MONITORING REPORT FORM (CDM-MR) *
Version 01 - in effect as of: 28/09/2010

CONTENTS

* as contained within the document entitled "Guidelines for completing the monitoring report form (CDM-MR)" (EB 54 meeting report, annex 34).

MONITORING REPORT
Version 1.0 22/02/2012

Energeticos Jaremar – Biogas recovery from Palm Oil Mill Effluent (POME) ponds, and heat & electricity generation, Honduras

Reference number: 1483
Third monitoring period and dates (01/12/2009 – 31/12/2010)

SECTION A. General description of the project activity

A.1. Brief description of the project activity: >>

>>
The project activity involves the recovery and energetic use of biogas. The biogas is originally produced by the palm oil mill effluent (POME) ponds at Agrotor palm oil mill located in Honduras. The effluent waste water treatment system converts the organic content of the waste water to biogas. As part of the biogas, methane is formed and, without this project activity, would have been released into the atmosphere. The CDM-project activity established a biogas recovery system which covers the lagoons with floating plastic membranes. This system captures the biogas, which is then utilised on-site for the production of heat & electricity for internal processes of Agrotor's production facility.

The recovered biogas is primarily fed into four boilers for the production of heat and into the biogas turbine for generation of electricity. Biogas that is not used for the generation of heat and electricity will be flared. Biogas replaces bunker consumption of the boilers at the refinery located near the palm oil mill. The electricity produced by biogas generation system will replace electricity imports from the grid.
All electricity generated will be used at the palm oil mill and the refinery.

The total amount of CERs achieved during this monitoring period is 47,996.0 tCO2eq.

A.2. Project Participants

>>
Energeticos Jaremar, S.A. de C.V.

A.3. Location of the project activity:

>>
The project is located near the village of San Alejo in Honduras. The project is delineated by mainly African palm plantations, and the San Alejo River.
The precise coordinates for the project are N 15° 43.41' and W 87°35.4'

A.4. Technical description of the project

>>
The project consists of 1) the methane recovery and 2) the biogas utilisation.

1) Methane recovery

The project activity involves the covering of two existing open anaerobic lagoons with a high density polyethylene (HDPE), linear low-density polyethylene (LLDPE), or ethylene propylene dimonomer (EPDM) liner, which resist bad weather and provide a system to evacuate accumulated rainwater. The cover is anchored along the edge of each lagoon to guarantee that they are hermetically sealed. This cover will prevent the release of biogas to the atmosphere. The biogas recovery system is managed in order to establish optimal operation conditions.

Before both the lagoons were covered, they were adapted to assure ease of maintenance and steady biological conditions throughout the project's lifetime. Measures under this adaptation include an increase of the treatment capacity, installation of an internal mixing system and a refurbishment of the old sludge

removal system. A piping system was installed which serves as a by-pass in case of malfunctions or maintenance. Old pumps and piping are used in the project.

Sludge management: There is no dewatering process for the complete treatment system. A sludge removal unit was installed to avoid the progressive accumulation of sludge at the bottom of the lagoons, which could have affected the methane capture capacity. Surplus sludge is continuously circulated to the digester system and is occasionally removed from the recirculation cycle.
Removed sludge is dried on dedicated fields. All the dried sludge is managed under aerobic and controlled conditions.
The project proponent used to use the sludge for land application to enhance the quality of the soil, and this is still practiced.

2) Biogas utilisation

The composition of the captured biogas is typically primarily methane (65%) and carbon dioxide (35%). The biogas distribution system includes PVC piping for the biogas flow and biogas blowers to transport the gas. The piping system further includes: water condensation system (to remove water content), H2S biological and chemical filters (eliminate impurities), biogas flow measurement, biogas analysis, flare, pressure measurement devices on several points, valves and accessories, sampling points and several blowers to inject biogas into the different combustion units. For safety reasons, and to minimise biogas loss, the biogas pipeline is periodically checked and maintained if necessary.

The biogas is utilised in the following priority:
1) Heat generation in two existing and boilers one new boiler: The biogas replaces bunker consumption at the refinery located near the palm oil mill:
- Boiler 1: Utilised for the production of steam for internal production processes at the palm oil refinery;
- Boiler 2: Utilised for the heating of thermal oil internal production processes at the palm oil refinery;
- Boiler 3: Utilised for the production of steam for internal production processes at the palm oil refinery;
- Boiler 4: Utilised for the heating of thermal oil internal production processes at the palm oil refinery.
- Boiler 3 and 4 replace boiler 1 and 2.

2) Electricity production by a biogas generator system: The produced electricity avoids electricity imports from the grid. All electricity generated is used at the palm oil mill and the refinery.
3) Flaring: If there is an excess of biogas, it is flared by an open candlestick flare.

The biogas utilisation priorities can be restructured. If the grid operator Empresa Nacional de Energía Eléctrica (ENEE) cannot supply the additional electricity required for the operation of the refinery or the mill, electricity generation will be considered as the highest priority for the consumption of biogas (including the possibility to incorporate a new biogas generator). The same is applicable if heat/steam generation is considered as a highest priority.

Technical details for each utilisation unit for biogas can be found below:
1) Heat generation in four boilers:
The biogas captured replaces bunker consumption. In order to utilise the captured biogas in the boilers one burner was replaced and the other one was upgraded. The specifications of the boilers are:
- Boiler 1:
  - Thermal capacity: 7.36 MWth
  - Model: Cleaver-Brooks peritubular boiler
  - Purpose: Energy steam production for internal production process at the palm oil refinery.
  - Efficiency from Cleaver Brooks Manual (conservative reference on Efficiency): lower value for steam boiler with biogas (81%) and higher value for steam boiler with fuel oil N°5 and N°6 (86%).
- Boiler 2:
  - Thermal capacity: 1.17 MWth
  - Model: HTT wtö 1.250-30-1-v (vertical). Provided by HTT Energy systems
  - Purpose: Energy System for heating thermal oil.
  - Efficiency: 85% for any fuel. The technology provider has informed that there are no efficiency differences between bunker and biogas.

- Boiler 3:
  - Thermal capacity: 9.8 MWth
  - Model: Cleaver Brooks 800
  - Purpose: Energy steam production for internal production process at the palm oil refinery.
  - Efficiency: From Cleaver Brooks Manual (conservative reference on Efficiency): lower value for steam boiler with biogas (83.1%) and higher value for steam boiler with fuel oil N°6 (87.5%.)
- Boiler 4:
  - Thermal capacity: 0.93 MWth
  - Model: NUK-HP 930 from GekaKonus
  - Purpose: Energy System for heating thermal oil.
  - Efficiency: Considering that the technology provider has informed that there are no efficiency differences between bunker and biogas a conservative approach is chosen: Lower value with biogas (86%) and higher value with fuel oil N°6 100%.

2) Biogas generator system:
The project activity involves the operation of a 0.848 MWe biogas fuelled generator. The generator is sized based on the electricity needs of the complete refinery and palm oil mill in Agrotor and minimize the consumption from the grid. The specifications of the generator are:
  - Installed capacity: 0.848 MWe
  - Model: Jenbacher GenSet JGC316 GS-B.L
  - Voltage: 840 Volts
  - Frequency: 60 Hz

3) Flaring:
The open flare burns the surplus biogas, to avoid any dangerous accumulation in the covered lagoon of the biogas management system.

