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	La Vuelta and La Herradura Hydroelectric Project
Reference number of the project activity	0735
Version number of the monitoring report	01
Completion date of the monitoring report	August 18/2014
Registration date of the project activity	15 January 2007
Monitoring period number and duration of this monitoring period	01/01/2010 – 31/12/2011
Project participant(s)	Empresas Públicas de Medellín E.S.P. (private) MGM Carbon Portfolio S.a.r.l.
Host Party(ies)	Colombia
Sectoral scope and selected methodology(ies), and where applicable, applied standardized baseline(s)	Sectoral scope 1: "Energy Industries – Renewable Sources". Baseline methodology ACM0002/version 06 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources".
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	137,590 t CO2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	102,239.59 t CO2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period up to 31 December 2012(if applicable)	102,239.59 t CO2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period from 1 January 2013 onwards (if applicable).	N.A

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The purpose of the project activity is to build a hydroelectric power plant, with a total installed nameplate capacity of 33.48 MW, in order to take advantage of the capacity of La Herradura River, by means of two subprojects in a chain (La Vuelta and La Herradura). The proposed subprojects were not strictly built to cover the expected increase in electricity demand but to add efficiency to the electricity system as a whole, to improve electricity service in the west of Antioquia Department, and to contribute to the regional sustainable development, while reducing CO2 emissions.

The project displaces other generation sources connected to the local grid that use fossil fuels to produce energy. The project provides clean energy and reduces CO2 emissions in Colombia.

The following table shows a description of the technology that was included in the registered PDD:

Tabla 1: Design data of La Vuelta and La Herradura Hydroelectric Project.

Hydro Plant / Characteristic	La Vuelta	La Herradura
Nominal Capacity	12.4 MW	21.08 MW
Mean flow	12 m^3/ s	10 m^3/ s
Net design fall	112.9 m	230.6 m
Hydraulic turbine	Francis horizontal axis. One unit	Francis horizontal axis. Two units

The construction of the facilities started in April 2002. La Vuelta was completed and fully commissioned in December 2004 and La Herradura was completed and fully commissioned in October 2004, at which points they started commercial operations. The power plants has been generating electricity since then.

The emission reductions achieved by the implementation of the project activity for the monitoring period, 1 January 2010 - 31 December 2011 are 102,239.59 tCO2.

A.2. Location of project activity

The project activity is located in the Republic of Colombia. The power plants are located in the north-western area of Antioquia Department, under the jurisdiction of Cañasgordas, Frontino and Abriaquí municipalities, although the whole of Urabá Antioqueño can be considered as regional area of influence, which goes from Santa Fé de Antioquia to Arboletes.

La Herradura Sub-Project

La Herradura plant is located on La Herradura River, starting from an existing topographic fall between that river and the Cañasgordas River. Both rivers later join to form the Sucio River basin, a tributary to the Atrato River. The hydrographic basin area of La Herradura River is 320 km2, which contributes to a mean flow of 14 m^3/s at catchment point. The construction is located in Frontino and Cañasgordas jurisdictions.

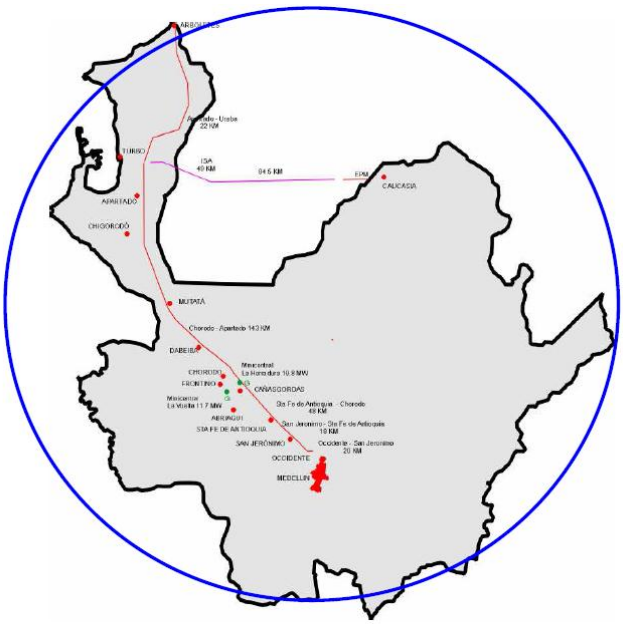
Location of La Herradura power plant: -76.09º; 6.73º (-76°05'18.01"; 6°43'49.60")

La Vuelta Sub-Project

La Vuelta plant is located in the upper and middle basin of La Herradura River, up to the fork at the Nancuí gulch, at 1,595 m elevation, covering all Abriaquí municipality. The limits coincide with the dividing basin and, to a lesser extent, with Frontino municipality. The hydrographic basin area of La Herradura River contributes to a mean flow of 12.3 m3/s at catchment point.

