Monitoring report form

(Version 04.0)

Complete this form in accordance with the Attachment "Instructions for filling out the monitoring report form" at the end of this form.

MONITORING REPORT	
Title of the project activity	Introduction of the recovery and combustion of methane in the existing sludge treatment system of the Cañaveralejo Wastewater Treatment Plant of EMCALI, in Cali, Colombia
Reference number of the project activity	2341
Version number of the monitoring report	01
Completion date of the monitoring report	31/07/2014
Registration date of the project activity	15/09/2009
Monitoring period number and duration of this monitoring period	Period 2 01/11/2012 – 31/12/2013
Project participant(s)	EMCALI Empresas Municipales de Cali EICE E.S.P
Host Party(ies)	Colombia
Sectoral scope and selected methodology(ies), and where applicable, applied standardized baseline(s)	Scope: 13 Handling and waste disposal Methodology: Wastewater treatment methane recovery (AMS III.H, Version 09, Scope 13, march 28, 2008
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	68185.4 tCO2e tCO2e[1]
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	46,618.7 tCO2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks	5,524.6 tCO2e[2]

[1] Estimated amount of GHG emission reductions for the current monitoring period (426 days) based on average annual estimation of CER's as per the registered PDD

[2] Actual GHG emission reductions achieved during the period from November 1, 2012 up to December 31,2012

achieved during the period up to 31 December 2012(if applicable)	
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period from 1 January 2013 onwards (if applicable).	41,090.7 tCO_2e[3]

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The activity of the proposed Clean Development Mechanism (CDM) small- scale project is the capture and high efficiency combustion of methane, present in biogas generated during the process of treatment of sludge in the Wastewater Treatment Plant (WWTP), located in Cali, Colombia. Methane is burned in the internal high efficiency combustion engines of the electric generator.

The owner and operator of the proposed project activity is EMPRESAS MUNICIPALES DE CALI EMCALI EICE ESP. The EMCALI mission is to contribute to the well-being and the development of the Cali community through the provision of essentials and complementary public services, committed with the environment and guaranteeing social and economic profitability. Among the services provided by EMCALI are telecommunications, water, electricity and sewer services.

The plant was designed by NITOGOI and constructed by Degremont-Mitsubishi-Conciviles-Norbert Odebrecht, consortium contracted by EMCALI. The PTAR-C is designed to operate with an average flow of 7.6 m^3/s from wastewaters generated by the city of Cali. The construction of PTAR-Cañaveralejo was started on August 10 1997, and on December 26 2002, EMCALI received the plant in operation.

The project activity WWTP-Cañaveralejo contributes to the principle "Contribution to the long-term improvement of the social and economic wellbeing of local communities and society in general" due to contributes to its commitment to invest in programs of protection of the environment.

The Project was registered on September 15, 2009 with a 10-year fixed crediting period. Emcali requested post-registration changes to the start date of crediting period to UNFCCC, which was approved by the Executive Board of UNFCCC, and accordingly, the start date of crediting period was set forth as of September 14, 2010 until September 13, 2020.

The total emission reductions achieved in the monitored period between September 14, 2010 and October 31, 2012 were 71312 ton CO2e.

A.2. Location of project activity

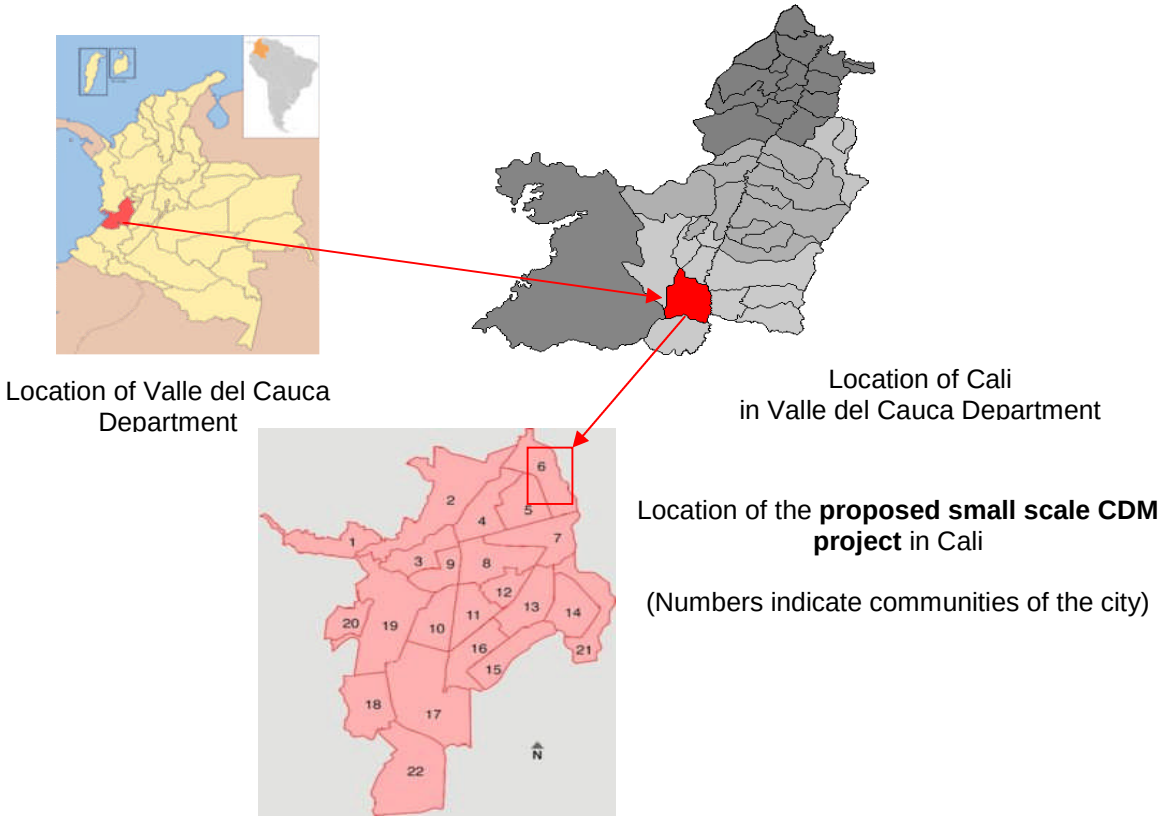
The project activity is located in the Wastewater Treatment Plant, Cañaveralejo, (WWTP-C), located in the northeast of Cali in the department of Valle del Cauca, Republic of Colombia. The Plant has a total area of 22 hectares, at the following geographical coordinates:

3 ° 28 '10.06538 "North, 76 ° 28' 44.03571" West

The WWTP is located 995 meters above sea level. Locally, the WWTP- Cañaveralejo is located in the commune 6 in the Petecuy I neighbourhood of Cali.

[3] Actual GHG emission reductions achieved during the period from January 1, 2013 up to December 31,2013

Figure 1. Geographical location of the proposed project



Picture 1: Wastewater Treatment Plant (WWTP) – Cañaveralejo, Cali, Colombia

A.3. Parties and project participant(s)

Party involved ((host) indicates 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)
Colombia	Empresas Municipales de Cali EMCALI EICE ESP (mixed private/public) entity)	No

A.4. Reference of applied methodology and standardized baseline

Recovery of methane in the Wastewater Treatment (AMS III.H, Version 09, Scope 13, March 28, 2008

Title
Recovery of methane in the Wastewater Treatment Plant

Reference
Appendix B of the simplified modalities and procedures for CDM project activities of small scale (UNFCCC, 2005).
Recovery of methane in the treatment of wastewater (AMS III.H). Version 09, Scope 13, March 28, 2008

A.5. Crediting period of project activity

Type: Fixed

Start date of crediting period: It relates to the registration date of the CDM project: 15/09/2009
The project participant requested post-registration changes to the start date to UNFCCC, which was accepted by the Executive Board of UNFCCC, and accordingly, the starting date of crediting period was set as of 14 September 2010

Choice of Crediting Period	: Fixed crediting period for 10 years
Crediting Period	: 14/09/2010 - 13/09/2020
Second Monitoring period	: 01/11/2012 - 31/12/2013

A.6. Contact information of responsible persons/ entities

See Appendix 1

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

Recovery and combustion of methane in the project has been implemented in accordance with the established in the approved Project Design Document (PDD)

All the physical characteristics of the proposed CDM project activity, including the systems of data collection and storage has been carried out in accordance with the registered Project Design Document (PDD).