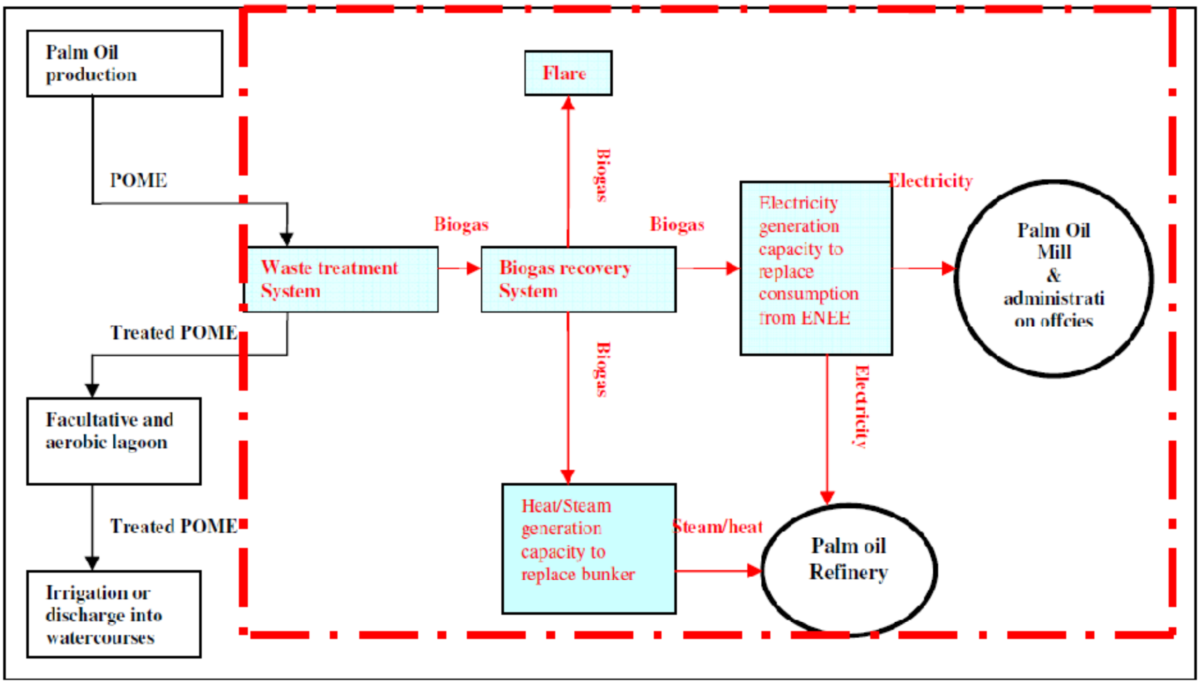

Figure 1: Graphical representation of the CDM project's boundaries represented by red lines

A.5. Title, reference and version of the baseline and monitoring methodology applied to the project activity:

>>
The details of the applied methodologies for this small project activity are listed below:

Methane recovery
Title: Methane Recovery in Wastewater Treatment

Category:	Type III, Other project activities
Sub Category:	III.H
Version:	5, 18 May 2007
Reference:	'*Methane recovery in wastewater treatment'* approved small-scale CDM baseline methodology III.H./Version 05_Scope 13_EB31.

Heat generation

Title:	Thermal energy for the user with or without electricity
Category:	Type I, Renewable energy projects
Sub Category:	I.C
Version:	11, 6 July 2007
Reference:	'*Thermal energy for the user with or without electricity'* approved small-scale CDM baseline methodology I.C./Version 11_Scope 1_EB32.

A.6. Registration date of the project activity:

>>
08 March 2008

A.7. Crediting period of the project activity and related information (start date and choice of crediting period):

>>
The first (current) crediting period is from 8 March 2008, 7 years, renewable.

A.8. Name of responsible person(s)/entity(ies):

>>
Edgar Hernan Cruz Martinez,
Adeline de Lamar
SQ Consult
Monitoring Verifications & Review
T: +31 (0) 616563730
e.cruz@sqconsult.com

SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

>>
The project is fully implemented according to the description presented in the PDD. The project activity is completely operational since the start date of operation on 08 March 2008.

The important milestones of the project activity during the verification period are:

Date	Milestone
8/08/2008	The project installation is completed according to the description in the PDD and fully operational. The project activity is registered. The crediting period begins.
8/03/2008–31/12/2008	First Monitoring Period. CERs Issued.
26/03/2010	In EB53 Annex 56, the EB decided that the DOE shall submit a request to revise the monitoring plan to comply with the requirement of the methodology MSI.C.v.11 regarding the metering of energy produced, measurement of fossil fuel and comparison between the metered energy and calculated energy using the specific fuel consumption prior to the next request for issuance.
10/09/2010	2 new boilers are in operation according to the optional boilers described in the PDD. These boilers replaced the existing ones which were put off permanently.
09/11/2011	Approval of monitoring plan that is relevant for this monitoring period

B.2. Revision of the monitoring plan

>>
The Monitoring Plan has been revised according to the UNFCCC-EB request (EB53). This revision was approved by the EB on November 9th 2011.

Although the new monitoring system is not yet completely implemented, this new monitoring plan is relevant for this monitoring period.

B.3. Request for deviation applied to this monitoring period

>>
The monitoring plan, monitoring procedures and the project layout is as described in the updated and approved monitoring plan.

B.4. Notification or request of approval of changes

>>
No changes to the project activity described as in the registered CDM-PDD are requested in this period.

SECTION C. Description of the monitoring system

>>
Data collection procedures and control measures
The monitored data is read by the PLC (programmable logic controllers) and stored in a data management system directly connected to the PLC which is called SCADA. SCADA is the main interface of the monitoring system, although the data stored will be also kept in an external hard drive which will work as a backup. This system will permit to graphically represent the collected data. Every week a copy of this information will be stored on an external hard drive as a compilation of the variables of the monitoring plan and as backup.

Agrotor is a subsidiary of Jaremar Group, of which divisions / sections are certificated since 2008 according the international quality standard ISO 9001. The operation of the biogas plant is not certified according to this standard, but the quality standard is implemented. Internal audits and control measures are known for improving workflows and ensuring quality standards.
Furthermore, audits for the management system include review of the data collected and the reports written according to this manual, to confirm that indeed the data is gathered and processed as required.
This is done once a month.

Organizational structure
The project owner is Energeticos Jaremar. Energeticos Jaremar is therefore responsible for the operation and the monitoring of the project activities. Energeticos Jaremar is supported by the technology provider Biotec and the CDM-consultant SQ Consult.

