**PROJECT DESIGN DOCUMENT FORM
FOR SMALL-SCALE CDM PROJECT ACTIVITIES (F-CDM-SSC-PDD)
Version 04.1**

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	Landfill Gas Recovery Project in Myanmar
Version number of the PDD	01.0
Completion date of the PDD	15/02/2013
Project participant(s)	Kaung Kyaw Say Engineering Co., Ltd.
Host Party(ies)	Republic of the Union of Myanmar
Sectoral scope(s) and selected methodology(ies)	13: Waste handling and disposal
Estimated amount of annual average GHG emission reductions	8,662

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

Landfill Gas Recovery Project in Myanmar (hereafter referred to as the "Project") involves the installation of an LFG collection system and an enclosed flare at the site of the Htein Bin Landfill located in Yangon City, Republic of the Union of Myanmar ("Myanmar"). The Project is developed by Kaung Kyaw Say Engineering Co., Ltd. ("KKSE"). The company is specialized in engineering and consulting, especially related to clean energy generation.

The purpose of the project is to provide a sustainable solution for waste management in Yangon City and Myanmar in general and reduce the emissions of methane an odorous gases from the landfill site through LFG flaring. It is estimated that the Project will lead to the capture and destruction of an average of 507 t_{CH4}/yr in the period 2013 – 2022. The captured LFG will be flared in an enclosed flare. Thus, the operation of the Project will result in average annual emission reduction of approximately 8,662 tCO_2/yr or a total of 86,617 tCO_2 over the ten-year crediting period through the capture of LFG and its flaring.

The Project is a small scale CDM project activity and belongs to Type III, waste management and utilization. The Project cannot be implemented without the benefits of the CDM, as further described in Section B.5., therefore it is additional.

a) Situation existing prior to the starting date of the Project

The Htein Bin landfill in located in Hlaing Thaya in the western end of Yangon City. The landfill started operation in 2002 and is expected to accept waste at least until the end of 2013, when the existing waste receptions cells will be filled. The MSW is collected from the city and transported by trucks, All incoming MSW was directed to special deposition areas and piled. The composition of the MSW in the landfill is shown in Table 1 below.

WASTE TYPE	Share
Wood and wood products	2.46%
Pulp, paper and cardboard	19.51%
Food, food waste, beverages and tobacco	44.66%
Textiles	5.95%
Garden, yard and park waste	3.90%
Glass, plastic, metal, other inert waste	23.51%

Table 1. MSW Composition (based on preliminary data)

The landfill is a managed with small depth and no system for LFG capture has been installed. Additionally, no waste separation is practiced in Yangon or anywhere else in Myanmar, therefore various types of wastes (except for toxic and hazardous waste) are disposed there. Figure 1 below shows the current state of the landfill.

Figure 1: Htein Bin Landfill Site

b) Baseline scenario

The baseline scenario is the continuation of the situation existing prior to the start of the Project meaning that under business-as-usual there will be no capturing of landfill gas: LFG is freely released into the atmosphere. Additional information on the procedure for establishing the baseline scenario is provided in Section B.4.

c) Project scenario (expected outcome, including a technical description)

As part of the Project, it is proposed to cover the landfill and install an enclosed flare. The enclosed flare guarantees high levels of methane decomposition, which may reach 90% in case of extremely efficient equipment.

This Project shall contribute to the sustainable development of Myanmar and reduce the amount of methane and odorous gas emissions from organic waste decomposition at landfills. It will also provide a pioneering example for waste management practices.

The Project will result in knowledge transfer by introduction of a state-of-the art technology for landfill gas collection and destruction in enclosed flares.

Finally, the construction and operation phases the Project will also provide additional employment for skilled and unskilled workers.

Contribution to Sustainable Development

There are no officially approved sustainable development criteria in Myanmar. However, the Project is considered to significantly contribute the sustainable development of the country in the following areas:

Environment

The Project will result in the capture and destruction of LFG in an enclosed flare. In this way, it will reduce the emissions of methane, a highly potent GHG, as well odorous gases. Additionally, the capture of LFG and will improve the landfill management and reduce the danger of landfill fires.

Technology Transfer

The Project will result in a significant technology and knowledge transfer. The Project will use for the first time in Myanmar enclosed flare for LFG flaring. This will also be associated with transfer from of valuable knowledge and practices on LFG collection and landfill management. The successful implementation of the Project is also expected to give impetus to further utilization of LFG at the Project site and other landfills, such as power and heat generation.

Social and Economic Effects

The implementation and operation of the Project will generate new employment for skilled and unskilled workers. This will partially contribute to the alleviation the unemployment issues in Yangon. Additionally, it is expected that a part of the revenue stream from the Project will be diverted to the support of education of children n the local area.

A.2. Location of project activity
A.2.1. Host Party(ies)

Republic of the Union of Myanmar

A.2.2. Region/State/Province etc.

Yangon City

A.2.3. City/Town/Community etc.

Hlaing Thaya

A.2.4. Physical/ Geographical location

The landfill is located in the western part of Yangon, the largest city in Myanmar.

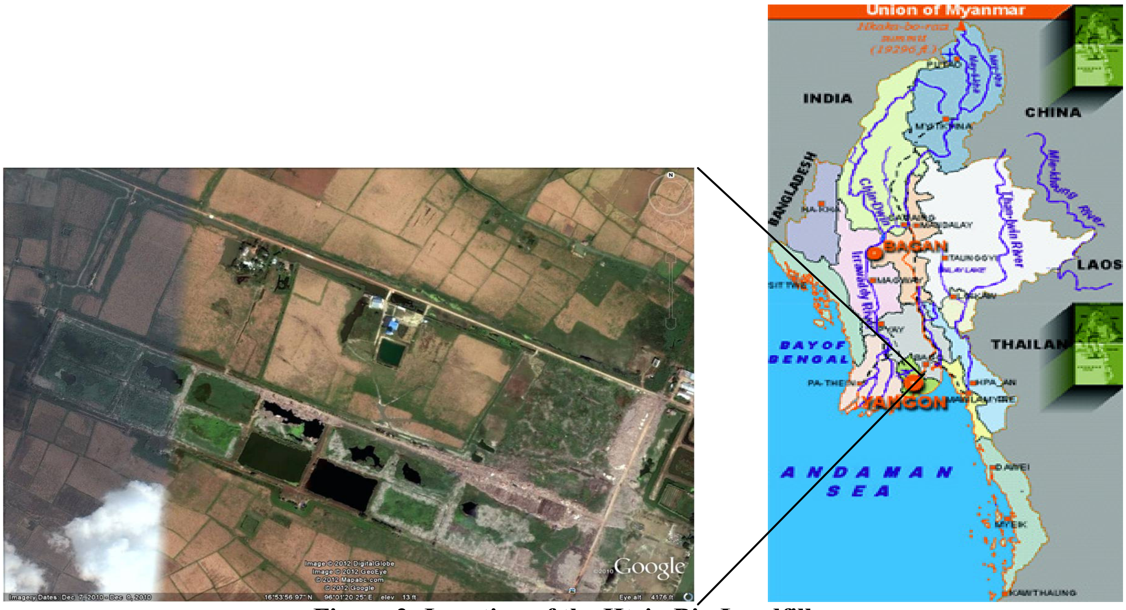

Figure 2: Location of the Htein Bin Landfill

The geographical coordinates of the site are as follows:

