the project crediting period. For more details please refer to the project Feasibility Study.

Equipment performance

The specification of equipment, such as flaring efficiency 97%, generator efficiency 30%, etc., will be used ex ante to determine the amount of the methane destroyed.

Emission factor of Tianjin Grid

According to the methodology AMS.I.D, the emission factor of Tianjin grid which the proposed project is connected is calculated as follows:

Based on China's Electric Power Yearbook, Version 2002, 2003, 2004

Fuel consumed by Tianjin Grid (Only fossil fuel-based power plants considered)

Year	Generation capacity (MW)	Electricity generated (MWh)	Fuel consumed: Coal consumed by power plants of 6MW and above (ton）	Fuel consumed: Oil consumed by power plants of 6MW and above (ton)	Fuel consumed: Natural gas consumed by power plants of 6MW and above (m3)	Power supply (MWh)	Power use (MWh)
2001	5,632.00	22,166,000	9,227,500	15,700	0	22,610,000	21,217,000
2002	6,245.50	27,263,000	11,656,600	1,900	54,650,000	25,028,000	23,259,000
2003	6,008.50	32,191,000	13,850,700	n/a	n/a	27,985,000	26,149,000

Note: The regional fuel consumption statistics is not available in China's Electric Power Yearbook 2004

Fuel type	TJ/t fuel	tC/TJ	Oxidation factor	tCO2e/t fuel
Coal	0.02052	25.8	0.980	1.9024
Heavy oil	0.04019	21.1	0.990	3.0783
Natural gas	0.0523	15.3	0.995	2.9194

Source: 1996 IPCC Guideline

Year	Fuel consumed by power plants of 6MW and above: Coal t/year	Heavy oil t/year	Natural gas m3/year	CO2 emission: Coal tCO2e/year	Heavy oil tCO2e/year	Natural gas tCO2e/year	Total tCO2/year	CEF tCO2/MWh
2001	9,227,500	15,700	0	17,554,102	48,329	0	17,602,431	0.7941
2002	11,656,600	1,900	54,650,000	22,175,145	5,849	106,894	22,287,887	0.8175
2003	13,850,700			26,349,131			26,349,131	

Note: Natural gas density 0.00067

Based on the above parameters and their values, First Order Decay Model below will be used for calculation the baseline emissions.

$$Q_T = \sum 2kR_X L_o e^{-kx_i}$$

Q_T : Expected LFG generation flow rate (m^3/year)

R_X : Amount of waste disposed in year x (tons)

x_i : Age of the waste disposed in the i[th] year (years)

The emission reductions are calculated with the formula stated in Section E of this document. Therefore, the baseline emission and the emission reductions achieved by the proposed project are shown below.

Year	LFG Generation (m^3)	Collection Efficiency (%)	LFG to be collected (m^3)	Electricity to be supplied to the grid (kWh)	ERs by combusted methane in generators (tCO_2e)	ERs by combusted methane in flares (tCO_2e)	ERs by displacing the grid electricity (tCO_2e)	Total ERs achieved by the project (tCO_2e)
2008	17,389,100	45	7,825,095	9,500,000	50,126	8,506	7,544	66,176
2009	21,883,304	48	10,503,986	9,500,000	50,126	28,063	7,544	85,733
2010	26,031,977	50	13,015,989	16,938,615	89,375	8,331	13,451	111,157
2011	29,861,685	55	16,423,927	19,000,000	100,252	22,661	15,088	138,000
2012	33,396,951	60	20,038,171	26,077,071	137,593	12,825	20,708	171,126
2013	36,660,413	60	21,996,248	28,500,000	150,377	14,720	22,632	187,729
2014	39,672,967	60	23,803,780	28,500,000	150,377	27,916	22,632	200,925
2015	42,453,906	60	25,472,344	28,500,000	150,377	40,097	22,632	213,107
2016	45,021,036	60	27,012,622	35,153,412	185,484	17,290	27,915	230,688
2017	47,390,796	60	28,434,477	37,003,772	195,247	18,200	29,385	242,831
Total	339,762,136		194,526,638	238,672,870	1,259,334	198,609	189,530	1,647,473