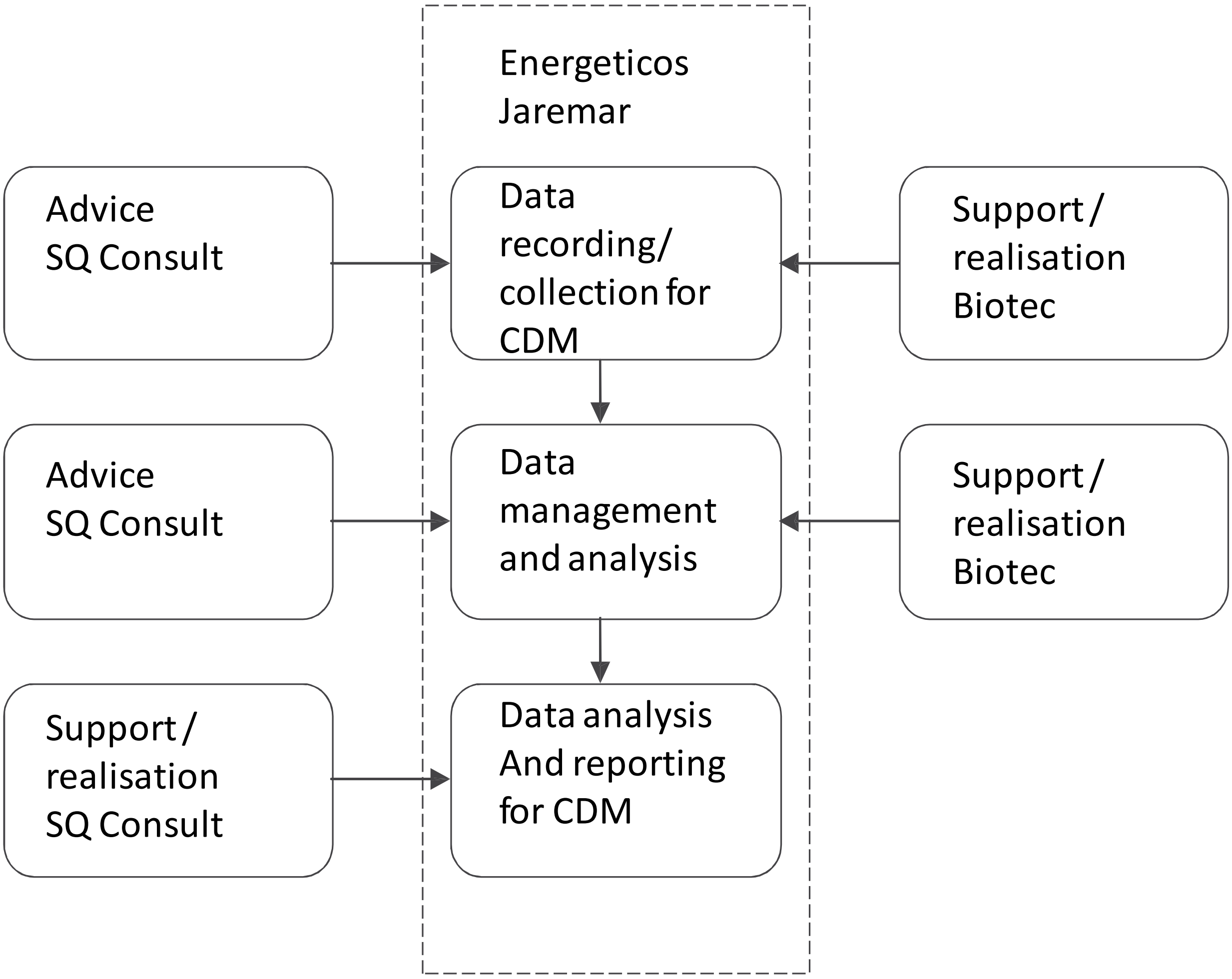

Figure 2: Organisations and management structure

Roles and responsibilities of personnel

Responsibilities for the implementation of the monitoring plan	
Activity	**Responsible**
Implementation and accomplishment of the monitoring plan during the first year	Biotec
Definition of a team that will be trained for the correct operation and monitoring of the wastewater treatment system and the biogas utilization units.	Energeticos Jaremar
Implementation of the monitoring plan after the first year of operation	Energeticos Jaremar
Supervision and guidance for the implementation of the monitoring plan, after the first year of operation	Energeticos Jaremar
Records of the monitoring plan kept at least two years after the crediting period, permitting any future auditing of the values.	Energeticos Jaremar
The historical records for the operation of this project, including all the variables for the monitoring plan, will be initially kept in a data management system directly connected to the PLC, called SCADA.	Biotec & Energeticos Jaremar

If any of the measuring devices show signs of malfunction, it will be fixed by the respective technology supplier. There will be an auxiliary mass flowmeter on stock to serve as a backup for these cases.	Biotec for the first year and Energeticos Jaremar for the next years
Frequent internal audits through experienced engineers coming regularly from the main engineering office.	Biotec
Assistance in the implementation of the CDM monitoring plan and close follow up of the monitoring process.	SQ Consult (CDM project consultant)

Responsibilities for the installation, operation and maintenance of the project	
Activity	**Responsible**
Make available on site Operation and maintenance manuals	Biotec
Responsible for the startup and first year of operation of the system, with possibility of extension	Biotec.
Operation and administration of the wastewater treatment system after Biotec	Energeticos Jaremar
Operation and maintenance costs of the following units: o lagoons, o biogas recovery unit and o boilers and generator.	Energeticos Jaremar
Design and supervision of the project's operation.	Biotec
Installation of the equipment	Biotec
Fill in log of activities including identifying malfunctions and maintenance performed to the system.	Biotec for the first year and Energeticos Jaremar for the next years

Responsibilities for training	
Activity	**Responsible**
Capacity building to the team within Jaremar that will operate the wastewater treatment system.	Biotec
A Jenbacher expert, supplier of the power generation system, will train the same team on operation and maintenance of the generator set.	Jenbacher expert

Biotec has developed a training school to provide training to its personnel. Operators will receive training in biogas handling and operation of the generating system. Also training in instrumentation and monitoring system has been provided through Biotec experienced engineers. These conditions are stated under the contract of Biotec as a service provider for Energeticos Jaremar.

Emergency procedures

In case of emergency cases or failures of the data recording system or the PLC the operating staff will switch to manual readings of all meters. This procedure is well defined and trained to the people since manual readings as backup for the computerized data readings are part of the normal operation during the starting period of this project. Furthermore, a log-book will be written and all the time where observations

and all other information necessary to document are included. In this way jumps or periods with not normal operating conditions can be identified and explained.
In cases where no data are available due to failures of the monitoring equipment the responsible for the monitoring decides as soon as possible which actions will be undertaken to minimize the amount of not registered GHG emission reduction. In this case the CDM-consultant SQ Consult will be consulted.

Diagrams

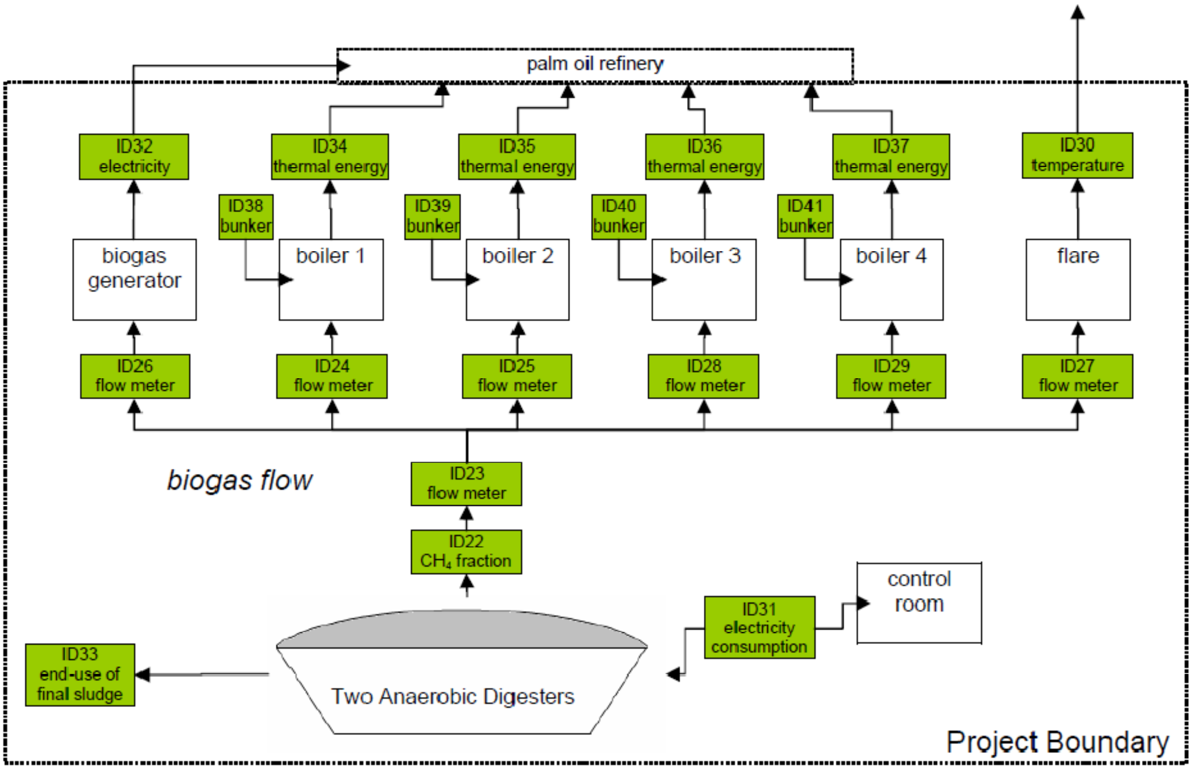

Figure 3: Monitoring plan of Energeticos Jaremar

SECTION D. Data and parameters

D.1. Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors	
(Copy this table for each data and parameter. To report multiple values, a table may be used)	
Data / Parameter:	**GWP_{CH4}**
Data unit:	-
Description:	Global Warming Potential, value for methane
Source of data used:	IPCC 2006 Guidelines
Value(s) :	21
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	BE+PE
Additional comment:	

Data / Parameter:	**ID 6: EF_{grid}**
Data unit:	tCH4/m³CH4
Description:	Grid Emission Factor, Honduras
Source of data used:	determined ex-ante in PDD using ENEE data
Value(s) :	646
Indicate what the data are used for (Baseline/ Project/	BE+PE

Leakage emission calculations)	
Additional comment:	

Data / Parameter:	**ID 11: EF_{CO2}**
Data unit:	tCO_2/TJ
Description:	Carbon emission factor of residual fuel oil (bunker)
Source of data used:	IPCC 2006 Guidelines
Value(s) :	77.4
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	BE+PE
Additional comment:	

Data / Parameter:	**ID 12: NCVbiogas**
Data unit:	TJ/Gg
Description:	NCV of methane
Source of data used:	IPCC 2006 Guidelines
Value(s) :	50.4
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	BE+PE
Additional comment:	

Data / Parameter:	**ID 15: D_{CH4}**
Data unit:	tCH_4/m^3CH_4
Description:	Density of methane at STP (273.15 K and 1,013 bar)
Source of data used:	IPCC 2006 Guidelines
Value(s) :	0.0007168
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	BE+PE
Additional comment:	

Data / Parameter:	**ID 17: η_{SB}**
Data unit:	%
Description:	Efficiency of the steam boiler using bunker (boiler 1)
Source of data used:	Manufacturer value
Value(s) :	86
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	BE+PE
Additional comment:	