16°55'00"N 98°02'19"E

A.3. Technologies and/or measures

Project Technology

The Project will use approbated and environmentally friendly technologies meeting the highest international standards. Gas wells with an average depth of 10m will be made across the landfill. LFG will be collected through creating a vacuum in the gas well and sucking out the LFG. In order to increase the efficiency of LFG collection, it is expected that a polyethylene or other cover will be spread over the landfill. The expected efficiency of LFG collection is 50 %.

The collected gas will be supplied to an enclosed flare with methane destruction efficiency of 90 %. The amount of LFG will be monitored at the entrance of the flare. Operating parameters of the flare, including temperature of flaring and composition of the gas flared, as well as operating time of the flare will be monitored as described in Section B.7.

The system is presented on Figure 3 below.

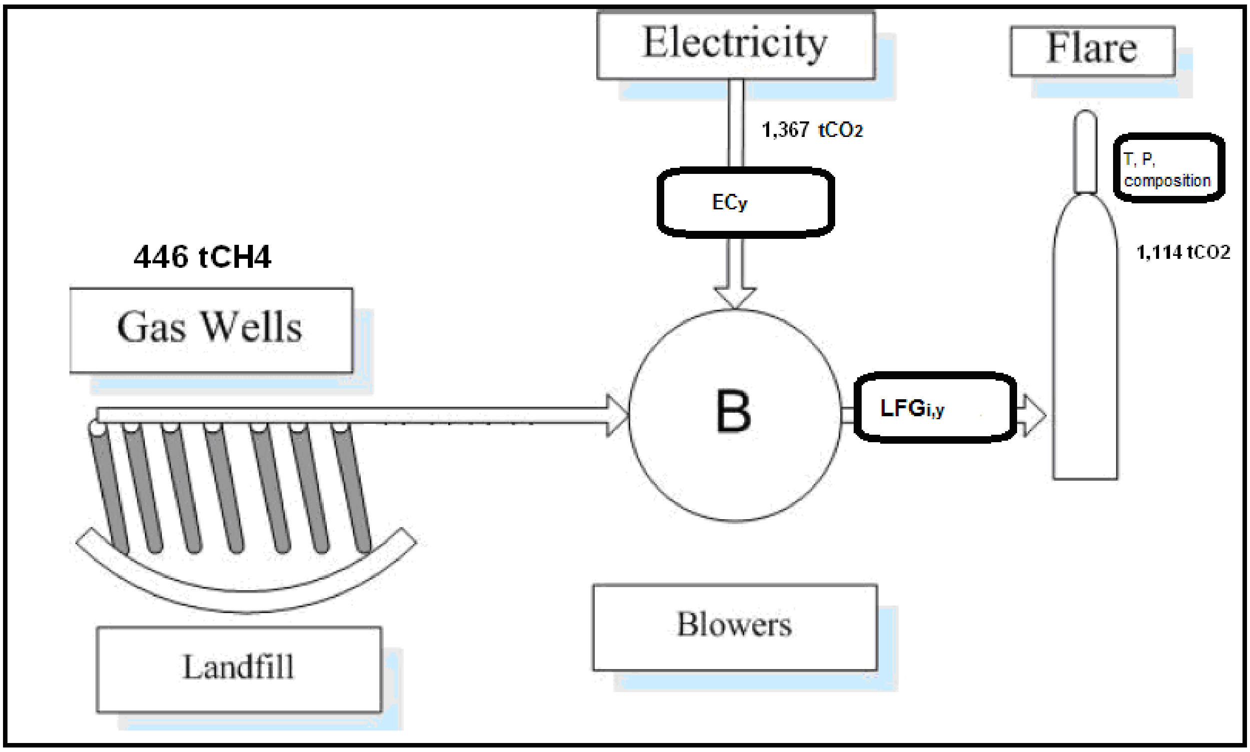

Figure 3. LFG Collection and Utilization System

Situation prior to the Implementation of the Project

Prior to the implementation of the Project, the landfill remains uncovered and large volumes of methane (app. 446 tCH_4/yr) will be released in the atmosphere. The users of electricity have on-site diesel generators that supply their electricity needs.

Figure 4: Situation prior to the Implementation of the Project

Baseline

The baseline is the continuation of the current practice as described above.

A.4. Parties and project participants

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of the Union of Myanmar (host)	Kaung Kyaw Say Engineering Co., Ltd.	No

A.5. Public funding of project activity

The Project involves no public funding.

A.6. Debundling for project activity

The "Guidelines on assessment of debundling for SSC project activities" (ver. 03) are applied to determine that the SSC project activity is not a debundled component of a large scale project activity as follows:

1. Is there a registered SSC PA with the same project participants as the proposed SSC PA? – **No**, this is the first CDM project applying for registration where Kaung Kyaw Say Engineering Co., Ltd. is a project participant.

Then, as per the guidelines, the proposed SSC PA is not deemed to be a debundled component of a large project activity; therefore it is eligible to use the simplified modalities and procedures for SSC PAs.

SECTION B. Application of selected approved baseline and monitoring methodology
B.1. Reference of methodology

The Project will apply the following methodologies:

AMS-III.G. "Landfill methane recovery", version 08.0

Additionally, the following tools are referred to:

"Projects emissions from flaring", ver. 02.0.0

"Emissions from solid waste disposal sites" (ver. 06.0.1)

"Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (ver. 01.0)

"Tool to determine the mass flow of greenhouse gas in a gaseous stream" (ver. 02.0.0)

B.2. Project activity eligibility

The Project meets the applicability conditions of AMS-III.G. "Landfill methane recovery", version 08.0, as demonstrated below:

Applicability Condition	Project Case
1. This methodology comprises measures to capture and combust methane from landfills (i.e. solid waste disposal sites) used for the disposal of residues from human activities including municipal, industrial, and other solid wastes containing biodegradable organic matter.	✓ The Project involves the collection and flaring of the landfill gas. The landfill is used for disposal of residues from human activities containing biodegradable organic matter.
2. Different options to utilise the recovered landfill gas as detailed in paragraph 3 of AMS-III.H "Methane recovery in wastewater treatment" (version 16) are eligible for use under this methodology. The relevant procedures in AMS-III.H shall be followed in this regard.	✓ The Project does not involve utilization of recovered landfill gas other than flaring.
3. Measures are limited to those that result in aggregate emission reductions of less than or equal to 60 kt CO_2 equivalent annually from all Type III components of the project activity.	✓ The Project activity will generate an average of 8,662 tCO_2/yr of emission reductions as a result of the landfill gas capture and utilization (flaring), which is less than 60 $ktCO_2$/yr. As no expansion of the area in the landfill where landfill gas capture will occur is expected, the emission reductions will stay under the Type III project limit throughout the crediting period.
4. The proposed project activity does not reduce the amount of organic waste that would have been recycled in the absence of the project activity.	✓ The proposed Project activity does not reduce the amount of organic waste that would have been recycled in the absence of the Project activity.
5. This methodology is not applicable if the management of the Solid Waste Disposal Site (SWDS) in the project activity is deliberately	✓ No changes in the Project site that will increase the methane generation are planned as part of the Project.

changed in order to increase methane generation compared to the situation prior to the implementation of the project activity (e.g. other than to meet a technical or regulatory requirement). Such changes may include, for example, the addition of liquids to a SWDS, pre-treating waste to seed it with bacteria for the purpose of increasing the rate of anaerobic degradation of the SWDS or changing the shape of the SWDS to increase methane production.	

B.3. Project boundary

The spatial extent of the Project boundary is the physical, geographical site of the landfill where the gas is captured and destroyed and the enclosed flaring unit. An illustration of the Project boundary is shown in the Figure 5 below.

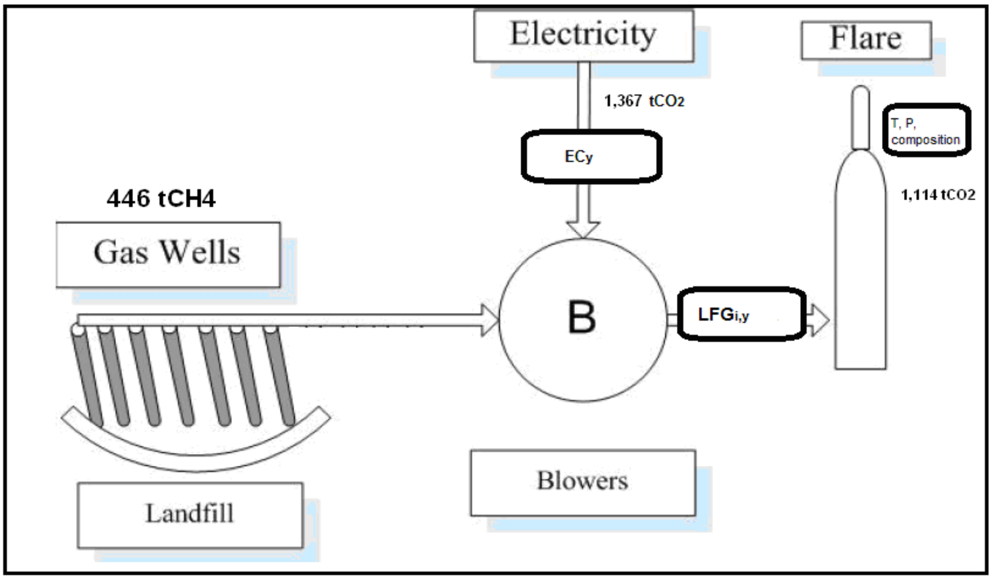

Figure 5: Project Boundary

Emission sources and gases included in or excluded from the Project boundary are listed in the table:

Table 2: GHG included in the Project Boundary

	Source	Gas	Included?	Justification / Explanation
Baseline	Emissions from decomposition of waste at the landfill site	CO_2	No	CO_2 emissions from the decomposition of organic waste are not accounted
		CH_4	Yes	The major source of emissions in the baseline
		N_2O	No	N_2O emissions are small compared to CH4 emissions from landfills. Exclusion of this gas is conservative.

Project Activity	Emissions from LFG flaring	CO_2	No	Negligible.
		CH_4	Yes	This is a major emission source due to incomplete oxidation of methane.
		N_2O	No	Negligible.
	Emissions from on-site electricity use	CO_2	Yes	An important emission source
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.

B.4. Establishment and description of baseline scenario

The baseline is the situation where in the absence of the Project activity, biomass and other organic matter are left to decay within the Project boundary and methane is emitted to the atmosphere. As no regulations requiring partial LFG collection and/or its utilization exist in Myanmar, the entire amount of LFG generation is included in the baseline. Baseline emissions are calculated as per equation (1) in AMS-III.G., as further described in Section B.6.1.

The values used in determining the baseline are summarized in the table below.

ID	Data variable	Symbols	Data Unit	Value	Comment
1.	Efficiency of the LFG capture system that will be installed in the project activity	η_{PJ}	-	50%	Default value
2.	Model correction factor to account for model uncertainties for year *y*	φ_y	-	0.75	Default value for humid/wet conditions.
3.	Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year *y*	f_y	-	0	As per the instructions in AMS-III.G.
4.	Global warming potential of methane	GWP_{CH4}	tCO_2/tCH_4	25	As the project will start after 01/01/2013, the GWP values for the Second Commitment Period are applied.
5.	Oxidation factor reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste	OX	-	0.1	Default value.
6	Fraction of methane in the SWDS gas	F	-	0.5	Default value

7	Fraction of degradable organic carbon (DOC) that decomposes under specific conditions occurring in the SWDS for year *y*	$DOC_{f,y}$	-	0.5	Default value
8	Methane correction factor for year *y*	MCF_y	-	0.4	Value for unmanaged-shallow SWDS.
9	Amount of organic waste type *j* disposed in the SWDS in the year *y*	$W_{j,x}$	t	See Appendix 4.	-
10	Fraction of degradable organic carbon in the waste type *j*	DOC_j	-	See Section B.6.1.	Default value.
11	Decay rate for the waste type *j*	k_j	-	See section B.6.1.	Default values for wet tropical climate are applied.

B.5. Demonstration of additionality

The Project is located in Myanmar, which is classified as a Least Developed Country. The maximum annual reductions from the Project are 19,873 tCO_2/yr, which is less than 20,000 tCO_2/yr, the upper limit for microscale Type III projects. Therefore, the Project meets the requirements of the "Guidelines for demonstrating additionality of microscale project activities" (ver. 04.0) paragraph 4a) respectively, and is considered additional.