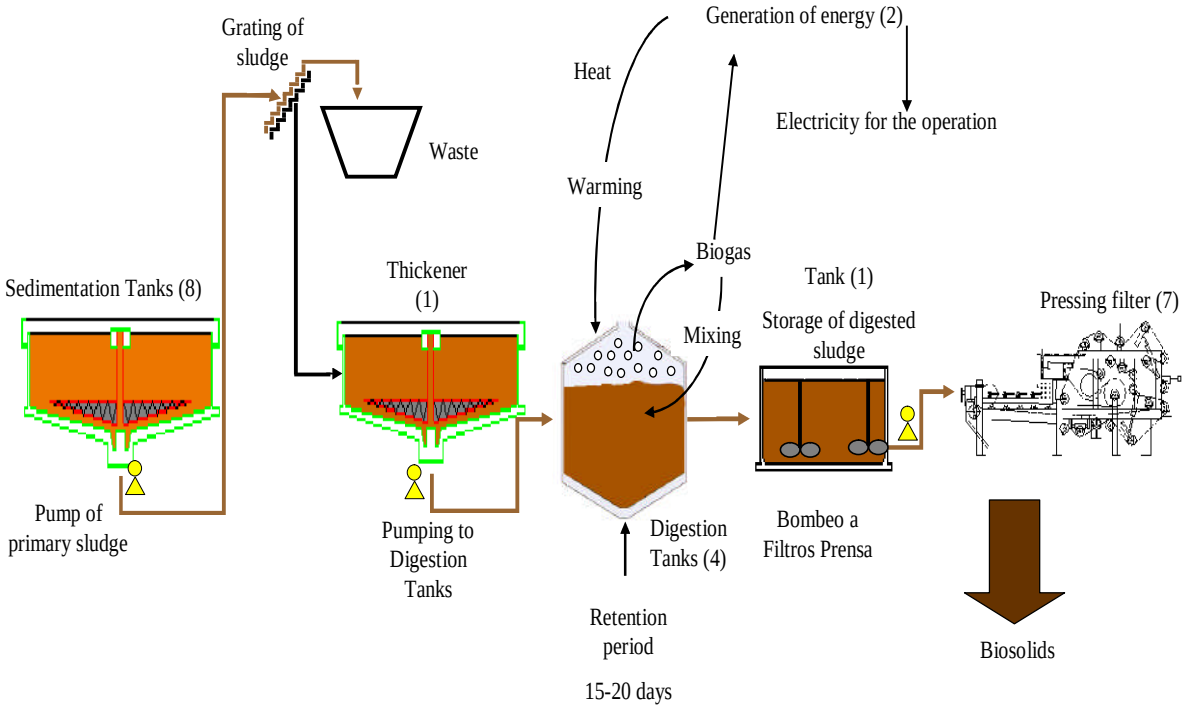
The project activity involves methane capture and combustion, present in the biogas generated during the sludge treatment process of the Wastewater Treatment Plant of Cañaveralejo.

The technology used for the proposed project is based on the collection of biogas, storage, purification and methane combustion in the electric power generation system.

During the primary treatment of wastewater from Cali, carried out in the WWTP- Cañaveralejo, sludge are composed of organic matter and are produced in eight sedimentation tanks which are then taken to the thickener tank. Sludge is transported to four anaerobic digestion tanks (digesters) in order to obtain a stable final product free of pathogenic microorganisms present in the untreated sludge. Anaerobic digestion in addition to sludge stabilization generates biogas with high methane content (between 57% and 65%) according to the reported analysis by the WWTP- Cañaveralejo.

The generated biogas in the anaerobic sludge digesters passes through the purifier with continuous regeneration, which uses a bed of iron oxide as an active mean for separating the hydrogen sulfur. The supporting mean of the iron oxide particles are sawdust. As the biogas is passed through the purifier, the hydrogen sulfide gas contained therein, is removed by the reaction with the iron oxide to form ferric sulfide .In the continuous regeneration system, a small amount of air(less than 5% of total flow) is added to the gas stream to regenerate the medium. The effluent gas has a hydrogen sulfide concentration of less than 10 ppm

Figure 2. Sludge treatment line WWTP - Cañaveralejo



The implemented technology in the CDM project activity is described below:

Equipment of the technology implemented in the CDM project activity for the capture and combustion of methane are:

- Gas storage tanks
- Gas dehumidifier
- Gas engine of the electric generator.
- Biogas flares
- Water heater

The captured gas is stored in two cylindrical metal tanks and subsequently burned in the internal combustion generators and alternately is burned in the flares or water heater. Each generator is a three-phase type, the WWTP- Cañaveralejo has two motor-generator to work, high efficiency, 12 V-type cylinder: 4 times, 4 valves per cylinder capable of transmitting 1053,5 KW at rpm. Before introducing the gas in the generator engines, the gas passes through the dehumidifier, which allows the biogas moisture stabilization by optimizing the combustion process. With the purpose of optimizing the processes in the plant, the water from the engine cooling is used to maintain the water temperature that is used in the digesters exchangers (between 33 ° C to 35°C), this allows to control the optimal thermal conditions for the anaerobic digestion. In case the generation system has flaws, the biogas is burned in the water heater, which in this case, is expected to maintain the water temperature in the digesters exchangers.

The following are some basic technical specifications of the storage tanks, dehumidifier, engine of electric generator, flares and water heater.

Gas storage tanks:

Quantity:	2
Volume:	1000 m3
Diameter:	12.5 meters
Height:	13 meters
Lifetime:	5 years (estimated according to the manufacturer's recommendation)

Gas Dehumidifier:

Quantity:	1
Inlet temperature:	30 °C
Inlet hygrometry:	100%
Flow:	1.000 Nm3
Pressure abs:	1033 mbar
Lifetime:	5-7 years (according to the Project design information.)

Engines of electric generator:

Model:	WAUKESHA L-7042GL or equivalent
Type:	engine with the gas pre - chamber, 4 strikes, 4 valves
Quantity:	2 sets
Operation:	Automatic
No cylinders:	V-12
Velocity:	1200 rpm approx.
Fuel consumption:	450 – 500 m³/h of biogas
Lifetime:	20 year approximately (according to the Project design information).

Gas Flare

Brand:	HAAT
Model:	FL550
Quantity:	2
Power:	2.2 kW (gas booster), 1.1 kW (Ventilator)
Operation:	Automatic with the biogas level in the gas storage tank
Flow:	550 m³/ h
Lifetime:	20 years and more (according to the Project design information).

Water heater:

Brand:	KAYANSON-DRAGON SHELL
Model:	D5
Quantity:	1
Capacity:	1.200 Mcal/ h
Lifetime:	25 years (according to the information obtained by the manufacturer)

B.2. Post registration changes

B.2.1. Temporary deviations from registered monitoring plan, applied methodology or applied standardized baseline

B.2.2. Corrections

Not applicable for this monitoring period

B.2.3. Permanent changes from registered monitoring plan, applied methodology or applied standardized baseline

Not applicable for this monitoring period

B.2.4. Changes to project design of registered project activity

Not applicable for this monitoring period

B.2.5. Changes to start date of crediting period

There was a change to start date of crediting period, which, initially, related to the registration date of the CDM project N° 2341 i.e. September 15 2009. Subsequently, the project participant requested a post-registration change to UNFCCC, which was accepted by the Executive Board of UNFCCC, and therefore, the start date of crediting period was set as of September 14, 2010.

The date of notification of change of date of the crediting period of the CDM project 2341 by UNFCCC addressed to Emcali was on June 7, 2011 via email

B.2.6. Types of changes specific to afforestation or reforestation project activity

Not applicable for this monitoring period

SECTION C. Description of monitoring system

During the second period of monitoring the CDM project N° 2341 presented some periods of time without data of monitoring due to stops and other internal variables the WWTP-C Emcali, these activities will be explained by the WWTP-C Emcali to the Designated Operational Entity when considers relevant

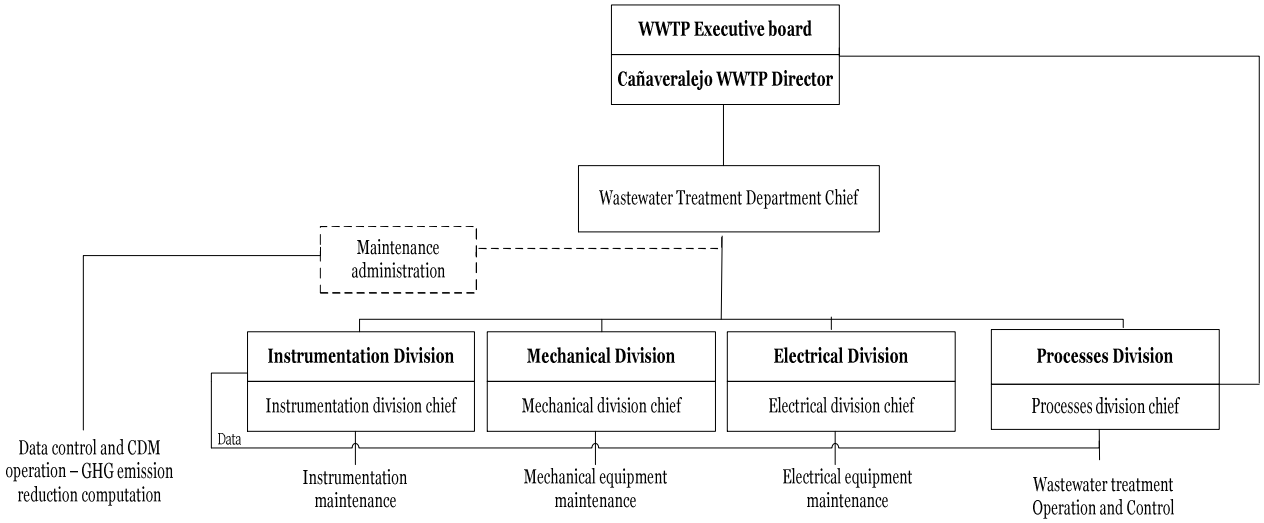
Specified parameters according to the registered PDD document have been controlled and monitored using calibrated measuring equipment according to the technical specifications provided by the manufacturer or by the certified laboratories.

In order to manage CDM projects WWTP- Cañaveralejo, the direction of the WWTP-C assigned to the Maintenance Management Division as a technical support from control activities, monitoring and results calculation of the CDM project activity.

1. Organizational Structure of the monitoring system

The CDM Project Management Structure is shown in Figure 3 below.

Figure 3. Monitoring Plan Organizational and Management Structure



1.1 Direction of WWTP - Cañaveralejo

Direction of WWTP- Cañaveralejo is responsible for:

- Administrative direction and monitoring of the CDM projects activities and the monitoring plan of WWTP – Cañaveralejo of EMCALI
- Annual review of performance monitoring plan and approval of changes from the monitoring plan in case they are required.
- Approval of the annual calculations of GHG reductions made by the Maintenance management Division.