Data / Parameter:	**ID 18: η_{SP}**
Data unit:	%
Description:	Efficiency of the steam boiler using biogas (boiler 1)
Source of data used:	Manufacturer value
Value(s) :	81
Indicate what the data are used for (Baseline/ Project/	BE+PE

Leakage emission calculations)	
Additional comment:	

Data / Parameter:	**ID 19: η_{thB}**
Data unit:	%
Description:	Efficiency of the thermal oil heater using bunker (boiler 2)
Source of data used:	Manufacturer value
Value(s) :	85
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	BE+PE
Additional comment:	

Data / Parameter:	**ID 20: η_{thP}**
Data unit:	%
Description:	Efficiency of the thermal oil heater using biogas (boiler 2)
Source of data used:	Manufacturer value
Value(s) :	85
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	BE+PE
Additional comment:	

Data / Parameter:	**ID 21: η_{flare}**
Data unit:	%
Description:	Flare efficiency
Source of data used:	methodology tool
Value(s) :	50
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	BE+PE
Additional comment:	

Data / Parameter:	**ID 42: $\eta_{3,b}$**
Data unit:	%
Description:	Efficiency of the thermal oil heater using biogas (boiler 3)
Source of data used:	Manufacturer value
Value(s) :	83.1%
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	BE+PE
Additional comment:	

Data / Parameter:	**ID 43: $\eta_{4,p}$**
Data unit:	%
Description:	The efficiency of high-pressure boiler 4 using biogas
Source of data used:	Manufacturer value
Value(s) :	86%
Indicate what the data are used for (Baseline/ Project/	BE+PE

Leakage emission calculations)	
Additional comment:	

Data / Parameter:	**ID 45: $\eta_{3,p}$**
Data unit:	%
Description:	The efficiency of boiler 3 using bunker that would have been used in the absence of the project activity.
Source of data used:	Paragraph 13. AMS-I.C (version 11), Option b. Value chosen: Cleaver Brooks Efficiency Facts, page 18. Table. Guaranteed fuel-to steam efficiencies No.6 Oil.
Value(s) :	87.5
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	BE+PE
Additional comment:	The document "Cleaver Brooks Efficiency Facts", indicates that when testing the efficiency of a CB600-800 using fuel oil No.6 across a range of operating conditions, the highest value obtained is 87.5%. This value has been selected according to paragraph 13 (b) of the methodology comparing the efficiencies of three different providers for similar equipment.

Data / Parameter:	**ID 46 / $\eta_{4,b}$**
Data unit:	%
Description:	The efficiency of high-pressure boiler 4 using bunker that would have been used in the absence of the project activity.
Source of data used:	AMS-I.C (version 11), default value - option (c) – has been adopted
Value(s) :	100%
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	BE+PE
Additional comment:	The project owner will be able to use a more realistic (lower) efficiency value if sufficient information is provided at verification to support a change according to the requirements of AMS- I.C (version 11), paragraph 13.

D.2. Data and parameters monitored	
(Copy this table for each data and parameter. To report multiple values, a table may be used)	
Data / Parameter:	**ID 22: $w_{CH4,y}$**
Data unit:	%
Description:	Methane fraction of biogas
Measured /Calculated /Default:	Measured
Source of data:	Portable meters registered in logbooks
Value(s) of monitored parameter:	58.65
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	BE
Monitoring equipment (type, accuracy class, serial number,	**Manufacturer** | **Model** | **Serial no.** | **Calibration Frequency** | **Recent calibration**

calibration frequency, date of last calibration, validity)	<table><tr><td>Sewerin</td><td>SR2-DO</td><td>046 03 000553</td><td>Yearly</td><td>07/11/2009</td></tr><tr><td>Sewerin</td><td>SR2-DO</td><td>046 03 000553</td><td>Yearly</td><td>05/05/2010</td></tr><tr><td>Sewerin</td><td>SR2-DO</td><td>046 03 000553</td><td>Yearly</td><td>14/12/2010</td></tr></table>
Measuring/ Reading/ Recording frequency:	Manual, ca. weekly
Calculation method (if applicable):	
QA/QC procedures applied:	QA: The device will be recalibrated according to the instructions (schedules, procedures) for QA of the technology provider. QC: There will be strict compliance to maintenance schedule recommended by the technology provider.

Data / Parameter:	**ID 23: BG_{Total}**
Data unit:	Nm³
Description:	Biogas recovered
Measured /Calculated /Default:	Calculated + Measured
Source of data:	ID 24 through 29, all connected to the data management system
Value(s) of monitored parameter:	5,160,377
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	BE
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	<table><tr><th>Manufacturer</th><th>Model</th><th>Serial no.</th><th>Calibration Frequency</th><th>Recent calibration</th></tr><tr><td>Magnetrol</td><td>TA2 (Biogas)</td><td>618962-01-001</td><td>Every 3 years</td><td>8/11/2007</td></tr></table>
Measuring/ Reading/ Recording frequency:	Daily
Calculation method (if applicable):	Sum of sub-meters (ID 24 through 29)
QA/QC procedures applied:	A total flow meter was installed and is used as QC for this value. The relevant value, if no errors are detected, is the calculated one. *QA:* The device will be recalibrated according to the instructions (schedules, procedures) for QA of the technology provider. Cross checks of the sum of all sub flow meters will be made with the total biogas recovered. *QC:* There will be strict compliance to maintenance schedule recommended by the technology provider.

Data / Parameter:	**ID 24: $BG_{boiler1}$**
Data unit:	Nm³
Description:	Biogas combusted in boiler 1
Measured /Calculated /Default:	Measured
Source of data:	Mass flow meter connected to the data management system
Value(s) of monitored parameter:	2,221,543
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	BE
Monitoring equipment (type,	<table><tr><th></th><th></th><th></th><th>Calibration</th><th>Recent</th></tr></table>

accuracy class, serial number, calibration frequency, date of last calibration, validity)	<table><tr><th>Manufacturer</th><th>Model</th><th>Serial no.</th><th>Frequency</th><th>calibration</th></tr><tr><td>Magnetrol</td><td>TA2 (Biogas)</td><td>618962-05-001</td><td>every 3 years</td><td>5/11/2007</td></tr></table>
Measuring/ Reading/ Recording frequency:	Daily
Calculation method (if applicable):	
QA/QC procedures applied:	*QA:* The device will be recalibrated according to the instructions (schedules, procedures) for QA of the technology provider. Cross checks of the sum of all sub flow meters will be made with the total biogas recovered. *QC:* There will be strict compliance to maintenance schedule recommended by the technology provider.

Data / Parameter:	**ID 25:** $BG_{boiler2}$
Data unit:	Nm³
Description:	Biogas combusted in boiler 2
Measured /Calculated /Default:	Measured
Source of data:	Mass flow meter connected to the data management system
Value(s) of monitored parameter:	700.392
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	BE
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	<table><tr><th>Manufacturer</th><th>Model</th><th>Serial no.</th><th>Calibration Frequency</th><th>Recent calibration</th></tr><tr><td>Magnetrol</td><td>TA2 (Biogas)</td><td>618962-04-001</td><td>every 3 years</td><td>6/11/2007</td></tr></table>
Measuring/ Reading/ Recording frequency:	Daily
Calculation method (if applicable):	
QA/QC procedures applied:	*QA:* The device will be recalibrated according to the instructions (schedules, procedures) for QA of the technology provider. Cross checks of the sum of all sub flow meters will be made with the total biogas recovered. *QC:* There will be strict compliance to maintenance schedule recommended by the technology provider.

Data / Parameter:	**ID 26:** $BG_{generator}$
Data unit:	Nm³
Description:	Biogas combusted in generator
Measured /Calculated /Default:	Measured
Source of data:	Mass flow meter connected to the data management system
Value(s) of monitored parameter:	1,617,542
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	BE
Monitoring equipment (type, accuracy class, serial number,	<table><tr><th>Manufacturer</th><th>Model</th><th>Serial no.</th><th>Calibration Frequency</th><th>Recent calibration</th></tr></table>

calibration frequency, date of last calibration, validity)	Magnetrol | TA2 (Biogas) | 618962-02-001 | every 3 years | 5/11/2007
Measuring/ Reading/ Recording frequency:	Daily
Calculation method (if applicable):	
QA/QC procedures applied:	*QA:* The device will be recalibrated according to the instructions (schedules, procedures) for QA of the technology provider. Cross checks of the sum of all sub flow meters will be made with the total biogas recovered. *QC:* There will be strict compliance to maintenance schedule recommended by the technology provider.