Location of La Vuelta power plant: -76.08º; 6.80º (-76°04'52.90''; 6°48'10.08'')

Location of Substation Chorodó: -76.14°; 6.85° (-76°08'16.50''; 6°50'53.93'')



A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Colombia (host)	Empresas Públicas de Medellín E.S.P	No
Switzerland	MGM Carbon Portfolio, S.a.r.l. (private)	No

A.4. Reference of applied methodology and standardized baseline

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The methodology applied to the registered CDM project activity is ACM0002 Version 6: "*Consolidated methodology for grid-connected electricity generation from renewable sources*". The methodology also refers to the "*Tool for demonstration and assessment of additionality*".

A.5. Crediting period of project activity

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The crediting period of the project activity is January 1st 2005 to December 31st 2011 (renewable)

A.6. Contact information of responsible persons/ entities

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Empresas Públicas de Medellín
Oscar Alonso Fernadez
Tel (57.4) 380.22.45
Oscar.fernandez@epm.com.co

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

>>

The project is fully implemented and operational since the end of 2004.
No events or situations occurred during the monitoring period, which may impact the applicability of the methodology.

	La Vuelta	La Herradura
Construction start date	15 April 2002	22 April 2002
Operation start date	18 December 2004	08 October 2014

Technologies and/or measures

The project activity consists of two hydroelectric power plants, with a total installed turbine capacity of 33.48 MW[1] , in order to take advantage of the capacity of La Herradura River, by means of two subprojects in a chain (La Vuelta and La Herradura).

La Vuelta Sub-Project

Hydraulic Turbine	
Type	Francis, horizontal axis
Number of units	1
Nameplate capacity (without losses)	12,400 kW[1]
Rotation speed	870 min-1
Design net head	112.9 m
Generator	
Type	synchronic, horizontal axis
Number of units	1
Nominal power output(nameplate)	14,000 kVA
Nominal tension	13,800 V
Nominal frequency	60 Hz
Power factor (cosine ø)	0.85
Synchronic speed	514.3 rpm

La Herradura Sub-Project

Hydraulic Turbine	
Type	Francis, horizontal axis
Number of units	1
Nameplate capacity (without	10,540 kW[1]

[1] As per post registration changes PRC ref No. PRC-0735-001, approved on May 20-2014

losses)	
Rotation speed	900 min-1
Design net head	230.6 m
Generator	
Type	synchronic, horizontal axis
Number of units	2
Nominal power output(nameplate)	12,000 kVA
Nominal tension	13,800 V
Nominal frequency	60 Hz
Power factor (cosine ø)	0.85
Synchronic speed	900 rpm

Turbine Regulator: programmable digital type with electronic head operated from central or by remote control from another control centre. It also has an electro-hydraulic system for normal operations of synchronization, charge and discharge.

Transformers: It has been decided the use of an outdoors transformer for the two generators, with a capacity of 24 MVA: three-phase, with primary nominal voltage of 13.8 kV and secondary of 44 kV and 60 Hz, oil-cooled under normal conditions and by forced air under operating conditions at continual maximum capacity.

Mechanical auxiliary equipments: Oil in bolsters is cooled in a dry type tower, the oil circuit is closed and the pumps are directly propelled by the unit axis. For the drainage of the spiral chamber, the relief valve discharge pit, the draft duct and infiltrated water and power house floors drainage, there is a system with submergible vertical pumps installed in the drainage pit to conduct water to the discharge channel.

Electric auxiliary equipments: A 480 kV-13.8 kV transformer is used as normal feed, fed from any of the two generators as main source. It has a diesel electric generator of 480 V and 60 Hz emergency system[2].

Each generation unit has a control center and a 480 V distribution board so that maintenance and selection processes in auxiliary services operations are independent. There is a surveillance system and water level control in the load tank. Therefore, the central is interconnected, so as to secure accurate load tank operation hydraulic conditions.

Turbine specifications: The turbines are Francis reaction turbines, with a martensitic stainless steel welded impeller, with spiral chamber and welded draft pipe from soothed carbon steel sheets, of thin austenitic grain size.

A Francis turbine is a type of hydraulic reactor turbine where the flow exits the turbine blades in radial direction. Francis turbine is common in power generation facilities and is used in applications where high flow rates are available at medium hydraulic head (e.g. Niagara Falls). Water enters the turbine through a casing and is directed to the blades by wicket gates. The low momentum water then exits the turbine through a draft tube.