B.6. Emission reductions
B.6.1. Explanation of methodological choices

Baseline emissions

The baseline emissions for methane avoidance are calculated *ex-ante* as the methane emissions from the LFG that would have been released in the atmosphere in the absence of the Project as demonstrated below:

$$BEy = \eta_{PJ} \times BE_{CH_4,SWDS,y} - (1 - OX) \times F_{CH_4,BL,y} * GWP_{CH_4}$$

where:

$BE_{CH4,SWDS,y}$ Methane emission potential of a solid waste disposal site (in tCO_2e), calculated using the methodological tool "Emissions from solid waste disposal sites". This tool may be used:

- With the factor "*f=0.0*"because the amount of LFG that would have been captured and destroyed is already accounted for in this equation;
- With the definition of year *x* as 'the year since the landfill started receiving wastes, *x* runs from the first year of landfill operation (*x*=1) to the year for which emissions are calculated (*x*=*y*)'.

OX Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in

	the soil or other material covering the waste) (dimensionless).
η_{PJ}	Efficiency of the LFG capture system that will be installed in the Project activity. It is used for ex ante estimation only. A default value of 50% is be used.
$F_{CH4,BL,y}$	Methane emissions that would be captured and destroyed to comply with national or local safety requirement or legal regulations in the year y (t_{CH4}). The relevant procedures in ACM0001 "Flaring or use of landfill gas" may be followed, as well as taking into account the compliance with the relevant local laws and regulation if such laws and regulations exist
GWP_{CH4}	Global Warming Potential for methane (value of 25 for the second commitment period)

As there are no regulations for methane capture in the baseline scenario, $F_{CH4,BL,y}$ is assumed to be zero, and the above formula is simplified as follows:

$$BE_y = \eta_{PJ} \times BE_{CH_4,SWDS,y}$$

Where:

$$BE_{CH4,SWDS,y} = \varphi \cdot (1-f) \cdot GWP_{CH4} \cdot (1-OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y} \sum_{j} W_{j,x} \cdot DOC_j \cdot e^{-k_j (y-x)} \cdot (1-e^{-k_j})$$

Where:

$BE_{CH4,SWDS,y}$	Methane emissions avoided during the year y from preventing waste disposal at the solid waste disposal site (SWDS) during the period from the start of the project activity to the end of the year y (tCO_2e)
φ	Model correction factor to account for model uncertainties (0.75)
f	Fraction of methane captured at the SWDS and flared, combusted or used in another manner (0.0)
GWP_{CH4}	Global Warming Potential (GWP) of methane, valid for the second commitment period (25)
OX	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste) (0.1)
F	Fraction of methane in the SWDS gas (volume fraction) (0.5)
DOC_f	Fraction of degradable organic carbon (DOC) that can decompose (0.5)
MCF	Methane correction factor (0.4, for unmanaged shallow landfills)
$W_{j,x}$	Amount of organic waste type j prevented from disposal in the SWDS in the year x (tons) (see Table 3 below)
DOC_j	Fraction of degradable organic carbon (by weight) in the waste type j (see Table 3 below)
k_j	Decay rate for the waste type j (see Table 3 below)
j	Waste type category (index)

x Year since the landfill started receiving wastes [*x* runs from the first year of landfill operation (*x*=1) to the year for which emissions are calculated (*x*=*y*)]

y Year for which methane emissions are calculated

The following coefficients are used for DOC_j, W_j and k_j.

Table 3: Values of Certain Parameters

	DOC_j	W_j	k_j
Wood and wood products	43 %	2.46%	0.035
Pulp, paper and cardboard	40 %	19.51%	0.07
Food, food waste, beverages and tobacco	15 %	44.66%	0.4
Textiles	24 %	5.95%	0.07
Garden, yard and park waste	20 %	3.90%	0.17
Glass, plastic, metal, other inert waste	0 %	23.51%	0.0

Project emissions

Project emissions consist of project emissions from flaring and project emissions from electricity consumption.

$$PE_y = PE_{flare,y} + PE_{power,y}$$

$PE_{flare,y}$ Project emissions from flaring of the residual gas in year *y*(tCO_2e)

$PE_{power,y}$ Project emissions from electricity consumption in year *y* (tCO_2e)

a) Project emissions from flaring

Project emissions from flaring of the gas that is not used for electricity generation, $PE_{flare,y}$ are calculated according to the methodological tool "Project emissions from flaring" ver. 02.0 (the "flaring tool"). Accordingly, Project emissions from flaring, $PE_{flare,y}$, are calculated according to Steps 1~3 of the Flaring Tool.

STEP 1: Determination of methane mass flow rate of the residual gas;
STEP 2: Determination of flare efficiency;
STEP 3: Calculation of project emissions from flaring.

Step 1. Determination of methane mass flow rate of the residual gas

The quantity of methane in the residual gas flowing into the flare is calculated as per the Methodological tool "Tool to determine the mass flow of greenhouse gas in a gaseous stream" (ver. 02.0.0). As the flow rate will be determined from the volume flow on dry basis (as the temperature of the gaseous stream is less than 60^{o}C), Option A is selected. The mass flow is determined as follows:

$$F_{CH4,RG,m} = V_{m,db} \times v_{CH4,m,db} \times \rho_{CH4,m}$$

With

$$\rho_{CH4,m} = \frac{P_m \times MM_{CH4}}{R_u \times T_m}$$

Where:

$F_{CH4,RG,m}$	Mass flow of CH_4 in the gaseous stream in the minute *m* (kg gas/h)
$V_{m,db}$	Volumetric flow of the gaseous stream in the minute *m* on a dry basis (m^3 dry gas/h)
$v_{CH4,m,db}$	Volumetric fraction of CH_4 in the gaseous stream in the minute *m* on a dry basis (m^3 CH_4/m^3 dry gas)
$\rho_{CH4,m}$	Density of CH_4 in the gaseous stream in the minute *m*; at reference conditions 0.716 (kg CH_4/m^3 CH_4)
P_m	Absolute pressure of the gaseous stream in the minute *m* (Pa)
MM_{CH4}	Molecular mass of CH_4 (kg/kmol):16.04
R_u	Universal ideal gases constant (Pa.m^3/kmol.K):8,314
T_m	Temperature of the gaseous stream in the minute *m* (K)

Step 2: Determination of flare efficiency

The Project uses an enclosed flare. Option A, default value will be applied. The flare efficiency is established for each minute *m* based on default values plus operational parameters as follows:

Flare efficiency ($\eta_{flare,m}$)

- **90 %**, if the temperature in the exhaust gas of the flare ($T_{EG,m}$) and the flow rate of the residual gas to the flare ($F_{RG,m}$) is within the manufacturer's specification for the flare ($SPEC_{flare}$) in minute *m* and the flame is detected in minute *m*.
- **0 %** if otherwise.

Step 3: Calculation of project emissions from flaring.