Data / Parameter:	**ID 27: BG_{flare}**
Data unit:	Nm³
Description:	Biogas combusted in flare
Measured /Calculated /Default:	Measured
Source of data:	Mass flow meter connected to the data management system
Value(s) of monitored parameter:	94,959
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	BE
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	**Manufacturer** | **Model** | **Serial no.** | **Calibration Frequency** | **Recent calibration** Magnetrol | TA2 (Biogas) | 618962-06-001 | every 3 years | 5/11/2007
Measuring/ Reading/ Recording frequency:	Daily
Calculation method (if applicable):	
QA/QC procedures applied:	*QA:* The device will be recalibrated according to the instructions (schedules, procedures) for QA of the technology provider. Cross checks of the sum of all sub flow meters will be made with the total biogas recovered. *QC:* There will be strict compliance to maintenance schedule recommended by the technology provider.

Data / Parameter:	**ID 28: $BG_{boiler3}$**
Data unit:	Nm³
Description:	Biogas combusted in boiler 3
Measured /Calculated /Default:	Measured
Source of data:	Mass flow meter connected to the data management system
Value(s) of monitored parameter:	451,043
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	BE
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of	**Manufacturer** | **Model** | **Serial no.** | **Calibration Frequency** | **Recent calibration** Magnetrol | TA2 | 650444-01- | every 3 years | 9/9/2009

last calibration, validity)	| | | 001 | | |
Measuring/ Reading/ Recording frequency:	Daily
Calculation method (if applicable):	
QA/QC procedures applied:	*QA:* The device will be recalibrated according to the instructions (schedules, procedures) for QA of the technology provider. Cross checks of the sum of all sub flow meters will be made with the total biogas recovered. *QC:* There will be strict compliance to maintenance schedule recommended by the technology provider.

Data / Parameter:	**ID 29: $BG_{boiler4}$**
Data unit:	Nm^3
Description:	Biogas combusted in boiler 4
Measured /Calculated /Default:	Measured
Source of data:	Mass flow meter connected to the data management system
Value(s) of monitored parameter:	169,857
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	BE
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	see table below
Measuring/ Reading/ Recording frequency:	Daily
Calculation method (if applicable):	
QA/QC procedures applied:	*QA:* The device will be recalibrated according to the instructions (schedules, procedures) for QA of the technology provider. Cross checks of the sum of all sub flow meters will be made with the total biogas recovered. *QC:* There will be strict compliance to maintenance schedule recommended by the technology provider.

Manufacturer	**Model**	**Serial no.**	**Calibration Frequency**	**Recent calibration**
Magnetrol	TA2	650444-02-001	every 3 years	9/9/2009

Data / Parameter:	**ID 30: T_{flare}**
Data unit:	°C
Description:	Temperature measurement is used to detect if the flare is operational
Measured /Calculated /Default:	Measured
Source of data:	Flare thermocouple connected to the data management system
Value(s) of monitored parameter:	Various
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	PE
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of	see table below

Manufacturer	**Model**	**Serial no.**	**Calibration Frequency**	**Recent calibration**
Magnetrol	TA2 (Biogas)	AZB/U9007276	Yearly	5/02/2008

last calibration, validity)	
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	If Tflare > 300, the flow to the flare is used for the calculations, otherwise the flow is ignored, assuming no ER for this day[1].
QA/QC procedures applied:	*QA:* The flare has a back up thermocouple sensor in case of failure. The device will be recalibrated according to the instructions (schedules, procedures) for QA of the technology provider. *QC:* There will be strict compliance to maintenance schedule recommended by the technology provider.

<table>
<tr><th>Data / Parameter:</th><th>ID 31: EC</th></tr>
<tr><td>Data unit:</td><td>MWh</td></tr>
<tr><td>Description:</td><td>Electricity consumption</td></tr>
<tr><td>Measured /Calculated /Default:</td><td>Measured</td></tr>
<tr><td>Source of data:</td><td>Two installed electricity meters connected to the data management system</td></tr>
<tr><td>Value(s) of monitored parameter:</td><td>334.34</td></tr>
<tr><td>Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)</td><td>PE</td></tr>
<tr><td>Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)</td><td>
<table>
<tr><th>Manufacturer</th><th>Model</th><th>Serial no.</th><th>Calibration Frequency</th><th>Recent calibration</th></tr>
<tr><td>Siemens</td><td>9200</td><td>SX07080157403</td><td>every 10 years</td><td>09/2007</td></tr>
<tr><td>Siemens</td><td>9200</td><td>SX07080157703</td><td>every 10 years</td><td>09/2007</td></tr>
</table>
</td></tr>
<tr><td>Measuring/ Reading/ Recording frequency:</td><td>Continuous metering, daily reading</td></tr>
<tr><td>Calculation method (if applicable):</td><td>-</td></tr>
<tr><td>QA/QC procedures applied:</td><td>QA: The device will be recalibrated according to the instructions (schedules, procedures) for QA of the technology provider.
QC: There will be strict compliance to maintenance schedule recommended by the technology provider.</td></tr>
</table>

Data / Parameter:	**ID 32: EG**
Data unit:	MWh
Description:	Electricity generation
Measured /Calculated /Default:	Measured
Source of data:	Electricity meter connected to the data management system or logged in logbook
Value(s) of monitored parameter:	3,518
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	BE

[1] According to request for clarification 199 of the SSC-WG.

<table>
<tr><td>Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)</td><td><table><tr><th>Manufacturer</th><th>Model</th><th>Serial no.</th><th>Calibration Frequency</th><th>Recent calibration</th></tr><tr><td>Jenbacher</td><td>JGC 316 GS-B.L</td><td>542199 1</td><td>never</td><td>N/A[2]</td></tr></table></td></tr>
<tr><td>Measuring/ Reading/ Recording frequency:</td><td>Daily</td></tr>
<tr><td>Calculation method (if applicable):</td><td>-</td></tr>
<tr><td>QA/QC procedures applied:</td><td>QA: The device will be recalibrated according to the instructions (schedules, procedures) for QA of the technology provider.
QC: There will be strict compliance to maintenance schedule recommended by the technology provider.</td></tr>
</table>

Data / Parameter:	**ID 33: End use of final sludge**
Data unit:	NA
Description:	Use of final sludge
Measured /Calculated /Default:	NA
Source of data:	Project logbooks
Value(s) of monitored parameter:	Aerobic utilisation on fields
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	PE
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/ Reading/ Recording frequency:	N/A
Calculation method (if applicable):	N/A
QA/QC procedures applied:	Sludge removed from the system will be dried on dedicated fields or directly be applied as fertilizer to the surrounding land. The procedure used will be recorded and included in the monitoring system by the team responsible of the implementation of the monitoring plan. All the dried sludge will be managed under aerobic and controlled conditions. Unexpected deviations from the procedures will be recorded and reported as well.

Data / Parameter:	**ID 34:** $HG_{measured,1,y}$
Data unit:	TJ/yr
Description:	The directly measured total quantity of thermal energy supplied by steam boiler 1 during the year y
Measured /Calculated /Default:	Measured
Source of data:	The amount of the generated steam will be measured with a specialized mass flow meter. The operation conditions of the boilers are known, so that the mass flow can converted to energy using standard steam tables.
Value(s) of monitored parameter:	NA

[2] Factory calibration

Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	BE
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The equipment was not installed during the crediting period as the modified monitoring plan requested on EB 53 was not approved yet.
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	N/A
QA/QC procedures applied:	- QA: The device will be subject to regular maintenance and calibration according to the technology provider. - QC: The value used to cross check HG_1, calculated according to equation 18 of the updated MP, will be the thermal energy generation prediction calculated using the amount of biogas combusted. The lower of these two values is used in the ER calculation, as the methodology requires.

Data / Parameter:	**ID 35:** $HG_{measured,2,y}$
Data unit:	TJ/yr
Description:	The directly measured total quantity of thermal energy supplied by thermal oil heater (boiler 2) during the year y
Measured /Calculated /Default:	Measured
Source of data:	N/A
Value(s) of monitored parameter:	N/A
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	BE
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The equipment was not installed during the crediting period as the modified monitoring plan requested on EB 53 was not approved yet.
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	The enthalpy of the generated energy will be calculated using measurement of the temperature gain and the flow properties: $HG_{measured,2,y} = \Delta Tt_{boiler,2} \cdot Flow \cdot Heat\ capacity$ The Heat capacity is taken from the data sheet of the heat carrier, the official information from the supplier.
QA/QC procedures applied:	-QA: The device will be subject to regular maintenance and calibration according to the technology provider. - QC: The value will be used to cross check HG_2, calculated according to equation 19 of the updated MP, which is calculated using the amount of methane destroyed. The lower of these two values is used in the ER calculation, as the methodology requires.