1.2 Instrumentation Division

Instrumentation division is responsible for:

- Maintenance of control and instrumentation equipment of the WWTP-C, including the maintenance of the Control system and Data Acquisition - SCADA,
- Preparation of the annual program of preventive and corrective maintenance of the WWTP-C instruments
- Preparation of a weekly schedule of preventive and corrective maintenance of the WWTP-C instruments
- Review and approval of work orders by the Chief of instrumentation Division
- Archives of work orders for a period of 10 +2 years in instrumentation office.
- Supervision and control of the operation of the data servers, as well as monitoring and supervision of the maintenance activities SCADA hired through an outsourced service.

1.3 Process Division

The process division is responsible for the following activities:

- Preparation of monthly reports of the results of the plant operations.
- Operate and control the process of the Wastewater treatment.

With regard to the CDM management projects WWTP-Cañaveralejo, the WWTP-C direction assigned to the Maintenance Management Division as support and technical support in activities control, monitoring and calculations results of the CDM project activity.

The Maintenance Management Division is responsible for:

- Computation of GHG emissions reduction of the two CDM projects and presentation to the WWTP-C direction for approval.
- Storage and control of computation and the results of GHG emission reductions of CDM projects in the servers' database from the control system located in the control room of the WWTP-C for a period of 10 + 2 years on magnetic media.

- Control and monitoring of statistical techniques and management trends applied to the variables of the monitoring plan of the two CDM projects.

1.4 Mechanical Division

The Mechanical Division is responsible for the following:

- General maintenance of mechanical equipment of WWTP-Cañaveralejo
- Preparation of the annual program of WWTP-C mechanical equipment maintenance
- Preparation of a weekly schedule of WWTP-C mechanical equipment maintenance.
- Review and approval of work orders by the mechanical division chief and subsequent delivery of orders to the maintenance management division.
- Archives of work orders for a period of 10 +2 years in instrumentation office.

1.5 Electrical Division

Electrical division is responsible for the following:

- General maintenance of the plant electrical equipment (preventive, corrective and predictive).
- Generators operation and maintenance.
- Preparation of the annual WWTP-C program electrical equipment maintenance.
- Preparation of a weekly schedule of the WWTP-C electrical equipment maintenance
- Review and approval of work orders by the Electrical division chief and subsequent delivery of maintenance orders of maintenance management division
- Archives of work orders for a period of 10 +2 years in the electrical division office.

2. Procedure of WWTP- Cañaveralejo staff training

The WWTP-C staff training method according with the operation, maintenance, calibration and project equipment monitoring activity is as follows:

Suppliers, who provide equipment, instruments and systems to WWTP-C, have to adapt staff training to the WWTP-C technical staff according to the operation and / or maintenance.

The training is considered appropriate when the trained staff shows the sufficient skills to operate the equipment.

3. **Control System description and data acquisition – SCADA**

SCADA is the acronym in English, "Supervisory Control and Data Acquisition.

SCADA is a set of software (system) that are intended for the collection of information, usually in real-time in order to provide feedback on a process development under controlled conditions. SCADA is the tool that supports the proper functioning of the system and the WWTP-C process and therefore contributes to generate stable biogas as well as its capture and combustion.

The SCADA of the Wastewater Treatment Plant of Cañaveralejo (WWTP-C) is formed by the following three levels:

a) Field level:

This level constitutes the set of measuring instruments installed in the processing lines, which, by nature, measure different measurement variables. On the other hand, values are sent by wiring to their field installed transmitters. The transmitters have a local display panel of the measure and they are responsible for interpreting the sent values by the sensor and to display the result on the screen, and they also convert digital signals into a voltage signal and analogue signals into electrical current signals from 4 to 20 mA.

b) Level of electrical and control rooms:

This level is made up of 5 electrical control rooms located on 5 strategic divisions of the plant (Water or elevation, Settlers, Digesters, Dehydration and generation) in each electrical and control room there is a Programmable Logic Controller PLC and a View panel or computer control. The PLC receives via a copper cable the signals from the field transmitters. The Signals depending on their digital or analogous nature

reach the PLC to input or analogue cards respectively. The PLC's are responsible for converting the voltage or current signals received in its input cards in numerical values of the process variables measured in the field. The interpreted values in the PLC's are sent to two servers in a HMI (Human Machine Interface) application, through an Ethernet network built on a dual fibre optic ring that runs the plant. Local view panel with an HMI application allow monitoring and control of treatment processes.

c) Level of main control room:

This level is formed by two HMI application servers (redundantly one of the other) that allows monitoring and equipment control and treatment variables. There are also two database servers (redundantly one of the other) with ORACLE installed manager and computers or workstations located in the control room.

The HMI (Human Machine Interface) application included on control servers SCADA is charge of handles stored in servers ORACLE database, in the form of trends, process variables measures at the field level and translated by the PLC in numerical values. These trends keep instantaneous values measured in the field in intervals of 30 seconds, for a period of 3 months. Its main function is to allow the operator and its respective chief, daily operating decisions. The workstation has developed a program in Microsoft Excel in order to control the CDM variables which automatically averages by hour the instantaneous values stored in a trend form of the monitoring variables that correspond to the CDM project ID (Shift Energy) and IIIH (methane recovery and incineration). These average hourly values calculated by the program from the trend data are stored by this, in the CDM report tables which exist on the CDM servers in the SCADA database
.
As this project is connected with another activity from the CDM project "Displacement of the electricity of the national electric grid by the auto-generation of renewable energy in the Cañaveralejo Wastewater Treatment Plant (WWTP-C) of EMCALI in Cali, Colombia" (Reference 2285),the measures related to electric engines generators also appear as monitored parameters in the project mentioned above.

Through the SCADA system, the operation information is collected, stored, processed and controlled.

Table1. Parameters collected parameters by the SCADA

Parameter		Unit	Frequency of Collection of data
fVCH4G,h fVCH4FG,h fVCH4H,h	Volumetric fraction of methane in biogas fed into the engines of the electric generators or combusted in flares and/or water heater	µ V/V	Continuous
$T_{,GH}$ $T_{,RGh}$ $T_{,Hh}$	Temperature of biogas fed into the engines of the electric generators, flared and/or combusted in water heater	°C	Continuous
P,G,h P,RGh P,Hh	Pressure of biogas fed into the engines of the electric generators, flared and/or combusted in water heater	mbar	Continuous
FVG,h FVRG,h FVH,h	Volumetric flow rate of biogas fed into the engines of the electric generators, flared and/or combusted in water heater	m3/h	Continuous
T,flare	Temperature of the exhaust gas of the flares	°C	Continuous

3.1 SCADA Stability and Security Aspects

SCADA stability is offered by having redundancy from the level of electrical and control rooms. From this level redundancy is manifested by the double fibre optic ring which goes through the plant communicating PLC's and workstations so that they work as a system. The panel views installed in each electrical room allow control of the entire plant becoming redundant one of the others.

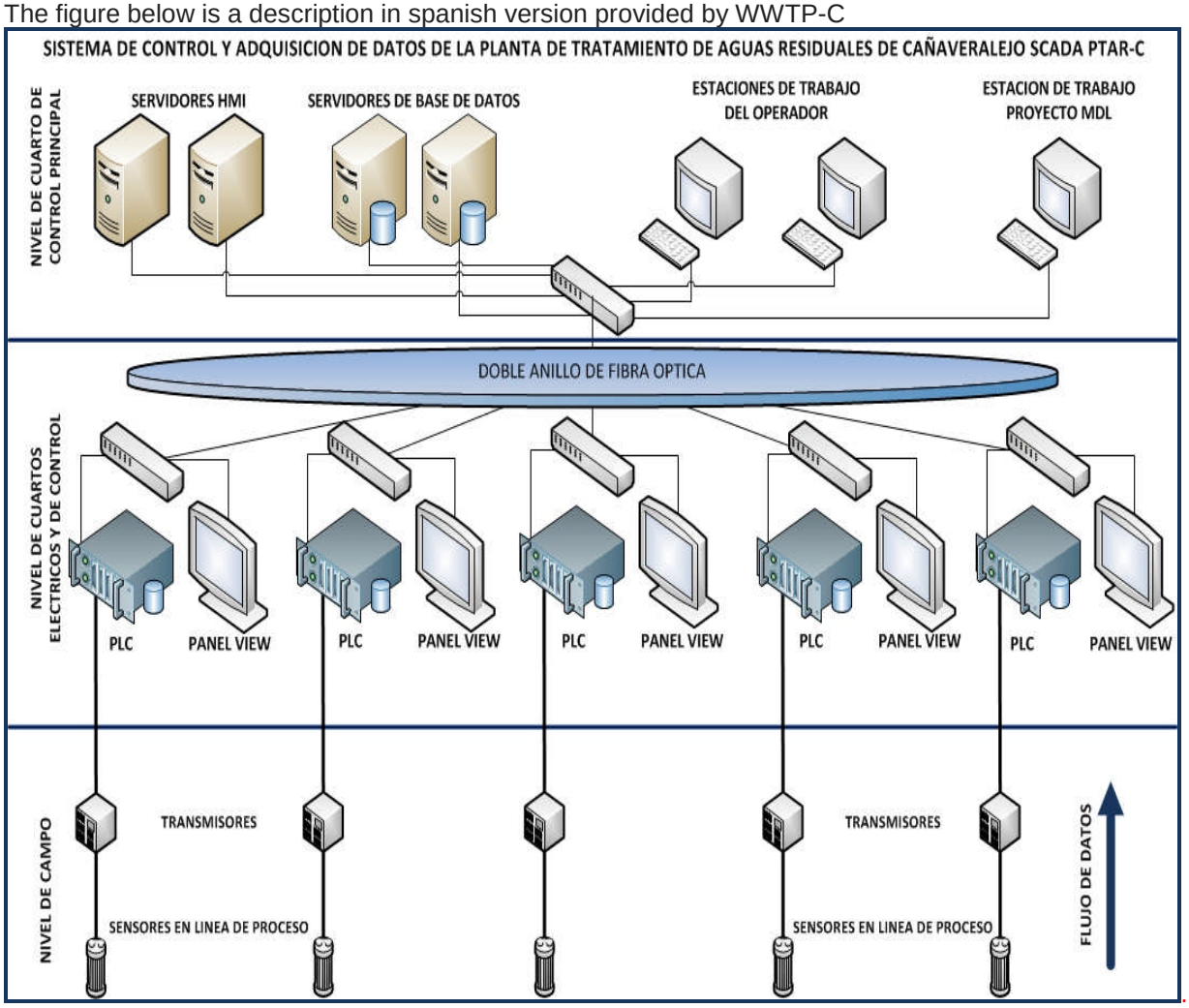
In the main control room the redundancy in HMI (Human Machine Interface) servers and redundancy in the database servers. In case one of the servers failure the other assumes the workload automatically. Once the server resets this fault automatically synchronizes again with the one in service and continues its normal operation. This applies to both applications HMI (Human Machine Interface) servers as the database server. Each server has inside an array of RAID 5 Array (HDD) hard drives which also allow replacement of hard drives. Each server has a dual power supply.