Project emissions from flaring are calculated as the sum of emissions for each minute *m* in year *y,* based on the methane mass flow in the residual gas ($F_{CH4,RG,m}$) and the flare efficiency ($\eta_{flare,m}$), as follows:

$$PE_{flare,y} = GWP_{CH4} \times \sum_{m=1}^{525600} F_{CH4,RG,m} \times (1 - \eta_{flare,m}) \times 10^{-3}$$

where:

$PE_{flare,y}$	Project emissions from flaring of the residual gas in year *y* tCO_2e)
GWP_{CH4}	Global warming potential of methane valid for the commitment period (tCO_2e/tCH_4)
$F_{CH4,RG,m}$	Mass flow of methane in the residual gas in the minute *m* (kg)
$\eta_{flare,m}$	Flare efficiency in minute *m*

b) Project emissions from electricity consumption

For electricity consumption, the project emission is the amount of the electricity consumed times the emission factor. As the Project consumes electricity from the grid, the emission factor is determined as per the procedures in the latest version of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (ver. 01.0). As this is the emission factor for project emissions from electricity consumption, the default value in Option A2 of the Tool is selected. Based on that, an emission factor of 1.3 tCO_2/MWh is used. TDL_y is assumed to equal the default value, 20%. Then, baseline emissions for electricity generation equal:

$$PE_{power,y} = EC_{PJ,y} \times EF_{EL,y} \times (1+TDL_y)$$

Where:

$PE_{power,,y}$	Project emissions from electricity consumption in year y (tCO_2/yr)
$EC_{PJ,y}$	Quantity of electricity that is consumed by the Project in year y (MWh/yr)
$EF_{EL,y}$	Emission factor for electricity generation in year y (tCO_2/MWh)
TDL_y	Average technical transmission and distribution losses for providing electricity to the source in year y

Emission Reductions

The emission reductions achieved by the Project activity are estimated *ex ante* in the PDD by:

$$ER_{y,estimated} = BE_y - PE_y - LE_y$$

The actual emission reductions achieved by the Project activity during the crediting period are calculated using the amount of methane recovered and flared by the Project activity, calculated as:

$$ER_{y,calculated} = (1 - \mathrm{OX}) \times F_{CH4,PJ,y} \times GWP_{CH4} - PE_y - LE_y$$

Where:

$F_{CH4,PJ,y}$	Methane captured and flared by the Project activity in the year y (tCH_4)

And

$$F_{CH4,PJ,y} = D_{CH4,y} \times w_{CH4,y} \times LFG_y$$

Where:

LFG_y	Landfill gas flared in year *y* (m^3_{LFG}). The flow or volume measurement will be made either on a dry basis or at the same humidity as $w_{CH4,y}$
$w_{CH4,y}$	Methane content in landfill gas in year *y* (volume fraction, m^3CH_4/m^3LFG). Landfill gas composition shall be measured either on a dry basis or at the same humidity as used to determine LFG_y
$D_{CH4,y}$	Density of methane at the temperature and pressure of the landfill gas in year y (tonnes/m^3). If LFG_y is reported at normal conditions of temperature and pressure, the density of methane is also determined at normal conditions

B.6.2. Data and parameters fixed ex ante

Data / Parameter	$SPEC_{flare}$
Unit	Temperature – C^o Flow rate – kg/h Maintenance schedule – number of days
Description	Manufacturer's specifications for temperature, flow rate and maintenance schedule.
Source of data	Flare manufacturer
Value(s) applied	Temperature: 600^{o}C Flow rate: 500 Nm^3/h Maintenance: 1 day/month
Choice of data or Measurement methods and procedures	Minimum and maximum values for the parameters. The exact values will be added upon the final selection of the equipment.
Purpose of data	Calculation of project emissions
Additional comment	-

B.6.3. Ex-ante calculation of emission reductions

Baseline Emissions

Baseline emissions are calculated ex-ante as explained in Section B.6.1. The results are shown in Table 4 below.

Table 4: Total Baseline Emissions

Year	$BE_{CH4,SWDS,y}$
	tCO_2/yr
2013	23,600
2014	18,264
2015	14,509
2016	11,829
2017	9,882
2018	8,439
2019	7,344
2020	6,493
2021	5,813
2022	5,258

Project Emissions

Project emissions from flaring are calculated as follows:

Step 1

$$F_{CH4,RG,m} = V_{m,db} \times v_{CH4,m,db} \times \rho_{CH4,m}$$

For the sake of illustration, data for 2013 is used:

$F_{CH4,RG,m}$ = 5.02m^3 LFG/min × 0.5 m^3 CH_4/m^3 LFG × 0.716 kgCH_4/m^3 CH_4 =1.76 kgCH_4

Step 2

$\eta_{flare,m}$ = 90%

Step 3

$$PE_{flare,y} = GWP_{CH4} \times \sum_{m=1}^{525600} F_{CH4,RG,m} \times (1 - \eta_{flare,m}) \times 10^{-3}$$

For the sake of illustration, data for 2013 is used:

$PE_{flare,y}$ = 25 tCH_4/tCO_2 × 944,000kgCH_4 × (1 – 90%) × 10^{-3} = 2,360 tCO_2

Total project emissions from flaring for the entire crediting period are shown in Table 5 below.

Table 5: Project Emissions from Flaring

Year	$PE_{flare,y}$
	tCO_2/yr
2013	2,360
2014	1,826
2015	1,451
2016	1,183
2017	988
2018	844
2019	734
2020	649
2021	581
2022	526

Project emissions for electricity are calculated following the latest version of "Tool to calculate project emissions from electricity consumption", as follows:

$PE_{power,y} = EC_{PJ,y} \times EF_{EL,y} \times (1+TDL_y)$

$EC_{PJ,y}$ = 876 MWh/year

$EF_{EL,y}$ = 1.3 tCO_2e/MWh

TDL_y = 20%

An example of the calculations is given below:

$PE_{EC,,y}$ = 876 $MWh \times$ 1.3 $tCO_2e/MWh \times$ (1+20%) = 1,367 tCO_2

Total project emissions are presented in Table 6.

Table 6. Total Project Emissions (2013 – 2022)

Year	**Project Emissions**
	tCO_2 /yr
2013	3,727
2014	3,193
2015	2,817
2016	2,549
2017	2,355
2018	2,210
2019	2,101
2020	2,016
2021	1,948
2022	1,892
Total	**24,809**

Leakage

Because no methane recovery technology is equipment transferred from another activity, leakage effects are not considered.

Emission Reductions

$ER_y = BE_y - PE_y$

The results of the estimates for the emission reductions are provided in Table 7 below.