Data / Parameter:	**ID 36:** $HG_{measured,3,y}$
Data unit:	TJ/yr

Description:	The directly measured total quantity of thermal energy supplied by steam boiler 3 during the year y
Measured /Calculated /Default:	Measured
Source of data:	The amount of the generated steam will be measured with a specialized mass flow meter. The operation conditions of the boilers are known, so that the mass flow can converted to energy using standard steam tables.
Value(s) of monitored parameter:	NA
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	BE
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The equipment was not installed during the crediting period as the modified monitoring plan requested on EB 53 was not approved yet.
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	
QA/QC procedures applied:	-QA: The device will be subject to regular maintenance and calibration according to the technology provider. -QC: The value will be used to cross check HG_3, calculated according to equation 20 of the updated MP, which is calculated using the amount of methane destroyed. The lower of these two values is used in the ER calculation, as the methodology requires.

Data / Parameter:	**ID 37: $HG_{measured,4,y}$**
Data unit:	TJ/yr
Description:	The directly measured total quantity of thermal energy supplied by high pressure boiler 4 during the year y
Measured /Calculated /Default:	Measured
Source of data:	The volume of the generated steam will be measured with a specialized steam meter. The operation conditions of the boilers are pre-set by the refinery process and known, so that the temperature, pressure, composition and density of the steam are known, and the volume flow is converted to energy using this information and standard steam tables.
Value(s) of monitored parameter:	NA
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	BE
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The equipment was not installed during the crediting period as the modified monitoring plan requested on EB 53 was not approved yet.
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	
QA/QC procedures applied:	-QC: The device will be subject to regular maintenance and calibration according to the

	technology provider. QA: The value will be used to cross check HG4, calculated according to equation 21 of the updated MP, which is calculated using the amount of methane destroyed. The lower of these two values is used in the ER calculation, as the methodology requires.

Data / Parameter:	**ID 38: $FF_{boiler,1}$**
Data unit:	Gg/y
Description:	Bunker fuel consumption by boiler 1
Measured /Calculated /Default:	Volume flow meter
Source of data:	The volume of bunker used will be continuously monitored. The mass of the consumed fuel will be determined by using the volume flow measured and multiplying it by the density of bunker. There will be at least monthly recording of the volume consumed. The volume data will be archived electronically.
Value(s) of monitored parameter:	0
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	PE
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The equipment was not installed during the crediting period as the modified monitoring plan requested on EB 53 was not approved yet.
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	N/A
QA/QC procedures applied:	The measurement equipment used will be of high quality. The measurements will be logged and documented. The result will be used, together with the thermal energy produced, to crosscheck the biogas consumption. The device's calibration and maintenance schedules will strictly follow the technical provider's specifications and the General Guidelines to SSC CDM methodologies. Its monitoring will be integrated in the plant's operational procedures. If the volume flow meter data are temporarily unavailable for technical reasons, internal fuel inventories will be used to calculate the fuel consumed. In such a case, internal inventories' procedures will be detailed in the monitoring report.

Data / Parameter:	**ID 39: $FF_{boiler,2}$**
Data unit:	Gg/y
Description:	Bunker consumption by boiler 2
Measured /Calculated /Default:	Measured
Source of data:	Volume flow meter
Value(s) of monitored parameter:	The volume of bunker used will be continuously monitored. The mass of the consumed fuel will be determined by using the volume flow measured and multiplying it by the density of bunker. There will be at least monthly recording of the volume consumed. The volume data will be archived electronically.
Indicate what the data are used for (Baseline/ Project/	0

Leakage emission calculations)	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The equipment was not installed during the crediting period as the modified monitoring plan requested on EB 53 was not approved yet.
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	
QA/QC procedures applied:	N/A
	The measurement equipment used will be of high quality. The measurements will be logged and documented. The result will be used, together with the thermal energy produced, to crosscheck the biogas consumption. The device's calibration and maintenance schedules will strictly follow the technical provider's specifications and the General Guidelines to SSC CDM methodologies. Its monitoring will be integrated in the plant's operational procedures. If the volume flow meter data are temporarily unavailable for technical reasons, internal fuel inventories will be used to calculate the fuel consumed. In such a case, internal inventories' procedures will be detailed in the monitoring report.

Data / Parameter:	**ID 40: $FF_{boiler,3}$**
Data unit:	Gg/y
Description:	Bunker consumption by boiler 3
Measured /Calculated /Default:	Measured
Source of data:	The volume of bunker used will be continuously monitored. The mass of the consumed fuel will be determined by using the volume flow measured and multiplying it by the density of bunker. There will be at least monthly recording of the volume consumed. The volume data will be archived electronically.
Value(s) of monitored parameter:	0
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	PE
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The equipment was not installed during the crediting period as the modified monitoring plan requested on EB 53 was not approved yet.
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	N/A
QA/QC procedures applied:	The measurement equipment used will be of high quality. The measurements will be logged and documented. The result will be used, together with the thermal energy produced, to crosscheck the biogas consumption. The device's calibration and maintenance schedules will strictly follow the technical provider's specifications and the General Guidelines to SSC CDM methodologies. Its monitoring will be integrated in the plant's operational procedures. If the volume flow meter data are temporarily unavailable for technical reasons,

	internal fuel inventories will be used to calculate the fuel consumed. In such a case, internal inventories' procedures will be detailed in the monitoring report.

Data / Parameter:	**ID 41: $FF_{boiler,4}$**
Data unit:	Gg/y
Description:	Bunker consumption by boiler 4
Measured /Calculated /Default:	Measured
Source of data:	The volume of bunker used will be continuously monitored. The mass of the consumed fuel will be determined by using the volume flow measured and multiplying it by the density of bunker. There will be at least monthly recording of the volume consumed. The volume data will be archived electronically.
Value(s) of monitored parameter:	0
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	PE
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The equipment was not installed during the crediting period as the modified monitoring plan requested on EB 53 was not approved yet.
Measuring/ Reading/ Recording frequency:	Continuous
Calculation method (if applicable):	N/A
QA/QC procedures applied:	The measurement equipment used will be of high quality. The measurements will be logged and documented. The result will be used, together with the thermal energy produced, to crosscheck the biogas consumption. The device's calibration and maintenance schedules will strictly follow the technical provider's specifications and the General Guidelines to SSC CDM methodologies. Its monitoring will be integrated in the plant's operational procedures. If the volume flow meter data are temporarily unavailable for technical reasons, internal fuel inventories will be used to calculate the fuel consumed. In such a case, internal inventories' procedures will be detailed in the monitoring report.

Data / Parameter:	**ID 44: $\rho_{fuel\ oil\ 6}$**
Data unit:	kg /m3
Description:	Density of fossil fuel no.6 (bunker)
Measured /Calculated /Default:	Measured
Source of data:	Laboratory report provided by manufacturer
Value(s) of monitored parameter:	997.3
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	BE+PE
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of	NA

last calibration, validity)	
Measuring/ Reading/ Recording frequency:	Per monitoring period
Calculation method (if applicable):	Maximum density of the different local providers used
QA/QC procedures applied:	At each monitoring period, Jaremar's fossil fuel suppliers will be asked to provide the specifications of the bunker provided. The maximum density among the values provided will be chosen to ensure conservativeness.