As for the security of SCADA the HMI (Human Machine Interface) application can be accessed only by entering specified username and password for each operator. This application offers various levels of access according to user profiles.

User activity in the system is recorded by an event registration. For databases and registered data themselves we must say that the ORACLE database can only be accessed with username and password. The data is written to the database only by the HMI (Human Machine Interface) application automatically and by the Microsoft Excel program. These have an encrypted code in their user name and password that allows them to fulfil their function. Users access to these programs, as mentioned above, entering a username and password.

Figure 4. Data control system of WWPT-Cañaveralejo

The figure below is a description in spanish version provided by WWTP-C

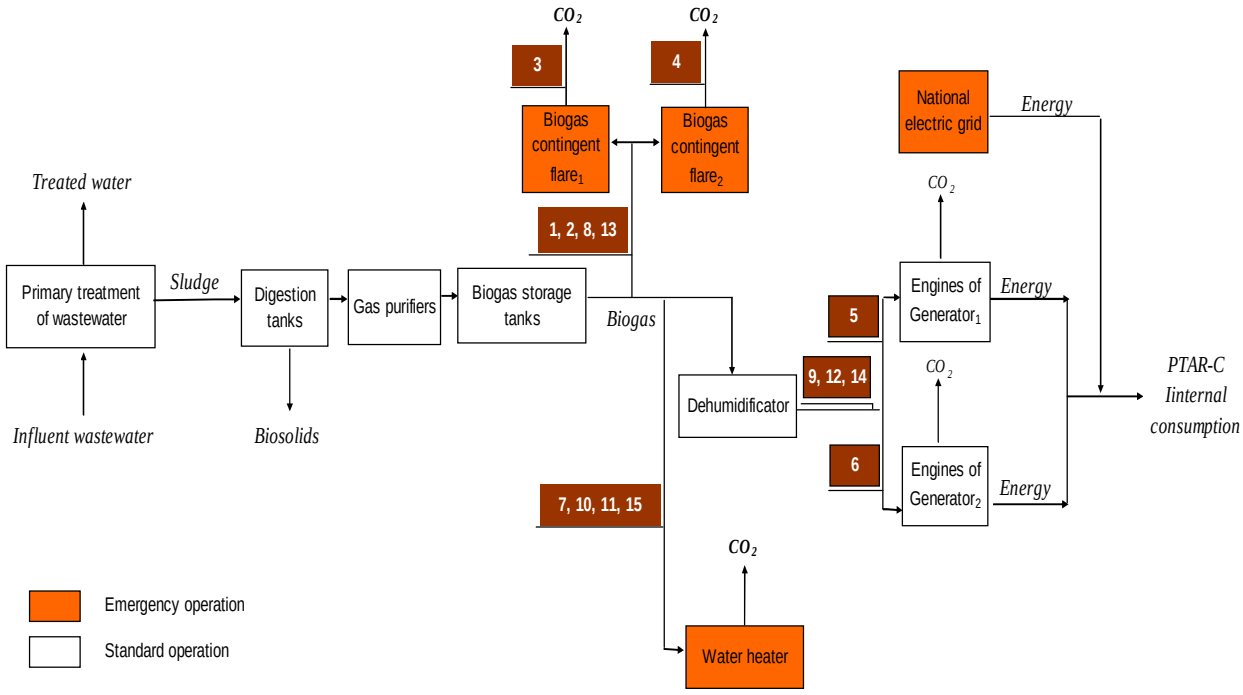


SECTION D. Data and parameters

The monitored parameters are described below:

1.	$fv_{CH4,FG,h}$:	Average volumetric fraction of methane in biogas (μV/V) combusted in flares (μV/V)
2.	$FV_{RG,h}$:	Volumetric biogas flow rate carried for combustion in the flare (m3/h)
3 and 4	T_{flare}:	Temperature in the exhaust gas of the flares (°C)
5 and 6	$FV_{G\ h}$:	Volumetric biogas flow rate carried to the engines of the electric generators (m^3/h).
7.	$FV_{H,h}$:	Volumetric biogas flow rate carried for combustion in water heater (m^3/h) .
8.	$T_{RG,\ h}$:	Temperature of biogas flared (°C)
9.	$T_{G,h}$:	Temperature of biogas fed into the engines of the electric generators (°C)
10.	$T_{,H,\ h}$:	Temperature of biogas fed into the water heater (°C)
11.	$FV_{CH4\ H,\ h}$:	Average volumetric fraction of methane in biogas combusted in water heater (μV/V)
12.	$FV_{CH4,G,H}$:	Average volumetric fraction of methane in biogas fed into the engines of the electric generators (μV/V)
13.	$P_{,RG,h}$:	Pressure of biogas flared (mbar)
14.	$P_{,G,h}$:	Pressure of biogas fed into the engines of the electric generators (mbar)
15.	$P_{H,\ h}$:	Pressure of biogas fed into the water heater (mbar)

Figure 5: Diagram of control parameters of CDM Project No. 2341 (Recovery and combustion of methane)



1. The Quality Assurance and Quality Control.

All monitoring equipment are calibrated according to the manufacturer's suggestions. The frequency of calibration is carried out according to the manufacturer's instruction, therefore the calibration activity and / or verification of each monitoring equipment ensures that the equipment operates at the indicated level of accuracy.

D.1. Data and parameters fixed ex ante or at renewal of crediting period

Data / Parameter:	GWP_{CH4}
Unit:	-
Description:	Methane Global-Warming Potential
Source of data:	Climate Change mitigation Climate Change 2014 – WGR Report AR5 -IPCC
Value(s) applied):	23
Purpose of data:	Used for calculation of baseline and project
Additional comment:	-

Data / Parameter:	D_{CH4}
Unit:	kg/m3
Description:	Methane Density
Source of data:	Tool to determine project emissions from flaring gases containing methane Refer to UNFCCC Annex 13 Defined in the methodological tool EB-68 Annex 15 CDM UNFCCC – Table 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied):	0.7168
Purpose of data:	Baseline and Project
Additional comment:	-

D.2. Data and parameters monitored

Data / Parameter:	$fv_{CH4FG,h}$
Unit:	µV/V
Description:	Volumetric fraction of methane in biogas fed into flares
Measured/ Calculated / Default:	Measured
Source of data:	Continuous flow meter. The measurement location is shown in Figure 5. Measurement Point 1
Value(s) of monitored parameter:	See data table - spreadsheets
Monitoring equipment:	Type: Infrared methane concentration meter Series Number: Transmitter Beacon 110 Serial B110-11Z004 Sensor 65-1011RK-CH4 Serial 7551 Calibration frequency: According to the suggestion made by the manufacturer (every year) Calibration date: 1st calibration: June 01, 2012 RBI Beacon 2nd calibration: July 24, 2013 Precision Range: ± 5 % Reading, ± 2% complete scale
Measuring/ Reading/ Recording frequency:	Continuously Monitored, Daily recording
Calculation method (if applicable):	-

QA/QC procedures:	**Quality Guarantee:** given by the equipment manufacturer. The data is stored digitally in the SCADA. The meter is operated and calibrated according to the manufacturer's specifications **Calibration:** every year, time specified by the manufacturer for this equipment. Data is stored electronically/digitally through SCADA and stored for the duration of the project + 2 years Security system is guaranteed by a multilevel password **Preventive Maintenance:** There are routine/prevention, cleaning or review records of the equipment every 15 days, which are stored in the folder named "OT Mantenimientos Equipos MDL" **Quality Control:** All evidence of maintenance performed by the PTAR-C personnel is stored in AQUAMAINT (Electromechanical Maintenance Administrator), at least during 10 + 2 years in magnetic media. Hard copies will be stored by the respective WWTP-C Division Chief at least for 10 + 2 years **Meter general technical specifications**: Precision: ± 5% reading ± 2% complete scale Ranges: From 0 to 100% V/V methane Sensor Type: Infrared Recording Frequency: Continuously Data Record: Electronic for the crediting period + 2 years
Purpose of data:	Project
Additional comment:	-

Data / Parameter:	$FV_{RG,h}$:
Unit:	m^3/h
Description:	Volumetric flow rate of biogas fed into flares
Measured/ Calculated / Default:	Measured
Source of data:	Continuous flow meter. The measurement location is shown in Figure 5. Measurement Point 2.
Value(s) of monitored parameter:	See data table - spreadsheets
Monitoring equipment:	Type: Thermal dispersion mass flow Series Number : D907E202000 Calibration frequency: According to the suggestion made by the manufacturer (every 5 years). Calibration date: 1st calibration: October 18, 2010 1st verification: November 22, 2011 2nd verification: December 13, 2012 3th verification: November 25,2013 Precision Range : ± 1 % maximum range
Measuring/ Reading/ Recording frequency:	Continuously monitored and daily recording
Calculation method (if applicable):	-