Table 7: Emission Reductions

Year	**ER_y**
	tCO_2 /yr
2013	19,873
2014	15,071
2015	11,691
2016	9,279
2017	7,527
2018	6,228
2019	5,242
2020	4,476
2021	3,865
2022	3,365

B.6.4. Summary of ex-ante estimates of emission reductions

Year	Baseline emissions (tCO_2e)	Project emissions (tCO_2e)	Leakage (tCO_2e)	Emission reductions (tCO_2e)
2013	23,600	3,727	0	19,873
2014	18,264	3,193	0	15,071
2015	14,509	2,817	0	11,691
2016	11,829	2,549	0	9,279
2017	9,882	2,355	0	7,527
2018	8,439	2,210	0	6,228
2019	7,344	2,101	0	5,242
2020	6,493	2,016	0	4,476
2021	5,813	1,948	0	3,865
2022	5,258	1,892	0	3,365
Total	**111,430**	**24,809**	0	**86,617**
Total number of crediting years	10			
Annual average over the crediting period	11,143	2,481	0	8,662

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter	LFG_y
Data unit	Nm^3
Description	Landfill gas captured and flared in year *y*
Time of determination/monitoring	Monitored constantly
Source of data to be used	On-site measurements
Value of data applied (for ex ante calculations/determinations)	Year: 2013 – 2,636,867; 2014 – 2,040,680; 2015 – 1,621,142; 2016 – 1,321,654; 2017 – 1,104,121; 2018 – 942,862; 2019 – 820,541; 2020 – 725,424; 2021 – 649,548; 2022 – 587,486 (Nm^3)
Description of measurement methods and procedures (to be) applied:	Measured continuously using a flow meter. Data to be aggregated monthly and yearly.
QA/QC procedures to be applied	Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy.

Year	Nm^3
2013	2,636,867
2014	2,040,680
2015	1,621,142
2016	1,321,654
2017	1,104,121
2018	942,862
2019	820,541
2020	725,424
2021	649,548
2022	587,486

Any comment	-

Data / Parameter	***$V_{m,db}$***
Data unit	Nm^3
Description	Volumetric flow of the gaseous stream in the minute *m* on a dry basis (m^3 dry gas)
Time of determination/monitoring	Monitored constantly
Source of data to be used	On-site measurements
Value of data applied (for ex ante calculations/determinations)	Year / Nm^3: 2013: 5.02; 2014: 3.88; 2015: 3.08; 2016: 2.51; 2017: 2.10; 2018: 1.79; 2019: 1.56; 2020: 1.38; 2021: 1.24; 2022: 1.12
Description of measurement methods and procedures (to be) applied:	Measured continuously using a flow meter.
QA/QC procedures to be applied	Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy.
Any comment	-

Year	Nm^3
2013	5.02
2014	3.88
2015	3.08
2016	2.51
2017	2.10
2018	1.79
2019	1.56
2020	1.38
2021	1.24
2022	1.12

Data / Parameter	***$v_{CH4,m,db}$***
Data unit	m^3CH_4/m^3LFG
Description	Methane fraction in the landfill gas
Time of determination/monitoring	Monitored constantly
Source of data to be used	On-site measurements
Value of data applied (for ex ante calculations/determinations)	50%
Description of measurement methods and procedures (to be) applied:	This parameter will be measured continuously using a continuous gas analyzer.
QA/QC procedures to be applied	The analyzer will be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check will be performed by comparison with a standard certified gas.
Any comment	The monitored parameter is also used for $fv_{CH4,h}$ in case this parameter is measured continuously using continuous gas analyzer.

Data / Parameter	***T***
Data unit	^0C
Description	Temperature of the landfill gas
Time of	Monitored continuously

determination/monitoring	
Source of data to be used	On-site measurements using thermocouple by the gas flow meter of the flare
Value of data applied (for ex ante calculations/determinations)	-
Description of measurement methods and procedures (to be) applied:	Measured to determine the density of methane D_{CH4}. No separate monitoring of temperature is necessary when using flow meters that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters
QA/QC procedures to be applied	Measuring instruments should be subject to a regular maintenance and testing regime in accordance to appropriate national/international standards
Any comment	

Data / Parameter	***P***
Data unit	Pa
Description	Pressure of the landfill gas
Time of determination/monitoring	Monitored continuously
Source of data to be used	On-site measurements by KKSE
Value of data applied (for ex ante calculations/determinations)	-
Description of measurement methods and procedures (to be) applied:	Measured to determine the density of methane D_{CH4}. No separate monitoring of temperature is necessary when using flow meters that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters
QA/QC procedures to be applied	Measuring instruments should be subject to a regular maintenance and testing regime in accordance to appropriate national/international standards
Any comment	-

Data / Parameter	$\eta_{flare,m}$
Data unit	%
Description	Flare efficiency in hour h
Time of determination/monitoring	Determined for every hour during the monitoring period.
Source of data to be used	The default value of “Project emissions from flaring”
Value of data applied (for ex ante calculations/determinations)	• **90 %**, if the temperature in the exhaust gas of the flare (T_{flare}) and the flow rate of the residual gas to the flare ($F_{RG,m}=V_{m,db}$) is within the manufacturer’s specification for the flare ($SPEC_{flare}$) in minute *m* and the flame is detected in minute *m*. • **0 %** if otherwise.
Description of measurement methods and procedures (to be) applied:	The default values of “Project emissions from flaring” applied based on the monitored results of the operational parameters of the flare.
QA/QC procedures to be applied	-
Any comment	-

Data / Parameter	T_{flare}
Data unit	^0C
Description	Temperature in the exhaust gas of the flare
Time of determination/monitoring	Monitored constantly
Source of data to be used	On-site measurements by KKSE
Value of data applied (for ex ante calculations/determinations)	500 ^oC
Description of measurement methods and procedures (to be) applied:	Temperature will be measured using thermocouples.
QA/QC procedures to be applied	Thermocouples should be replaced or calibrated every year
Any comment	For the sake of PDD production, a minimum value to guarantee the highest flaring efficiency is applied. An excessively high temperature at the sampling point (above 700 ºC) may be an indication that the flare is not being adequately operated or that its capacity is not adequate to the actual flow.

Data / Parameter	**-**
Data unit	YES/NO
Description	Flare operation time in minute m
Time of determination/monitoring	Continuously monitored
Source of data to be used	Measurements by KKSE.
Value of data applied (for ex ante calculations/determinations)	YES
Description of measurement methods and procedures (to be) applied:	The operation time will be monitored using a timer.
QA/QC procedures to be applied	The timer should be subject to a regular maintenance and testing regime to ensure accuracy.
Any comment	For the sake of PDD production, the minimal value guaranteeing efficient flare operation is applied.

Data / Parameter	$EC_{PJ,y}$
Data unit	MWh
Description	Quantity of electricity consumed by the Project during the year y
Time of determination/monitoring	
Source of data to be used	On-site measurements
Value of data applied (for ex ante calculations/determinations)	876 MWh/yr
Description of measurement methods and procedures (to be) applied:	Measured continuously using an electricity meter.
QA/QC procedures to be applied	-
Any comment	Based on the assumption of 100 kW capacity of the existing installation.