SECTION E. Emission reductions calculation

The total emission reductions can be easily calculated with the results of the below described equations. The emission reduction is equal to the baseline emissions minus project emissions and leakage emissions. Leakage emissions in this project are considered to be zero. The general equation (1) is as follows:

$$ER_y = BE_y - (PE_y + L_y) \quad (1)$$

ER_y = Emission reduction
BE_y = Baseline emissions
PE_y = Project emissions
L_y = Leakage year

E.1. Baseline emissions calculation

>>

Ex-post determination of methane combusted and destroyed

According to the PDD, the small scale methodology Type III.H (version 5) and the "Tool to determine project emissions from flaring gases containing methane" provides the way to calculate the emission reduction resulting from avoided methane emissions. The actual achieved emission reduction is calculated according to the following equations:
The amount of methane combusted and destroyed is determined by summation of the amount of methane fed into the two boilers, the generator and the flare minus the amount of emission resulting from incomplete combustion at the flare as follows:

$$ER_{MD,y} = (\Sigma_i MD_{boiler,i,y} + \Sigma_i MD_{generator,y} + MD_{flared,y}) \times GWP_{CH4}$$

Where:

$ER_{MD,y}$ = Emission reductions from the CH4 combusted and destroyed as fuel and flared in tCO_{2eq}/y
$MD_{boiler,i,y}$ = Amount of CH4 combusted in boiler i in t_{CH4}/y
$MD_{generator,y}$ = Amount of CH4 combusted in generator in t_{CH4}/y
$MD_{flared,y}$ = Amount of CH4 combusted in flare in t_{CH4}/y
GWP_{CH4} = Global warming potential for CH4

The amount of CH4 combusted by the boiler i is calculated according to:

$$MD_{boiler,i,y} = BG_{boiler,i,y} \times w_{CH4,y} \times D_{CH4}$$

Where:

$BG_{boiler,i,y}$ = The quantity of biogas fed into boiler i in Nm^3/y
$w_{CH4,y}$ = The average CH4 fraction of the biogas as measured and expressed as a fraction in m^3_{CH4}/m^3
D_{CH4} = The CH4 density in $t_{CH4}/m3_{CH4}$

The amount of CH4 combusted by the biogas generator is calculated according to:

$MD_{generator,y}$ = $BG_{generator,y} \times w_{CH4,y} \times D_{CH4}$

Where:

$BG_{generator,y}$ = The quantity of biogas fed into the generator in Nm³/

$w_{CH4,y}$ = The average CH4 fraction of the biogas as measured and expressed as a fraction in m^3CH_4/m^3

The amount of CH4 destroyed by the flare is calculated according to:

$MD_{flared,y}$ = $BG_{flare,y} \times w_{CH4} \times D_{CH4} \times \eta_{flare}$

Where:

$BG_{flare,y}$ = The quantity of biogas fed into the flare in year "y" in Nm³/y

$w_{CH4,y}$ = The average CH4 fraction of the biogas as measured and expressed as a fraction in m^3CH_4/m^3

η_{flare} = Flare efficiency (open flare, 50%)

If there is an excess of biogas, it will be flared by a flare. The project uses an open flare, and therefore the flare efficiency cannot be measured in a reliable manner (i.e. external air will be mixed and will dilute the remaining methane) and a default value of 50% is used, as requested by the applicable small scale methodology.

Ex-post emission reduction from heat generation

The following equations are included to estimate the thermal energy delivered and the emission reductions from the replacement of bunker:

For the steam boiler (boiler 1):

$HG_{1,y}$ = $MD_{boiler1,y} \times NCV_{biogas} \times \eta_{sp} \times 1/1000$

$HG_{1,y}$ = The net quantity of biogas associated thermal energy supplied by the steam boiler to the process in the project activity during the year y in TJ/year.

$MD_{boiler1,y}$ = Amount of CH4 combusted by the steam boiler in tCH_4/y

NCV_{biogas} = Net calorific value CH4 in TJ/Gg

η_{sp} = The efficiency of the steam boiler using biogas

For the thermal oil heater (boiler 2):

$HG_{2,y}$ = $MD_{boiler2,y} \times NCV_{biogas} \times \eta_{thp} \times 1/1000$

$HG_{2,y}$ = The net quantity of biogas associated thermal energy supplied by the thermal oil heater to the process in the project activity during the year y in TJ/year.

$MD_{boiler2,y}$ = Amount of CH4 combusted by the steam boiler in tCH_4/y

NCV_{biogas} = Net calorific value CH4 in TJ/Gg

η_{thp} = The efficiency of the thermal oil heater using biogas

For the steam boiler (boiler 3):

$HG_{3,y}$ = $MD_{boiler3,y} \times NCV_{biogas} \times \eta_{3,p} \times 1/1000$

$HG_{3,y}$ = The net quantity of biogas associated thermal energy supplied by the steam boiler to the process during the year y in TJ/year.

$MD_{boiler3,y}$ = Amount of CH4 combusted by the steam boiler in tCH4 /y

NCV_{biogas} = Net calorific value CH4 in TJ/Gg

$H_{3,p}$ = The efficiency of the steam boiler using biogas

For the steam boiler (boiler 4):

$HG_{4,y}$ = $MD_{boiler4,y} \times NCV_{biogas} \times \eta_{4,p} \times 1/1000$

$HG_{4,y}$	=	The net quantity of biogas associated thermal energy supplied by the high pressure steam boiler to the process during the year y in TJ/year.
$MD_{boiler4,y}$	=	Amount of CH4 combusted by the steam boiler in tCH4 /y
NCV_{biogas}	=	Net calorific value CH4 in TJ/Gg
$\eta_{4,p}$	=	The efficiency of the steam boiler using biogas

The use of bunker as an auxiliary fuel does not need to be monitored or subtracted from total emission reductions, since emission reductions from heat generation will be based on biogas flow and not in the total heat generation.

Comparison of estimated with measured thermal energy:

For the all boilers the heat generation estimation using biogas inflow will be compared to the measured heat generated by the boiler, and the lower value will be used for the calculations:

$$HG_{min,i,y} = min\left(HG_{i,y}, HG_{measured,i,y} - \frac{FF_{i,y}}{SFC_i}\right)$$

Where:

$HG_{min,i,y}$	The conservative quantity of biogas associated thermal energy supplied by boiler i to the process in the project activity during the year y in TJ/year.
$HG_{i,y}$	The net quantity of biogas associated thermal energy supplied by boiler i during the year y in TJ/year.
$HG_{measured,i,y}$	The directly measured total quantity of thermal energy supplied by boiler i during the year y in TJ/year.
$FF_{i,y}$	The amount of fossil fuel used in boiler i in Gg/y
SFC_i	Specific fuel consumption for fossil fuel in boiler i in Gg/TJ

Where:

$$SFC_i = \frac{1}{NCV_{FF} \cdot \eta_{i,p}}$$

NCV_{FF}	Calorific value of the fossil fuel in TJ/Gg.
$\eta_{i,p}$	Efficiency of project boiler i.

Emission reduction for thermal energy generation:

The emission reductions related to the heat/steam generation component are calculated as follows:

$$ER_{thermal,y} = \left(\frac{HG_{1,y}}{\eta_{s,b}} + \frac{HG_{2,y}}{\eta_{th,b}} + \frac{HG_{3,y}}{\eta_{3,b}} + \frac{HG_{4,y}}{\eta_{4,b}}\right) \times EF_{CO2}$$

Where:

$ER_{thermal,y}$:	The total baseline emissions from steam/heat displaced by the project activity during the year y in tonnes CO2 eq/year.
$HG_{min,1,y}$	The conservative quantity of biogas associated thermal energy supplied by the steam boiler 1 to the process in the project activity during the year y in TJ/year.
$HG_{min,2,y}$	The conservative quantity of biogas associated thermal energy supplied by the thermal oil heater 2 to the process in the project activity during the year y in TJ/year.
$HG_{min,3,y}$	The conservative quantity of biogas associated thermal energy supplied by the steam boiler 3 to the process in the project activity during the year y in TJ/year.

$HG_{min,4,y}$	The conservative quantity of biogas associated thermal energy supplied by the high pressure steam boiler 4 to the process in the project activity during the year y in TJ/year.
EF_{CO_2}	The CO2 emission factor per unit of energy of bunker that would have been used in the baseline plant in tCO2 / TJ.
$\eta_{s,b}$	The efficiency of the steam boiler using bunker that would have been used in the absence of the project activity.
$\eta_{th,b}$	The efficiency of the thermal oil heater using bunker that would have been used in the absence of the project activity.
$\eta_{3,b}$	The efficiency of steam boiler 3 using bunker that would have been used in the absence of the project activity.
$\eta_{4,b}$	The efficiency of high pressure steam boiler 4 using bunker that would have been used in the absence of the project activity.

For conservativeness and due to fact that the metering equipment required by the new monitoring plan[3] was not installed during the period covered by the crediting period, emissions reductions from heat generation are considered to be zero.

Ex-post emission reductions from electricity generation (AMS-I.C)

$ER_{power,y} = EG_y \times EF_{grid}$

Where:
EG_y = Net amount of electricity produced by the project activity in GWh/y
EF_{grid} = Emission factor of the Honduran grid, determined ex ante in tCO_{2eq}/GWh
The net amount of electricity generated will include the electricity delivered by the 0.848 MW_{el} generator plus any future installed generator which operates on the captured biogas.