QA/QC procedures:	**Quality Guarantee:** given by the equipment manufacturer. The data is stored digitally in the SCADA. The meter is operated and calibrated according to the manufacturer's specifications. **Calibration:** every 5 years, time specified by the manufacturer for this equipment. Data is stored electronically/digitally through SCADA and stored for the duration of the project + 2 years Security system is guaranteed by a multilevel password **Preventive Maintenance:** There are routine/prevention, cleaning or review records of the equipment every 15 days, which are stored in the folder named "OT Mantenimientos Equipos MDL" **Quality Control:** See statistics in SCADA All evidence of maintenance performed by the PTAR-C personnel is stored in AQUAMAINT (Electromechanical Maintenance Administrator), at least during 10 + 2 years in magnetic media. Hard copies will be stored by the respective WWTP-C Division Chief at least for 10 + 2 years **Meter general technical specifications**: Precision: ± 1% reading + 0.5% at complete scale standard precision Repeatability: ± 0,4% reading for speeds close to 1.0 m/s (3.3 ft/s) Flow Margin: from 29 to 2,900 Nm3/h a 0°C, 1.013 bar Operation Temperature: Process temperature 15°C to +50 °C Recording Frequency: Continuously Data Record: Electronic for the crediting period + 2 years
Purpose of data:	Project
Additional comment:	-

3

Data / Parameter:	T_{flare1}
Unit:	°C
Description:	Temperature in the exhaust gas of the flares to determine combustion efficiency in flare 1
Measured/ Calculated / Default:	Measured
Source of data:	Continuous flow meter. The measurement location is shown in Figure 5. Measurement Point 3
Value(s) of monitored parameter:	See data table - spreadsheets
Monitoring equipment:	Type: Thermocouple Type K Series Number: Thermocouple Model : TC10-HBA3CDSXCA200 Serial: D9002214168 Indicator RIA45-A1A1 Serial D9011704373 Calibration Frequency: According to the suggestion made by the manufacturer (every 5 years). Calibration date: 1st calibration: September 19, 2012 2nd calibration: September 19, 2013 Precision Range: ± 0,75%
Measuring/ Reading/ Recording frequency:	Continuously monitored and daily recording
Calculation method (if applicable):	-

QA/QC procedures:	**Quality Guarantee:** given by the equipment manufacturer. The data is stored digitally in the SCADA. The meter is operated and calibrated according to the manufacturer's specifications. **Calibration:** every 5 years, time specified by the manufacturer for this equipment. Data is stored electronically/digitally through SCADA and stored for the duration of the project + 2 years Security system is guaranteed by a multilevel password **Preventive Maintenance:** There are routine/prevention, cleaning or review records of the equipment every 15 days, which are stored in the folder named "OT Mantenimientos Equipos MDL" **Quality Control:** All evidence of maintenance performed by the PTAR-C personnel is stored in AQUAMAINT (Electromechanical Maintenance Administrator), at least during 10 + 2 years in magnetic media. Hard copies will be stored by the respective WWTP-C Division Chief at least for 10 + 2 years **Meter general technical specifications**: Precision: ± 0.75 °C Temperature Ranges: -40°C a 1,200 °C Recording Frequency: Continuously The thermocouple measures the temperature of the exhaust gas flow in the flare. A temperature higher than 500°C indicates a significant amount of gas still flaring and that the flare is still operating. An excessive high temperature in the monitoring point (higher than 700 ° C) may indicate that the flare is not being properly operated or its capacity is not adequate for the current flow.
Purpose of data:	Project
Additional comment:	-

Data / Parameter:	T_{flare2}
Unit:	°C
Description:	Temperature in the exhaust gas of the flare required to determine the combustion efficiency in flare 2
Measured/ Calculated / Default:	Measured
Source of data:	Continuous flow meter. The measurement location is shown in Figure 5. Measurement Point 4
Value(s) of monitored parameter:	See data table - spreadsheets
Monitoring equipment:	Type: Thermocouple Type K Series Number: Thermocouple Model TC10-HBA3CDSXCA200 Serial: D9002314168 Indicator RIA45-A1A1 Serial D9011604373 Calibration Frequency: According to the suggestion made by the manufacturer (every 5 years) Calibration date: 1st calibration: August 17, 2011 2nd calibration: September 19, 2012 3th calibration. September 19, 2013 Precision Range: ± 0.75%
Measuring/ Reading/ Recording frequency:	Continuously monitored and daily recording
Calculation method (if applicable):	-

QA/QC procedures:	**Quality Guarantee:** given by the equipment manufacturer. The data is stored digitally in the SCADA. The meter is operated and calibrated according to the manufacturer's specifications. **Calibration:** every 5 years, time specified by the manufacturer for this equipment Data is stored electronically/digitally through SCADA and stored for the duration of the project + 2 years Security system is guaranteed by a multilevel password **Preventive Maintenance:** There are routine/prevention, cleaning or review records of the equipment every 15 days, which are stored in the folder named "OT Mantenimientos Equipos MDL". **Quality Control:** All evidence of maintenance performed by the PTAR-C personnel is stored in AQUAMAINT (Electromechanical Maintenance Administrator), at least during 10 + 2 years in magnetic media. Hard copies will be stored by the respective WWTP-C Division Chief at least for 10 + 2 years **Meter general technical specifications**: Precision: ± 0.75°C Temperature Ranges: -40°C to 1,200 °C Recording Frequency: Continuously The thermocouple measures the temperature of the exhaust gas flow in the flare. A temperature higher than 500 °C indicates a significant amount of gas still flaring and that the flare is still operating. An excessive high temperature in the monitoring point (higher than 700 ° C) may indicate that the flare is not being properly operated or its capacity is not adequate for the current flow
Purpose of data:	Project
Additional comment:	-

Data / Parameter:	$FV_{G1,\ h:}$
Unit:	m^3/h
Description:	Volumetric flow rate of biogas fed into the electric generator engine 1
Measured/ Calculated / Default:	Measured
Source of data:	Continuous flow meter. The measurement location is shown in Figure 5. Measurement Point 5.
Value(s) of monitored parameter:	See data table - spreadsheets
Monitoring equipment:	Type: Thermal dispersion mass flow Series Number : F6103B02000 Calibration Frequency: According to the suggestion made by the manufacturer (every 5 years). Calibration date: The meter of Generator 2 was used 1st calibration: October 18,2010 Subsequently for the equipment of Generator 1 : 1st calibration: June 26, 2012 1st verification: August 22, 2013 Precision Range: ± 1 % of maximum range
Measuring/ Reading/ Recording frequency:	Continuously monitored and daily recording
Calculation method (if applicable):	-

QA/QC procedures:	**Quality Guarantee:** given by the equipment manufacturer. The data is stored digitally in the SCADA. The meter is operated and calibrated according to the manufacturer's specifications. **Calibration:** evey 5 years, time specified by the manufacturer for this equipment Data is stored electronically/digitally through SCADA and stored for the duration of the project + 2 years Security system is guaranteed by a multilevel password **Preventive Maintenance:** There are routine/prevention, cleaning or review records of the equipment every 15 days, which are stored in the folder named "OT Mantenimientos Equipos MDL". **Quality Control:** See statistics in SCADA All evidence of maintenance performed by the PTAR-C personnel is stored in AQUAMAINT (Electromechanical Maintenance Administrator), at least during 10 + 2 years in magnetic media. Hard copies will be stored by the respective WWTP-C Division Chief at least for 10 + 2 years **Meter general technical specifications**: Precision: ± 1% reading + 0.5% at complete scale standard precision Repeatability: ± 0.4% reading for speeds close to 1.0 m/s (3.3 ft/s) Flow Margin: from 29 to 2,900 Nm3/h a 0°C, 1,013 bar Operation Temperature: Process Temperature 15° C to +50 ° C Recording Frequency: Continuously Data Record: Electronic for the crediting period + 2 years
Purpose of data:	Project
Additional comment:	-

Data / Parameter:	$FV_{G2,h}$:
Unit:	m^3/h
Description:	Volumetric flow rate of biogas fed into the electric generator engine 2
Measured/ Calculated / Default:	Measured
Source of data:	Continuous flow meter. The measurement location is shown in Figure 5. Measurement Point 6
Value(s) of monitored parameter:	See data table - spreadsheets
Monitoring equipment:	Type: Thermal dispersion mass flow Series Number: D907E302000 Calibration Frequency: According to the suggestion made by the manufacturer (every 5 years) Calibration date: 1st calibration: October 18, 2010 1st verification: November 22, 2011 2nd verification: December 13, 2012 3th verification: November 26, 2013 Precision Range: ± 1 % of the maximum range
Measuring/ Reading/ Recording frequency:	Continuously monitored and daily recording
Calculation method (if applicable):	-

QA/QC procedures:	**Quality Guarantee:** given by the equipment manufacturer. The data is stored digitally in the SCADA. The meter is operated and calibrated according to the manufacturer's specifications. **Calibration:** every 5 years, time specified by the manufacturer for this equipment Data is stored electronically/digitally through SCADA and stored for the duration of the project + 2 years Security system is guaranteed by a multilevel password **Preventive Maintenance:** There are routine/prevention, cleaning or review records of the equipment every 15 days, which are stored in the folder named "OT Mantenimientos Equipos MDL" **Quality Control:** See statistics in SCADA All evidence of maintenance performed by the PTAR-C personnel is stored in AQUAMAINT (Electromechanical Maintenance Administrator), at least during 10 + 2 years in magnetic media. Hard copies will be stored by the respective WWTP-C Division Chief at least for 10 + 2 years **Meter general technical specifications**: Precision: ± 1% reading + 0.5% at complete scale standard precision Repeatability: ± 0.4% reading for speeds close to 1.0 m/s (3.3 ft/s) Flow Margin: from 29 to 2,900 Nm3/h at 0°C, 1,013 bar Operation Temperature: Process Temperature 15°C to +50°C Recording Frequency: Continuously Data Record: Electronic for the crediting period + 2 years
Purpose of data:	Project
Additional comment:	-