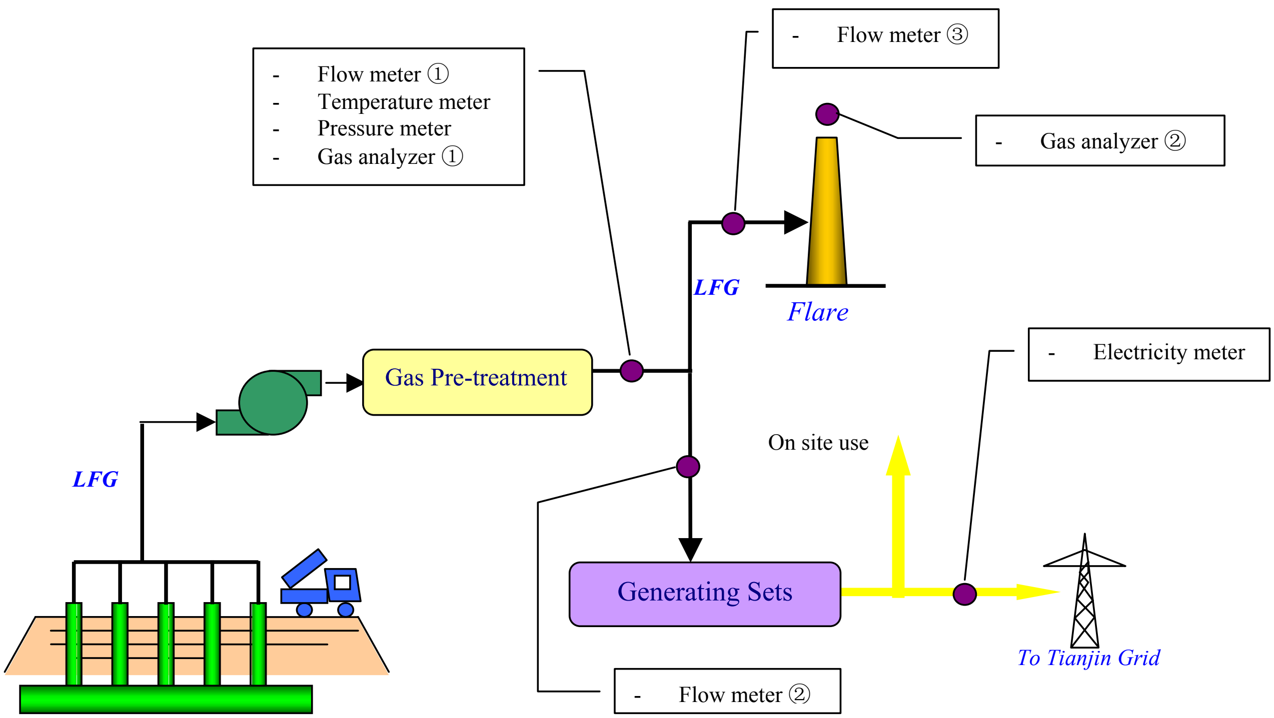
Annex 4

MONITORING PLAN

1. Monitoring methodologies

The project will monitor the emission reductions by the method, indicators, frequency as required by Monitoring Methodology ACM0001 and AMS.I.D to guarantee project ERs measurable, real.

The monitoring methodology is based on direct measurement of the amount of landfill gas captured and destroyed at the platform and electricity generating units to determine the quantities as shown below.



The monitoring plan provides for continuous measurement of the quantity and quality of LFG flared. The main variables that need to be determined are the quantity of methane actually captured, quantity of methane flared and the quantity of methane used to generate electricity. In order to determine these variables for Tianjin Shuangkou LFG project, the following main indicators have to be monitored.