Actual values:

Baseline emissions during this monitoring period according to AMS-III.H

Month	ID24: CH4 comb. Boiler 1 [Nm³]	ID25: CH4 comb. Boiler 2 [Nm³]	ID26: CH4 comb. Generator [Nm³]	ID27: CH4 comb. Flare [Nm³]	ID28: CH4 comb. Boiler 3 [Nm³]	ID29: CH4 comb. Boiler 4 [Nm³]	Baseline emission CH4 comb. AMS III.H [tCO_{2eq}]
Dec 09	241,940	90,821	13,179	51	0	0	2,389.1
Jan 10	167,339	90,278	10,018	0	0	0	1,918.8
Feb 10	131,389	76,082	19,539	0	0	0	3,216.5
Mar 10	242,941	102,106	2,112	0	0	0	2,699.0
Apr 10	209,875	93,940	170,469	0	0	0	2,822.8
May 10	81,922	67,560	88,783	0	0	0	3,499.5
Jun 10	242,640	65,234	252,999	0	0	0	5,692.2
Jul 10	302,321	89,875	174,824	0	0	0	3,415.9
Aug 10	187,867	24,496	143,941	0	0	0	4,201.3
Sep 10	290,823	0	247,082	7,187	0	37,849	3,860.0
Oct 10	122,486	0	232,485	66,095	0	34,907	5,024.9
Nov 10	0	0	181,402	21,626	297,457	28,804	3,558.0
Dec 10	0	0	80,709	0	153,586	68,297	3,648.0
Sum	2,221,543	700.392	1,617,542	94,959	451,043	169,857	45,946.0

[3] The new monitoring plan was approved in a date later than the period covered in this monitoring report.

Baseline emissions during this monitoring period according to AMS-I.C

Month	ID32: Electricity gen. EGy [GWh]	Baseline Emission Heat gen. [tCO2eq]	Baseline Emission Electricity gen. [tCO2eq]	Baseline Emissions AMS-I.C [tCO2eq]
Dec 09	0.1842	0	119.0	119.0
Jan 10	0.0262	0	16.9	16.9
Feb 10	0.0159	0	10.3	10.3
Mar 10	0.0464	0	30.0	30.0
Apr 10	0.0020	0	1.3	1.3
May 10	0.3599	0	232.5	232.5
Jun 10	0.1868	0	120.7	120.7
Jul 10	0.5620	0	363.1	363.1
Aug 10	0.3784	0	244.4	244.4
Sep 10	0.3045	0	196.7	196.7
Oct 10	0.5414	0	349.7	349.7
Nov 10	0.5175	0	334.3	334.3
Dec 10	0.39	0	253.6	253.6
Sum	3.518	0	2,272.4	2,272.4

The total baseline emissions are given as the sum of baseline emission from AMS-III.H and AMS-I.C.

Baseline emissions AMS-III.H	45,946.0	[t CO2eq]
Baseline emissions AMS-I.C	2,272.4	[t CO2eq]
Total Baseline emissions	48,218.4	[t CO2eq]

One of the main parameters to determine the baseline emissions and subsequently the emission reductions is the fraction of methane in the biogas. The PDD and the used methodology define for this project activity that these measurements have to be carried out at least quarterly and should meet a confidence level of at least 95%. The project followed the defined requirement throughout the monitoring period, and the measurements have been carried out periodically as the PDD requires. The confidence level required for the data is 95% according to the methodology, and the precision range of the measurements was taken as ±10%, according to the relevant tool[4].

The fraction of methane in the biogas was determined through a sampling effort taking place continuously year round. The goal is to measure the fraction on a weekly basis. However, the exact measuring frequency and measurement points vary largely as they are also determined by the process requirements.

The amount of measurements required was estimated using measurements from previous monitoring periods to evaluate the process characteristics. As part of the verification, the gathered measurements were evaluated to confirm that it indeed fulfils the required confidence/precision criteria. Both the sample size estimation and the confirmation that the data gathered is sufficient are available in the project CDM-monitoring Excel-file. The resulting methane fraction in the biogas is 0.5895, with 95% certainty and precision.

[4] http:// cdm.unfccc.int/EB/050/eb50_repan30.pdf

E.2. Project emissions calculation

>>

Ex-post project emission from electricity consumption (AMS-III.H)

$PE_{power,y}$ = $EC_y \times EF_{grid}$

Where:

EC_y = Electricity consumption of the project activity in GWh/y

Actual values:

Month	**ID31: EC_y** [MWh]	**Project emission - AMS-III.H** [tCO_{2eq}]
Dec 09	30.22	19.5
Jan 10	19.88	12.8
Feb 10	20.26	13.1
Mar 10	32.80	21.2
Apr 10	32.52	21.0
May 10	24.47	15.8
Jun 10	22.95	14.8
Jul 10	38.47	24.9
Aug 10	21.76	14.1
Sep 10	22.09	14.3
Oct 10	31.64	20.4
Nov 10	26.41	17.1
Dec 10	20.87	13.5
Sum	344.34	222.4

The total amount of Project Emissions during this monitoring period is therefore **222.4 tCO_{2eq}** Furthermore, the used quantity of the final sludge has to be monitored. Sludge removed from the system is applied as fertilizer to the surrounding land. So there are no additional project emissions by the usage of the final sludge. Parameter "ID 33 End use of final sludge" has been defined in the new monitoring plan as proof evidence.

E.3. Leakage calculation

>>

Since the used technology does not involve equipment transferred from another activity and the existing equipment is not transferred to another activity, no leakage needs to be considered.

E.4. Emission reductions calculation / table

>>

Total emission reduction (ex-post)

The calculation of emission reductions shall be based on the amount of methane recovered and fuelled or flared that is monitored ex-post, considering also emission reductions from power and heat generation minus the electricity consumption from the project activity. By monitoring the above parameters the total emission reductions can be calculated ex-post according to:

ER_y = $ER_{MD,y} + ER_{thermal,y} + ER_{power,y} - PE_{Power,y}$

ER_y = Emission reductions in tCO_{2eq}/y

ER_{MDy} = Emission reductions from the CH4 combusted and destroyed as fuel and flared in tCO_{2eq}/y

$ER_{thermal,y}$ = Emission reductions due to displacement of bunker fuel for the generation of heat in tCO_{2eq}/y

$ER_{power,y}$	=	Emission reductions due to displacement of electricity in tCO_{2eq}/y
$PE_{power,y}$	=	Project emissions due to electricity consumption in tCO_{2eq}/y

According to the general equation

$$ER_y = BE_y - (PE_y + L_y)$$

Emission reduction = Baseline emissions$_{total}$ *– (Project emissions + Leakage)*

The emission reduction according to AMS-III.H is therefore given through the baseline emissions due to recovered and destroyed methane minus project emissions due to electricity consumption of the biogas recovery equipment:

AMS-III.H

Baseline emissions	45,946.0	[t CO2eq]
Project emissions	222.4	[t CO2eq]
Leakage	0	[t CO2eq]
Emission reduction	45,723.6	[t CO2eq]

The emission reduction according to AMS-I.C is therefore given through the baseline emissions due to replaced grid electricity and bunker replacement.

AMS-I.C

Baseline emissions	2,272.4	[t CO2eq]
Project emissions	0	[t CO2eq]
Leakage	0	[t CO2eq]
Emission reduction	2,272.4	[t CO2eq]

Summary of emission reduction:

Total Baseline emissions	48,218.4	[t CO2eq]
Total Project emissions	222.4	[t CO2eq]
Total Leakage	0	[t CO2eq]
Total Emission reduction	47,996.0	[t CO2eq]

The emission reductions for the period which is covered by this monitoring report is therefore 47,996.0 tCO2eq.

The final amount of CERs calculated has been conservatively rounded down.

E.5. Comparison of actual emission reductions with estimates in the CDM-PDD

>>

Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reductions (tCO_2e)	32,529[5] tCO2eq.	47,996.0 tCO2eq.

E.6. Remarks on difference from estimated value in the PDD

[5] Adjusted to the period covered by the MR.

>>
The ex-ante calculations are done using IPCC default values, estimating a typical anaerobic digestion. However, the climate conditions in Honduras are favourable for this biological process, and the actual efficiency of the bio-digesters proved to be higher than predicted by the model.

- - - - -

History of the document

Version	Date	Nature of revision
01	EB 54, Annex 34 28 May 2010	Initial adoption.
Decision Class: Regulatory **Document Type**: Guideline, Form **Business Function**: Issuance		