Data / Parameter:	$FV_{RG,h}$:
Unit:	m^3/h
Description:	Volumetric flow rate of biogas fed into the water heater
Measured/ Calculated / Default:	Measured
Source of data:	Continuous flow meter. The measurement location is shown in Figure 5. Measurement Point 7
Value(s) of monitored parameter:	See data table - spreadsheets
Monitoring equipment:	Type: Thermal dispersion mass flow Series Number : F2037B02000 Calibration Frequency: According to the suggestion made by the manufacturer (every 5 years). Calibration date: 1st calibration: February 07, 2012 1st verification: June 07, 2013 Precision Range: ± 1 % of maximum range
Measuring/ Reading/ Recording frequency:	Continuously monitored and daily recording
Calculation method (if applicable):	-

QA/QC procedures:	**Quality Guarantee:** given by the equipment manufacturer. The data is stored digitally in the SCADA. The meter is operated and calibrated according to the manufacturer's specifications. **Calibration:** every 5 years, time specified by the manufacturer for this equipment. Data is stored electronically/digitally through SCADA and stored for the duration of the project + 2 years Security system is guaranteed by a multilevel password **Preventive Maintenance:** There are routine/prevention, cleaning or review records of the equipment every 15 days, which are stored in the folder named "OT Mantenimientos Equipos MDL". **Quality Control:** All evidence of maintenance performed by the PTAR-C personnel is stored in AQUAMAINT (Electromechanical Maintenance Administrator), at least during 10 + 2 years in magnetic media. Hard copies will be stored by the respective WWTP-C Division Chief at least for 10 + 2 years **Meter general technical specifications**: Precision: ± 1% reading + 0.5% at complete scale standard precision Repeatability: ± 0.4% reading for speeds close to 1.0 m/s (3.3 ft/s) Flow Margin: from 29 to 2,900 Nm3/h at 0°C, 1,013 bar Operation Temperature: Process Temperature 15° C to +50 ° C Recording Frequency: Continuously Data Record: Electronic for the crediting period + 2 years
Purpose of data:	Project
Additional comment:	-

8

Data / Parameter:	$T_{RG,h}$
Unit:	°C
Description:	Temperature of biogas flared in the flares
Measured/ Calculated / Default:	Measured
Source of data:	Continuous flow meter. The measurement location is shown in Figure 5. Measurement Point
Value(s) of monitored parameter:	See data table - spreadsheets
Monitoring equipment:	Type: RTD PT100 Series Number: Model RTD: TR10-BRA1CDSECC000 Serial: D903F014152 Indicator RIA451-A1A1 Serial F30BBB23373 Calibration Frequency: According to the suggestion made by the manufacturer (every 5 years). Calibration date: 1st calibration: September 19,2012 2nd calibration : September 19,2013 Precision Range: ± 0,2% of maximum range
Measuring/ Reading/ Recording frequency:	Continuously monitored and daily recording
Calculation method (if applicable):	-

QA/QC procedures:	**Quality Guarantee:** given by the equipment manufacturer. The data is stored digitally in the SCADA. The meter is operated and calibrated according to the manufacturer's specifications. **Calibration:** every5 years, time specified by the manufacturer for this equipment. Data is stored electronically/digitally through SCADA and stored for the duration of the project + 2 years. Security system is guaranteed by a multilevel password **Preventive Maintenance:** There are routine/prevention, cleaning or review records of the equipment every 15 days, which are stored in the folder named "OT Mantenimientos Equipos MDL" **Quality Control:** All evidence of maintenance performed by the PTAR-C personnel is stored in AQUAMAINT (Electromechanical Maintenance Administrator), at least during 10 + 2 years in magnetic media. Hard copies will be stored by the respective WWTP-C Division Chief at least for 10 + 2 years **Meter general technical specifications**: Precision: ± 0.2 °C (Visualization on screen) Flow Ranges: from -200 to 600 °C Recording Frequency: Continuously Data Record: Electronic for the crediting period + 2 years
Purpose of data:	Project
Additional comment:	-

Data / Parameter:	$T_{G,h}$
Unit:	°C
Description:	Temperature of biogas fed into the electric generator engines
Measured/ Calculated / Default:	Measured
Source of data:	Continuous flow meter. The measurement location is shown in Figure 5. Measurement Point 9
Value(s) of monitored parameter:	See data table - spreadsheets
Monitoring equipment:	Type : RTD PT100 Series Number: Model RTD: TR10-BRA1CDSECC000 Serial: D903F114152 Indicator RIA451-A1A1 Serial D9011804373 Calibration frequency: According to the suggestion made by the manufacturer (every 5 years). Calibration date: 1st calibration: September 20, 2012 2nd calibration: September 19, 2013 Precision Range: ± 0,2% of maximum range
Measuring/ Reading/ Recording frequency:	Continuously monitored and daily recording
Calculation method (if applicable):	-

QA/QC procedures:	**Quality Guarantee:** given by the equipment manufacturer. The data is stored digitally in the SCADA. The meter is operated and calibrated according to the manufacturer's specifications. **Calibration:** every 5 years, time specified by the manufacturer for this equipment. Data is stored electronically/digitally through SCADA and stored for the duration of the project + 2 years Security system is guaranteed by a multilevel password **Preventive Maintenance:** There are routine/prevention, cleaning or review records of the equipment every 15 days, which are stored in the folder named "OT Mantenimientos Equipos MDL" **Quality Control:** All evidence of maintenance performed by the PTAR-C personnel is stored in AQUAMAINT (Electromechanical Maintenance Administrator), at least during 10 + 2 years in magnetic media. Hard copies will be stored by the respective WWTP-C Division Chief at least for 10 + 2 years. **Meter general technical specifications**: Precision: ± 0,2 °C (Visualization on screen) Flow Ranges: from -200 to 600 °C Recording Frequency: Continuously Data Record: Electronic for the crediting period + 2 years
Purpose of data:	Project
Additional comment:	-

Data / Parameter:	$T_{H,h:}$
Unit:	°C
Description:	Temperature of biogas combusted in water heater
Measured/ Calculated / Default:	Measured
Source of data:	Continuous flow meter. The measurement location is shown in Figure 5. Measurement Point
Value(s) of monitored parameter:	See data table - spreadsheets
Monitoring equipment:	Type: RTD PT100 Series Number: Model RTD: TR10-BRA1CDSECC000 Serial: D903F214152 Indicator RIA451-A1A1 Serial F30BBA23373 Calibration Frequency: According to the suggestion made by the manufacturer (every 5 years). Calibration date: 1st calibration: September 20,2012 2nd calibration : September 19.2013 Precision Range: ± 0,2% of maximum range
Measuring/ Reading/ Recording frequency:	Continuously monitored and daily recording
Calculation method (if applicable):	-

QA/QC procedures:	**Quality Guarantee:** given by the equipment manufacturer. The data is stored digitally in the SCADA. The meter is operated and calibrated according to the manufacturer's specifications **Calibration:** every 5 years, time specified by the manufacturer for this equipment. Data is stored electronically/digitally through SCADA and stored for the duration of the project + 2 years Security system is guaranteed by a multilevel password **Preventive Maintenance:** There are routine/prevention, cleaning or review records of the equipment every 15 days, which are stored in the folder named "OT Mantenimientos Equipos MDL" **Quality Control:** All evidence of maintenance performed by the PTAR-C personnel is stored in AQUAMAINT (Electromechanical Maintenance Administrator), at least during 10 + 2 years in magnetic media. Hard copies will be stored by the respective WWTP-C Division Chief at least for 10 + 2 years **Meter general technical specifications**: Precision: ± 0.2 °C (Visualization on screen) Flow Ranges: From -200 to 600 °C Recording Frequency: Continuously Data Record: Electronic for the crediting period + 2 years
Purpose of data:	Project
Additional comment:	-

Data / Parameter:	$f_{VCH4, H:}$
Unit:	µV/V
Description:	Volumetric fraction of methane in biogas combusted in water heater
Measured/ Calculated / Default:	Measured
Source of data:	Continuous flow meter. The measurement location is shown in Figure 5. Measurement Point
Value(s) of monitored parameter:	See data table- spreadsheets
Monitoring equipment:	Type: Infrared methane concentration meter Series Number : Transmitter Beacon 110 Serial B110-128015, Sensor 61-0192RK-CH4 Serial 7719 Calibration frequency: as suggested by the manufacturer (every year). Calibration date: 1st calibration: August 17, 2012 Precision Range: ± 5% reading ± 2% at complete scale
Measuring/ Reading/ Recording frequency:	Continuously monitored and daily recording
Calculation method (if applicable):	-

QA/QC procedures:	**Quality Guarantee:** given by the equipment manufacturer. The data is stored digitally in the SCADA. The meter is operated and calibrated according to the manufacturer's specifications. **Calibration:** every year, time specified by the manufacturer for this equipment. Data is stored electronically/digitally through SCADA and stored for the duration of the project + 2 years Security system is guaranteed by a multilevel password **Preventive Maintenance:** There are routine/prevention, cleaning or review records of the equipment every 15 days, which are stored in the folder named "OT Mantenimientos Equipos MDL" **Quality Control:** All evidence of maintenance performed by the PTAR-C personnel is stored in AQUAMAINT (Electromechanical Maintenance Administrator), at least during 10 + 2 years in magnetic media. Hard copies will be stored by the respective WWTP-C Division Chief at least for 10 + 2 years **Meter general technical specifications**: Precision: 5% reading ± 2% at complete scale Ranges: from 0 to 100% V/V methane Sensor Type: Infrared route Recording Frequency: Continuously Data Record: Electronic for the crediting period + 2 years
Purpose of data:	Project
Additional comment:	-