Data / Parameter	**-**
Data unit	-
Description	Regulatory requirements relating to landfill gas projects
Time of determination/monitoring	
Source of data to be used	Local/national data
Value of data applied (for ex ante calculations/determinations)	-
Description of measurement methods and procedures (to be) applied:	The information will be recorded annually.
QA/QC procedures to be applied	-
Any comment	-

B.7.2. Sampling plan

Not applicable.

B.7.3. Other elements of monitoring plan

The monitoring plan is based on direct measurement of the amount of LFG collected and flared by the Project, as well as the consumption of electricity by the Project facility as described in Section B.7.1

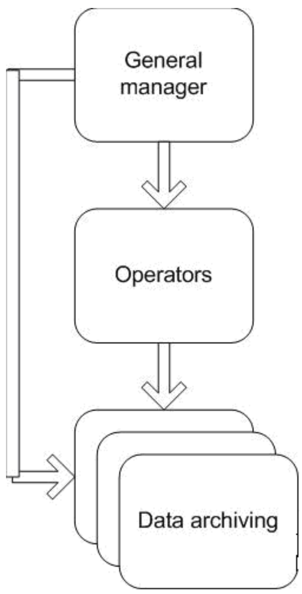

Figure 6: Operating and Management Structure of the Project

Figure 6 above outlines the operational and management structure that the Project will implemented to monitor the generated emission reductions. KKS will formed an operational and management team, which will be responsible for monitoring of all the parameters aforementioned. This team composes of a general manager and a group of operators. A group of operators, who are under the supervision of the general manager, are assigned for monitoring of different parameters on a timely basis as well as recording and archiving data in an orderly manner. Operators will be trained in the operation of all monitoring equipment and all readings will be taken under the supervision of management. An operations manual will be developed for the operating personnel.

Quality control and assurance procedures are to be undertaken for data monitored as outlined in the monitoring plan. A database will be maintained to record all relevant data as outlined in the monitoring plan. Monitoring reports are forwarded to and reviewed by the general manager on a monthly basis in order to ensure the Project follows the requirements of the monitoring plan.

All monitoring equipment will be installed by experts using standard methods. Once installed, this equipment will be calibrated to the highest standards by the Project staff or outside authorized agencies in depending on the requirements of the Myanmar regulations. Any irregularities or problems with equipment will be reported to management and rectified as soon as possible.

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

01/01/2013

C.1.2. Expected operational lifetime of project activity

15 years

C.2. Crediting period of project activity

C.2.1. Type of crediting period

Fixed

C.2.2. Start date of crediting period

01/07/2013

C.2.3. Length of crediting period

10 years

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

There are currently no regulations in Myanmar that require conducting environmental impact assessment for the Project, therefore, no formal EIA has been conducted.

The implementation of the Project will deliver a number of positive environmental effects. The collection of LFG prevents the accumulation of biogas inside the landfill, which can cause explosions or spontaneous fires. The flaring of landfill will also reduce the emissions of odorous gases, as well as methane, which is a highly potent greenhouse gas.

As a result of this Project the following positive environmental effects will be achieved:

People

Collection and utilization of biogas reduces the risk of explosions and potential negative health effects on nearby residents, as well as on landfill management staff.

Flora and Fauna

Management and closure of landfills create a less favorable environment for growth of parasites and outbreak of diseases. Closed managed landfills also do not attract scavenger birds such as ravens and crows, thus having an additional positive effect on the environment. The Project also will reduce the concentration of methane in the atmosphere that destroys the vegetation in the vicinity of the landfill site.

Air

Highly efficient LFG flaring system guarantees almost complete decomposition of methane and other toxic gases contained in LFG, which would have otherwise been freely emitted into the atmosphere in the absence of the Project.

Landscape

Covering and leveling of the surface of the landfill with sand and inert materials will allow it to fit better with the surrounding landscape. The presence of the flare, blowers and the associated noise and vibration will be minimal and within the limits defined in Myanmar legislation.

Conclusions

Collection of biogas and its utilization have a significant positive impact on the environment. Reduced emissions of greenhouse gases, mainly methane, and odorous gases will have reduce the occurrence of spontaneous fires, and reduce health and environmental hazards.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

The stakeholders' meeting was organized on Nov.15, 2012 at the township chief office of Hlaing Thayar Township.

After confirmation by the chairman of the Hlaing Thayar Township Administration Office, the announcement of the stakeholders meeting and the invitations were released directly to the concerned participants.

The residents, workers and concerned organizations within the radius of 5 km from the Project site are identified as the invitees to EIA study, including:

1. Kan Hla Village
2. Ka Lar Gyi Village
3. Slaughter House

The stakeholders covered the following groups: (A) Representatives from the local community; (B) Representatives of Local NGOs; and (C) Officials from the local administration.

The meeting took place as follows:

Vanue: The office of chief, Hlaing Thayar Administration Office
Date: Nov.15, 2012

Time: 11:00 AM

The explanation of the Project and the objective of the stakeholders meeting were presented by the organizer and brief Project summary was distributed to all attendees. A bilingual questionnaire form was also distributed during the meeting and the participants were requested to fill up their opinions and submit the questionnaire after the end of the meeting.

The following attendees participated:

(A) Representatives from the local community
1. Kan Hla Village
2. Ka Lar Gyi Village
3. Slaughter House

(B) Representatives of Local NGOs
1. TLMI
2. World Vision (Hlaing Thayar)
3. Save the Children
4. Red Cross (Hlaing Thayar Township)
5. Myanmar Engineering Society (MES)

(C) Officials from the local administration
1. Hlaing Thayar Administration Office
2. Fire Department (Hlaing Thayar Township)
3. Ministry of Education (Hlaing Thayar Township)
4. Ministry of Information (Hlaing Thayar Township)
5. Ministry of Warefare (Hlaing Thayar Township)
6. Yangon City Development Committee

The meeting was taking place as schedule. The opening speech was made by the Chairman of Hlaing Thayar Township Administration office. He briefly introduced the organizer and the experts and welcomed the participants. In his speech he described the present situation at the waste disposal site. He also mentioned about the regular fires at the landfill and how preoccupied fire-fighters are fire fighters to control the safety onsite. He also encouraged the attendees to discuss any issue freely and transparently.

Then, the Project developer explained the Project details. He told the audience that he got inspiration from the Sudokwan landfill site in Seoul, South Korea, which he visited some years before. He witnessed new technology and was keen to disseminate it in Myanmar. Therefore, KKS decided to set up a similar project in Yangon.

He was added that improving waste management is directly related to the global warming and climate change by reducing methane gas emission from the landfill. The Project could also help in poverty alleviation and create job opportunities.