- Flow meter ①: total amount of landfill gas captured, $LFG_{total,y}$
- Flow meter ②: amount of landfill gas fed to the generating units, $LFG_{electricity,y}$
- Flow meter ③: amount of landfill gas fed to the flare stack, $LFG_{flare,y}$
- W_{CH4}: methane content in landfill gas with gas analysers ① and ②
- T: landfill gas temperature
- P: landfill gas pressure
- FE: flare efficiency

- Net electricity fed into the Tianjin municipal grid
- Relevant regulations for LFG project activities for determine AF

2. Monitoring Management

- **CDM Monitoring Manager**

One competent manager, will be designated by the professional company and approved by TCEE, will be responsible for this monitoring plan and supervise the collected data. He/She will report monthly to both the professional company and the Management Board (MB) of TCEE about project performance and data. He/She will inform the PC and MB immediately as soon as he/she detects non-conformance in the performance to the mentioned regulations, problems in the performance (e.g. flow meters not working, data not correct). The CDM Manager will be the main contact person for the verifiers, National Development & Reform Committee of P.R.China, the World Bank, as well as Tianjin related authorities, during the crediting period.

- **CDM Project Team**

Tianjin Shuangkou LFG CDM project team will gather, at least monthly, to discuss the performance of the CDM project. Member of the CDM Project Team includes CDM Manager, the MB of TCEE, the chief engineer of the Shuangkou landfill. The meeting of the CDM project team can be part of regular meetings, but meeting minutes are recorded as required. In case of non-conformance, each members of the team can call in for a CDM project team meeting.

3. Quality control and quality assurance procedures

Regarding quality control and quality assurance procedures to be undertaken for the monitored indicators, the practices to be implemented in the context of the proposed project are as follows:

- **Gas field monitoring records**

- Daily readings of all field meters will be filled out in paper worksheets and filed consequently. All data collected will also be entered in electronic worksheets and stored in computer immediately and in discs periodically.
- Periodic controls of the LFG field monitoring records will be carried out to check any deviation from the estimated ERs following the guidelines for LFG plant operation and monitoring for correction or future references.
- Periodic reports to evaluate performance and assist with performance management will be elaborated.

- **Equipment calibration and maintenance**

- Flow meters, gas analyzers and other sensors will be subject to regular maintenance and testing according to the technical specifications from the manufactures to ensure accuracy and good performance.
- Calibration of equipment will be conducted periodically according to their technical specifications.

- **Corrective actions**

- Actions to correct deviations from the Monitoring Plan and the guidelines for LFG plant operation and monitoring will be implemented as these deviations are observed either by the operator or during internal audits.

- Except periodic meeting, additional technical meetings among the operator, the MB of the developer will be held, if necessary, in order to define the corrective actions to be carried out.

• **Site audits**
- CDM Project Team will make regular site audits to ensure that monitoring and operational procedures are being observed in accordance with the Monitoring Plan and the guideline for LFG plant operation and monitoring.

• **Training**
- For all employees, involved in Shuangkou LFG CDM project, a Training Plan will be created. It ensures that both project operational staff and monitoring staff are properly trained to enable them to undertake the tasks required by this Monitoring Plan. Appropriate staff training must be provided before the project starts operating and generating ERs.

• **Documents storage**
- List of monitoring equipment (flow meters, gas analyzers, thermometers, etc.), including their numbers, names, manufacturers, specifications, use requirements, etc.
- Calibration lists and reports, including equipment or parts calibrated, date, method and procedures of calibration, their precision after these procedures, personnel, devices needed, etc.
- Maintenance lists and reports, including equipment or parts maintained, date, method and procedures of maintenance, their performance after these procedures, personnel, devices needed, etc.
- Operational manual of the proposed project
- Meeting minutes of CDM project team meeting
- Non-conformance reports
- Worksheets, monthly and yearly
- Training plan
- Internal audit/inspection reports, including personnel, time, findings, corrective actions, follow-up inspections
- Annual monitoring review