Data / Parameter:	$f_{VCH4, G}$
Unit:	µV/V
Description:	Volumetric fraction of methane in biogas fed into the electric generator engine
Measured/ Calculated / Default:	Measured
Source of data:	Continuous flow meter. The measurement location is shown in Figure 5. Measurement Point 12
Value(s) of monitored parameter:	See data table - spreadsheets
Monitoring equipment:	Type: Infrared methane concentration meter Series Number: Model : D12IR-3 Serial: D12-IR-8394/CO-IR-501 Calibration Frequency: as suggested by the manufacturer (every year). Calibration date: 1st calibration: October 29,2010 – Local ATI (474) 1st calibration: February 15,2011 Series :XIHLX/S6486 1st calibration: September 17, 2013 Precision Range : ± 2%
Measuring/ Reading/ Recording frequency:	Continuously monitored and daily recording
Calculation method (if applicable):	-

QA/QC procedures:	**Quality Guarantee:** given by the equipment manufacturer. The data is stored digitally in the SCADA. The meter is operated and calibrated according to the manufacturer's specifications. **Calibration:** every 5 years, time specified by the manufacturer for this equipment. Data is stored electronically/digitally through SCADA and stored for the duration of the project + 2 years Security system is guaranteed by a multilevel password **Preventive Maintenance:** There are routine/prevention, cleaning or review records of the equipment every 15 days, which are stored in the folder named "OT Mantenimientos Equipos MDL". **Quality Control:** All evidence of maintenance performed by the PTAR-C personnel is stored in AQUAMAINT (Electromechanical Maintenance Administrator), at least during 10 + 2 years in magnetic media. Hard copies will be stored by the respective WWTP-C Division Chief at least for 10 + 2 years **Meter general technical specifications**: Precision: Generally ± 2% Ranges: from 0 to 100% V/V methane Sensor Type: Infrared route Recording Frequency: Continuously Data Record: Electronic for the crediting period + 2 years
Purpose of data:	Project
Additional comment:	-

13

Data / Parameter:	$P_{G,h}$:
Unit:	millibar Note: In the PDD document, for this parameter it was defined as measurement unit psi, kg/cm2 o Pa, but for recommendations of the manufacturer, and taking into account the precision and reading range of this application operation actual values, the supplier's recommendation of changing the measurement unit to milibar was considered
Description:	Pressure of biogas flared
Measured/ Calculated / Default:	Measured
Source of data:	Continuous flow meter. The measurement location is shown in Figure 5. Measurement Point 13
Value(s) of monitored parameter:	See data table - spreadsheets
Monitoring equipment:	Type: with measurement cell and ceramic capacitance-diaphragm gauge Series Number: Model Sensor: PMC-41-FC15C6H11A1 Serial: D9025301020 Indicator RIA 251-A1 Serial D900B7040AB Calibration Frequency: as suggested by the manufacturer (every 2 years). Calibration date: 1st calibration: December 13,2012 2nd calibration : October 03, 2013 Precision Range: ± 0.2 % of maximum range
Measuring/ Reading/ Recording frequency:	Continuously monitored and daily recording
Calculation method (if applicable):	-

QA/QC procedures:	**Quality Guarantee:** given by the equipment manufacturer. The data is stored digitally in the SCADA. The meter is operated and calibrated according to the manufacturer's specifications. **Calibration:** every 2 years, time specified by the manufacturer for this equipment. Data is stored electronically/digitally through SCADA and stored for the duration of the project + 2 years Security system is guaranteed by a multilevel password **Preventive Maintenance:** There are routine/prevention, cleaning or review records of the equipment every 15 days, which are stored in the folder named "OT Mantenimientos Equipos MDL". **Quality Control:** All evidence of maintenance performed by the PTAR-C personnel is stored in AQUAMAINT (Electromechanical Maintenance Administrator), at least during 10 + 2 years in magnetic media. Hard copies will be stored by the respective WWTP-C Division Chief at least for 10 + 2 years **Meter general technical specifications**: Precision: ± 0,25 complete scale Ranges: from -1.5 to 15 psi Recording Frequency: Continuously Data Record: Electronic for the crediting period + 2 years
Purpose of data:	Project
Additional comment:	-

14

Data / Parameter:	$P_{G,h}$:
Unit:	millibar Note: In the PDD document, for this parameter it was defined as measurement unit psi, kg/cm2 o Pa, but for recommendations of the manufacturer, and taking into account the precision and reading range of this application operation actual values, the supplier's recommendation of changing the measurement unit to millibar was considered
Description:	Pressure of biogas fed into electric generator engines
Measured/ Calculated / Default:	Measured
Source of data:	Continuous flow meter. The measurement location is shown in Figure 5. Measurement Point 14
Value(s) of monitored parameter:	See data table - spreadsheets
Monitoring equipment:	Type: with measurement cell and ceramic capacitance-diaphragm gauge Series Number: Model Sensor: PMC-41-FC15C6H11A1 Serial: D9025401020 Indicator RIA 251-A1 Calibration Frequency: as suggested by the manufacturer (every 2 years). Calibration date: 1st calibration : September 21, 2010 2nd calibration: September 21, 2011 3th calibration: December 13, 2012 4^{th} calibration: October 03, 2013 Precision Range: ± 0.2 % of maximum range
Measuring/ Reading/ Recording frequency:	Continuously monitored and daily recording
Calculation method (if applicable):	-

QA/QC procedures:	**Quality Guarantee:** given by the equipment manufacturer. The data is stored digitally in the SCADA. The meter is operated and calibrated according to the manufacturer's specifications. **Calibration:** every 2 years, time specified by the manufacturer for this equipment. Data is stored electronically/digitally through SCADA and stored for the duration of the project + 2 years Security system is guaranteed by a multilevel password **Preventive Maintenance:** There are routine/prevention, cleaning or review records of the equipment every 15 days, which are stored in the folder named "OT Mantenimientos Equipos MDL" **Quality Control:** All evidence of maintenance performed by the PTAR-C personnel is stored in AQUAMAINT (Electromechanical Maintenance Administrator), at least during 10 + 2 years in magnetic media. Hard copies will be stored by the respective WWTP-C Division Chief at least for 10 + 2 years **Meter general technical specifications**: Precision: ± 0.25 complete scale Ranges: from -1.5 to 15 psi Recording Frequency: Continuously Data Record: Electronic for the crediting period + 2 years
Purpose of data:	Project
Additional comment:	-

Data / Parameter:	$P_{G,h}$:
Unit:	millibar Note: In the PDD document, for this parameter it was defined as measurement unit psi, kg/cm2 o Pa, but for recommendations of the manufacturer, and taking into account the precision and reading range of this application operation actual values, the supplier's recommendation of changing the measurement unit to milibar was considered
Description:	Pressure of biogas combusted in the water heater
Measured/ Calculated / Default:	Measured
Source of data:	Continuous flow meter. The measurement location is shown in Figure 5. Measurement Point
Value(s) of monitored parameter:	See data table - spreadsheets
Monitoring equipment:	Type: with measurement cell and ceramic capacitance-diaphragm gauge Series Number: Model Sensor : PMC-41-FC15C6H11A1 Serial: D9025401020 Indicator RIA 251-A1 Serial D900B7040AB Calibration Frequency: as suggested by the manufacturer (every 2 years). Calibration date: 1st calibration: December 13, 2012 2nd calibration: 03 October 03, 2013 Precision Range: ± 0.2 % of maximum range
Measuring/ Reading/ Recording frequency:	Continuously monitored and daily recording
Calculation method (if applicable):	-

QA/QC procedures:	**Quality Guarantee:** given by the equipment manufacturer. The data is stored digitally in the SCADA. The meter is operated and calibrated according to the manufacturer's specifications. **Calibration:** every 2 years, time specified by the manufacturer for this equipment. Data is stored electronically/digitally through SCADA and stored for the duration of the project + 2 years Security system is guaranteed by a multilevel password **Preventive Maintenance:** There are routine/prevention, cleaning or review records of the equipment every 15 days, which are stored in the folder named "OT Mantenimientos Equipos MDL" **Quality Control:** All evidence of maintenance performed by the PTAR-C personnel is stored in AQUAMAINT (Electromechanical Maintenance Administrator), at least during 10 + 2 years in magnetic media. Hard copies will be stored by the respective WWTP-C Division Chief at least for 10 + 2 years. **Meter General Technical Specifications**: Precision: ± 0,2 Ranges: from : -1.5 a 15 psi Recording Frequency: Continuously Data Record: Electronic for the crediting period + 2 years
Purpose of data:	Project
Additional comment:	-

D.3. Implementation of sampling plan

Not applicable

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

For the baseline calculation the following parameters were considered:

The parameters used for the calculation of the emissions of the baseline are described as follow:

Amount of untreated sludge generated in the year "y" (Sy,untreated):

Sludge, which during the anaerobic digestion generates biogas,In order to determine the amount of sludge generated annually during the crediting period, a mass balance of the Total Suspended Solids – SST per its initials in Spanish was conducted. The calculation was made in conformity with the following equation:

$S_{y,untreated} = (Qy * SST * \mu_{remoción\ SST}) / 10000000$

Where:

$S_{y,untreated}$:	Quantity of untreated sludge generated in year "y" (tonnes)
Qy	Amount of influent wastewater to the WWTP-C in year "y" (m3)
SST	Average concentration of total suspended solids (SST) in influent wastewater entering the WWTP-C (Data operation of plant)
$\mu_{remoción\ SST}$	Average removal efficiency of SST in the WWTP-C (Data operation of plant)

According to the provisions of the PDD was considered the following equation related to emissions of the baseline:

$BEy = MEP_{y,ww,bl} * GWP\_CH4 + MEP_{y,s,treatment} * GWP\_CH4$

Where:

B_{Ey}	Baseline emissions in year "y" (tonnes CO2e)
$MEP_{y,ww,bl}$	Methane emission potential of the anaerobic wastewater treatment plant(s) in the

	baseline situation in year "y" (tonnes)
$MEP_{y,s,treatment}$	Methane emission potential of the sludge treatment system in the year "y" (tonnes)
GWP_CH4	Global Warming Potential for methane (value of 21 is used)

The treated wastewater characteristics and methane generation potential are alike to the baseline and the project activity. Therefore, the baseline is going to be calculated as follows:

$BE_y = MEP_{y,s,treatment} * GWP\_CH4$

$MEP_{y,s,treatment} = S_{y,untreated} * DOC_{y,s,untreated} * DOC_F * F * (16/12) * MCF_{s,treatment}$

Where:

$S_{y,untreated}$	Amount of untreated sludge generated in year "y" (tonnes)
$DOC_{y,s,untreated}$	Degradable organic content of the untreated sludge generated in the year y (fraction).
DOC_F	Fraction of DOC dissimilated to biogas
F	Fraction of CH4 in landfill gas
$MCF_{s,treatment}$	Methane correction factor for the sludge treatment system that will be equipped with methane recovery and combustion (MCF Lower value table III.H.1 of the methodologyAMS III.H Methane recovery in wastewater treatment, Version 09, Scope 13, Mar 28,2008).

The following table shows the related values of baseline of the first period

Month	**Q me. m^3/s**	**Affl. (TSS) mg/lt**	**VS/TS average**	Emission reductions
November-12	5.75	180	0.72	3237
December-12	5.54	205	0.71	2597
January-13	5.72	175	0.79	2705
February-13	6.19	141	0.72	2721
March-13	6.39	155	0.75	3417
April-13	6.17	153	0.71	8246
May-13	6.35	145	0.71	2598
June-13	5.78	174	0.77	3307
July-13	5.04	218	0.71	4475
August-13	5.64	183	0.73	3558
September-13	6.65	179	0.7	3182
October-13	6.41	145	0.7	2385
November-13	5.99	175	0.7	3418
December-13	7.27	144	0.71	2939

E.2. Calculation of project emissions or actual net GHG removals by sinks

In accordance with the approved monitoring methodology AMS III.H Methane recovery in wastewater treatment (Version 09, Scope 13, Mar 28, 2008), project activity emissions consist of:

$$\mathbf{PE_y = PE_{y,power} + PE_{y,ww,treated} + PE_{y,s,final} + PE_{y,fugitive} + PE_{y,dissolved} + PE_{y,upgrading} + PE_{y,leakage,pipeline}}$$

Where:

PE_y	Project activity emissions in year "y" (tCO2e)

$PE_{y,power}$	Emissions from electricity or diesel consumption in year "y"
$PE_{y,ww,treated}$	Emissions from degradable organic carbon in treated wastewater in year "y"
$PE_{y,s,final}$	Emissions from anaerobic decay of the final sludge produced in year "y"
$PE_{y,fugitive}$	Emissions from methane release in capture and utilization/combustion/flare systems in year "y"
$PE_{y,dissolved}$	Emissions from dissolved methane in treated wastewater in year "y"
$PE_{y,upgrading}$	Emission related to the upgrading and compression of biogas in year "y"
$PE_{y,leakage,pipeline}$	Emission due to the physical leakage from the dedicated piped network in year "y"

Relevant to the proposed project activity is the following formula:

$$PE_y = PE_{y,fugitive}$$

The reasons for leaving out other formula components are:

$PE_{y,power}$	The total energy used for the purposes of the operation of the PTAR-C comes from biogas,that is captured and combusted within the PTAR-C. Therefore, this term is not relevant for further calculations.
$PE_{y,ww,treated}$	Introduction of a recovery and combustion to an existing sludge treatment system does not changes the amount of methane produced per unit of COD removed. Having the aforementioned in mind, the content of degradable organic carbon in treated wastewater is expected to be the same in the baseline as in the project activity and therefore, this term is not relevant for further calculations.
$PE_{y,s,final}$	Introduction of a recovery and combustion to an existing sludge treatment system does not changes the amount of methane produced per unit of COD removed. Having the aforementioned in mind, the amount and characteristics of the sludge produced in the baseline scenario will not change in the proposed project activity and therefore, this term is not relevant for further calculations.
$PE_{y,dissolved}$	Introduction of a recovery and combustion to an existing sludge treatment system does not changes the amount of methane produced per unit of COD removed. Having the aforementioned in mind, the amount and characteristics of methane dissolved in treated wastewater in the baseline scenario will not change in the proposed project activity and therefore, this term is not relevant for further calculations.
$PE_{y,upgrading}$	The recovered methane is not upgraded for bottling, therefore, this term is neglected.
$PE_{y,leakage,pipeline}$	There are no emission due to the physical leakage from the dedicated piped network fortransport of upgraded biogas to the end users in the proposed project activity, therefore, this term is not relevant for further calculations
$PE_{y,fugitive}$	$= PE_{y,fugitive,ww} + PE_{y,fugitive,s}$

Where:

$PE_{y,fugitive,ww}$	Fugitive emissions through capture and utilization/combustion/flare inefficiencies in the anaerobic wastewater treatment in year "y" (tCO2e)
$PE_{y,fugitive,s}$	Fugitive emissions through capture and utilization/combustion/flare inefficiencies in the anaerobic sludge treatment in year "y" (tCO2e) .

As the recovery and combustion will be introduced only to an existing anaerobic sludge treatment system, the emissions will be associated only to the fugitive emissions from the capture and utilization/combustion/flare inefficiencies in this system. There will be no change in the anaerobic wastewater treatment between the baseline and the proposed project activity, therefore, $PE_{y,fugive,ww} = 0$.

The project emissions are produced only due to the capture and combustion efficiency of the methane

recovery system. In methodology AMS III.H Methane recovery in wastewater treatment (Version 09, Scope 13, Mar 28, 2008) the combustion efficiency is included in the capture efficiency of the system. For these combined project emissions, a default value can be used.

$PE_{y,fugitive,s}$ = (1 – CFEs) * MEPy,s,treatment * GWP_CH4

Where:

CFEs Capture and utilization/combustion/flare efficiency of the methane recovery and combustion/utilization equipment in the sludge treatment (a default value of 0.9 shall be used, given no other appropriate value).

MEPy,s,treatment Methane emission potential of the sludge treatment system in the year "y" (tonnes)

GWP_CH4 Global Warming Potential for methane (value of 21 is used)

MEPy,s,treatment = Sy,untreated * DOCy,s,untreated * DOCF * F * 16/12 * MCFs,treatment

Where:

$Sy_{,untreated}$ Amount of untreated sludge generated in year "y" (tonnes)
$DOCy_{,s,untreated}$ Degradable organic content of the untreated sludge generated in the year y (fraction).
$MCFs_{,treatment}$ Methane correction factor for the sludge treatment system that will be equipped with methane recovery and combustion (MCF higher value of 1.0 as per table III.H.1 of the methodology AMS III.H Methane recovery in wastewater treatment, Version 09, Scope 13, Mar 28, 2008).

E.3. Calculation of leakage

Given that technology used does not imply equipment transferred from another activity, and existing equipment is not transferred to another activity, no leakage must be considered in accordance with applied methodology.

E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

Item	Baseline emissions or baseline net GHG removals by sinks (t CO_2e)	Project emissions or actual net GHG removals by sinks (t CO_2e)	Leakage (t CO_2e)	Emission reductions or net anthropogenic GHG removals by sinks (t CO_2e)
Total	48,785	-	-	46,615.31

E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO_2e)	68,185	46,615.31

The monitoring period from 01/11/2012 to 31/12/2013 (426 days) is *ex-ante* calculated in accordance with the registered PDD.

Total number of days of the 2nd monitoring period:

61 days from (01/11/2012 – 31/12/2012) + 365 days (01/01/2013-31/12/2013) = 426 days

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

The difference from estimated values in registered PDD in relation to actual values obtained during the 1st monitoring period is mainly due to the following explanation:

- Flow rates projected in the PDD's by WWTP-Cañaveralejo Emcali were not actually achieved in the implementation of projects.
- TSS (total suspended solids) concentration described and projected in the PDD's by Emcali were superior to data obtained due to the rainy season presented during the year 2013 in the Department of Valle del Cauca in Colombia.
- Fraction of VSS (Volatile Suspended Solids) / TSS(Total Suspended Solids) was lower than projected in the PDD's of Emcali due to the drag of inorganic material presented in the sewage of the city of Cali, Valle del Cauca, Colombia
- VSS (Volatile Suspended Solids) destruction in the digesters in the WWTP-C was 45% on average, this data was lower than projected in the PDD 50's%

E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards
Emission reductions or GHG removals by sinks (t CO_2e)	5,524.6	41,090.7

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Appendix 1. Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	x☐ Project participant ☐ Responsible person/ entity for completing the CDM-MR-FORM
Organization name	Empresas Municipales de Cali EICE ESP – Emcali – PTAR-C
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Contact person	Jose Artemio Cerón
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Salutation	Mr.
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Document information

Version	*Date*	*Description*
04.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from *F-CDM-MR* to *CDM-MR-FORM*; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.

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