He explained about the process and employment opportunity during and after the Project. The project and its supporting facilities such as waste pre-screening plant, would be the main place of employment for those who are currently working at the landfill, including scavengers. At the end of his speech, KKS encouraged all participants to freely raise questions and participate actively in the discussions.

Following this speech, a Q&A session started. The questions are summarized in section E.2. The meeting was concluded at 12:30.

Figure 7: Stakeholders' Consultation

E.2. Summary of comments received

At the Q & A session, the following were asked by the participants and answered by the organizer and the team.

Q: Will the Project present any opportunities to the people presently involved in the recycling business (currently 200-300 are employed at the site)?

A: The Project includes the establishment of a waste sorting plant to separate the waste before dumping at the landfill site. This plant will be their new workplace for those who would like to join the Project and they will be paid up by this recycling business.

Q: Are there any arrangement to the children who are living at the disposal site and supporting their parents in generation of family income?

A: It is unfortunate that children have to support their parents who do not have sufficient income to send them to school. This is not an issue directly related to the Project. However, there will be a program prioritize the employment of parents with children, so that they can earn sufficient income and allow their children attend school.

Q: Are there similar Projects anywhere?

A: Not in Myanmar. We plan to disseminate this technology after the successful implementation of this pilot project.

After the meeting the attendees filled-in a questionnaire. The following questions were covered:

1. Do you think this Project can adversely affect the local residents?
2. Can this Project adversely affect the employment opportunities in the local area?

3. Will this Project adversely affect natural resources in this area?
4. Will the Project adversely affect the environment in the local area?
5. Will the Project cause any additional noise and vibration or release of light, heat energy or electromagnetic radiation?
6. Will the Project result in social changes?
7. Are there any transport routes or facilities which will get congested as a result of this Project?

The result of the above questionnaires (28 attendees) were summarized as following.

No.	Question	Yes	No	Remarks
1	Q.I	0	100%	yes=0 , no=28
2	Q.II	0	100%	yes=0 , no=28
3	Q.III	0	100%	yes=0 , no=28
4	Q.IV	0	100%	yes=0 , no=28
5	Q.V	0	100%	yes=0 , no=28
6	Q.VI	78.57%	21.43%	yes=22 , no=6
7	Q.VII	28.57%	71.43%	yes=8 , no=20

Figure 8: Summary of the Questionnaire Responses

The other remarks by the attendees are as following.

1. The participants were openly supportive of the Project.
2. The participants were happy that waste will be handled properly and that the Project will protect existing jobs and provide fair income.
3. The Project will positively affect the health of the communities residing around the project site.

E.3. Report on consideration of comments received

No additional comments are required.

SECTION F. Approval and authorization

The Project is preparing to apply for approval from the DNA of Myanmar.

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Appendix 1: Contact information of project participants

Organization	Kaung Kyaw Say Co., Ltd.
Street/P.O. Box	31Pinole Yeik Mon 5th Street, Pinole Yeikmon, Thingangyun Township
Building	
City	Yangon
State/Region	
Postcode	11071
Country	Myanmar
Telephone	+95-1-571284
Fax	
E-mail	kaungkyawsaymdoffice@gmail.com
Website	
Contact person	
Title	Chairman/CEO
Salutation	Mr.
Last name	Aung
Middle name	
First name	Htun Naing
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

Appendix 2: Affirmation regarding public funding

The Project will use no public funding.

Appendix 3: Applicability of selected methodology

No additional information is provided here.

Appendix 4: Further background information on ex ante calculation of emission reductions

Table 8. Information about the landfill

Parameter	Units	Data
Landfill data		
Year landfill started operation		2002
Waste in place at the beginning of Project	M tons	1.277
Area of site	Acre	150
Date gas collection Project starts		01.07.2013
Project operational data		
Gas collection efficiency	%	50%
General data		
GWP of CH_4	tCO_2/tCH_4	25
Density of Methane	tCH_4/m^3	0.000716
Baseline data		
The emission factor for electricity generation from Project electricity consumption in year	tCO_2e/ MWh.	1.3
Proportion of methane flared in Baseline (AF)	-	0%

Table 9. Share of Various Types of Waste

WASTE TYPE	Share
Wood and wood products	2.46%
Pulp, paper and cardboard	19.51%
Food, food waste, beverages and tobacco	44.66%
Textiles	5.95%
Garden, yard and park waste	3.90%
Glass, plastic, metal, other inert waste	23.51%

Table 10. Amount of MSW disposed at the landfill

Year	Waste amounts disposed (tons)	Aggregate Amount	Wood and Wood Products	Pulp, Paper and Cardboard	Food, Food waste Beverages and Tobacco	Textile	Garden, Yard and Park Waste	Inert Waste
2002	75,304	75,304	1,856	14,690	33,632	4,484	2,938	17,705
2003	87,066	162,370	2,145	16,984	38,885	5,185	3,397	20,470
2004	87,484	249,854	2,156	17,066	39,071	5,210	3,413	20,569
2005	77,569	327,423	1,911	15,132	34,643	4,619	3,026	18,237
2006	75,772	403,195	1,867	14,781	33,841	4,512	2,956	17,815
2007	85,728	488,923	2,112	16,723	38,287	5,105	3,345	20,156
2008	92,136	581,059	2,270	17,973	41,149	5,487	3,595	21,662
2009	93,668	674,727	2,308	18,272	41,833	5,578	3,654	22,023
2010	69,253	743,980	1,706	13,509	30,929	4,124	2,702	16,282
2011	266,546	1,010,526	6,568	51,996	119,043	15,872	10,399	62,668
2012	266,546	1,277,072	6,568	51,996	119,043	15,872	10,399	62,668
2013	190,000	1,467,072	4,682	37,064	84,856	11,314	7,413	44,671
2014	0	1,467,072	0	0	0	0	0	0
2015	0	1,467,072	0	0	0	0	0	0
2016	0	1,467,072	0	0	0	0	0	0
2017	0	1,467,072	0	0	0	0	0	0
2018	0	1,467,072	0	0	0	0	0	0
2019	0	1,467,072	0	0	0	0	0	0
2020	0	1,467,072	0	0	0	0	0	0
2021	0	1,467,072	0	0	0	0	0	0

Appendix 5: Further background information on monitoring plan

No additional information is provided here.

Appendix 6: Summary of post registration changes

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History of the document

Version	Date	Nature of revision
04.1	11 April 2012	Editorial revision to change history box by adding EB meeting and annex numbers in the Date column.
04.0	EB 66 13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the project design document form for small-scale CDM project activities" (EB 66, Annex 9).
03	EB 28, Annex 34 15 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.
02	EB 20, Annex 14 08 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
01	EB 07, Annex 05 21 January 2003	Initial adoption.
Decision Class: Regulatory **Document Type:** Form **Business Function:** Registration		