Francis turbines can be assembled both vertically and horizontally. Figure bellow shows a Francis turbine where water can enter freely through the whole circumference and through the outer ring of the guide vanes. These guide vanes can be adjusted so the amount of incoming water may be controlled. Francis turbines are highly efficient and versatile turbines (inflow-impulse type in the first stage and outflow-axial reaction type in the second stage).

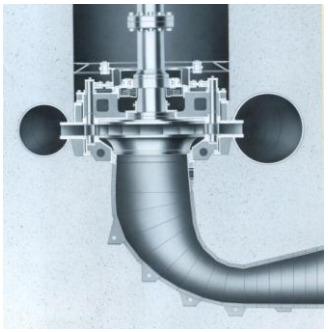


Figure 1: Francis Turbine Spiral Cased Horizontal Shaft - typical arrangement

[2] As stated in the methodology ACM0002 version 15.0.0, “the use of fossil fuels for the back up or emergency purposes (e.g. diesel generators) can be neglected”; thus potential emissions from the emergency diesel generator at the project site are neglected

B.2. Post registration changes

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

>>
There were no temporary deviations from registered monitoring plan or applied methodology during the current monitoring period.

B.2.2. Corrections

>>
There were no corrections from registered project activity / monitoring plan or applied methodology during the current monitoring period.

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

>>
There were no corrections from registered monitoring plan or applied methodology during the current monitoring period.

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

>>
A post registration change (PRC ref No. PRC-0735-001) was submitted and accepted by the Chair of the EB on May 20 2014.

B.2.5. Changes to start date of crediting period

>>
Not applicable

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

>>
This section is not applicable.

SECTION C. Description of monitoring system

>>
The Monitoring Plan is based on i) recording electricity generation of LV and LH power plants and ii) obtaining the data required to calculate the grid emission factor: electricity generation and fuel consumption of all power plants serving the interconnected national system.

Considering the project boundary, the following data need to be monitored in order to calculate baseline emissions and emission reductions:

- Hourly electricity generation of the hydroelectric plants of the project. EE.PP.M takes measurements every hour (ID number of section D.2.1.3 of the registered PDD: 1).
- Plant dispatch order of the grid (ID number of section D.2.1.3 of the registered PDD: 2).
- Hourly electricity generation of all power plants and imports serving the interconnected national system (ID number of section D.2.1.3 of the registered PDD: 5 and 14).
- Power plants fuel consumption or heat rates for each fuel (ID number of section D.2.1.3 of the registered PDD: 6, 7 and 10).
- Emission factor and Net Calorific Value of each fuel used in the thermal power plants of the grid (ID number of section D.2.1.3 of the registered PDD: 8 and 9)

- Identification of the power plants for the OM and BM (ID number of section D.2.1.3 of the registered PDD: 3 and 4)

Electricity generation:
The power plants La Vuelta and La Herradura belong to the Metropolitan Area under the "Subgerencia Operación" of the "Gerencia Generación Energía" in charge of the operation and maintenance of the power plants. Monitoring procedures can be implemented on site or remote, using tele-measurement technology. The "Equipo de Medida" (Measurements Team) of EE.PP.M is in charge of taking the measurements. The Measurements Team is responsible for reporting to XM, the operator of the National Dispatch Center, on the Generation Boundaries, the boundaries between the agents and the large energy clients supplied by EE.PP.M. In the case of La Vuelta and La Herradura, the energy meters (in Chorodó substation) are read via the MV-90i software every 24 hours and uploaded in the GCE-Grandes Clientes de Energía software.

Once the information is uploaded, a file is created: cr41/mes/día.TXT and it is sent to XM. The codes assigned by XM to this project are:

EVLT1001 LA VUELTA
EHRD1001 LA HERRADURA

Electricity generation is measured by electronic electricity meters. The values are cross-checked with the generation measured in terminals and vs. SCADA system ("Supervisory Control And Data Acquisition").

Meters Information:

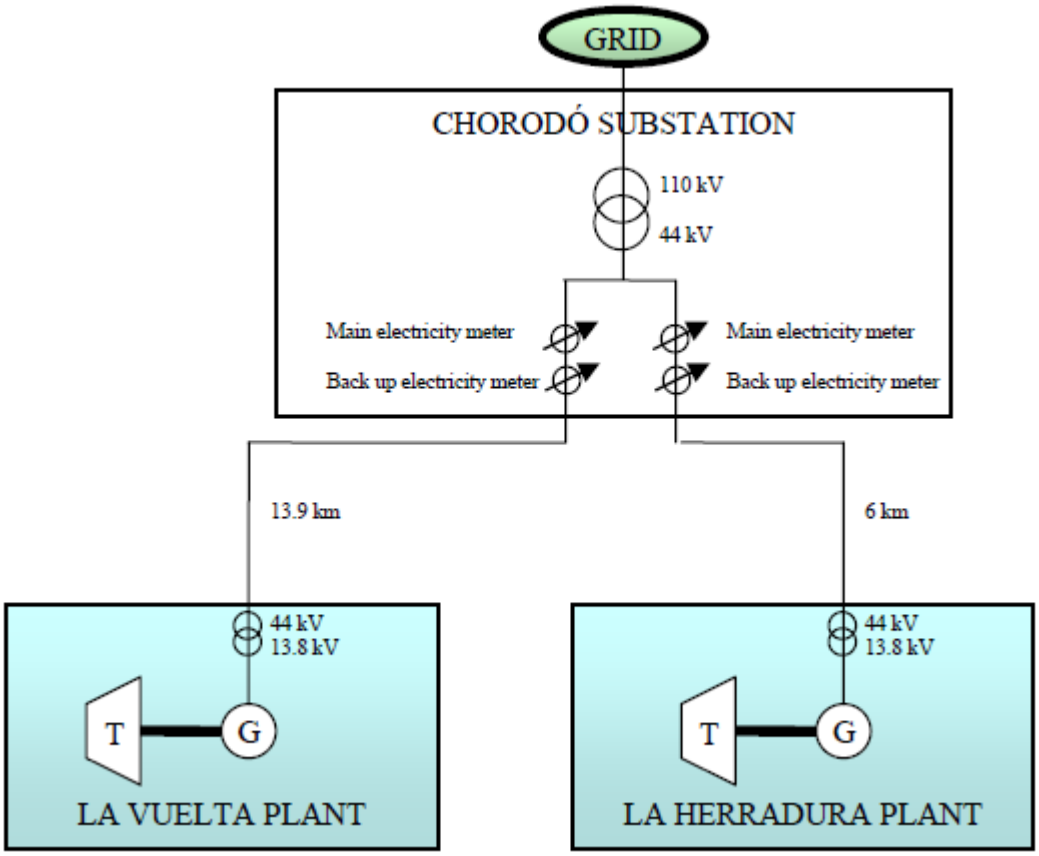
LA VUELTA ELECTRICITY METERS	
Main	**Backup**
Serial: 36099685	Serial: 36099687
Type: SL761A061	Type: SL761A061
Brand: ACTARIS	Brand: ACTARIS
Voltage: 3x57.7/100V – 3x240/415V	Voltage: 3x57.7/100V – 3x240/415V
Current: 5(10)A	Current: 5(10)A
Calibration constant: 10000 Wh/Imp	Calibration constant: 10000 Wh/Imp
TP measure: 44000/V3/120/V3V	TP measure: 44000/V3/120/V3
3 Phases – 4 lines	3 Phases – 4 Lines
TC Measure: 300/5	TC measure: 300/5
Class: 0.2S	Class: 0.2S

LA HERRADURA ELECTRICITY METERS	
Main	**Backup**
Serial: 36099681	Serial: 36099684
Type: SL761A061	Type: SL761A061
Brand: ACTARIS	Brand: ACTARIS
Voltage: 3x57.7/100V – 3x240/415V	Voltage: 3x57.7/100V – 3x240/415V
Current: 5(10)A	Current: 5(10)A
Calibration constant: 10000 Wh/Imp	Calibration constant: 10000 Wh/Imp
TP measure: 44000/V3/120/V3V	TP measure: 44000/V3/120/V3
3 Phases – 4 lines	3 Phases – 4 Lines
TC Measure: 300/5	TC measure: 300/5
Class: 0.2S	Class: 0.2S

This information is backed up by the IT Department of EE.PP.M through the software for GCE-Grandes Clientes de Energía ("Large Energy Consumers"). Daily data are read remotely using MV-

90xi software. The IT Department (Unidad Informática Energía) does information backups of the GCE database on a daily basis at 8.00 PM through the SQL Server. The backup of the previous day is overwritten by the new one. During the day, backups of the transaction log from the same database are made every three hours. The files are copied to a tape every day during a week. In this way, there is always an available backup of the previous week. Additionally, a tape is kept per week during a month and a tape per months during three months.

The following scheme shows the power plants, the substation and the metering points:



Grid emission factor:

EE.PP.M. management use data collected as inputs to complete a spreadsheet where data are entered to calculate the emission factor. The actual electricity generation of the power plants in the system and the fuel consumption are obtained through NEON system from XM, the operator of the National Dispatch Center.

The emission factors for the fuels are obtained from FECOC UPME - Factores de Emisión de los Combustibles Colombianos (Emission Factors of Colombian Fuels). The heat rates of the power plants are obtained from UPME (Unidad de Planeación Minero Energética) Mining & Energy Planning Unit), the official entity. All these data are processed in the workbook where the dispatch order is determined based on the price offers of the generators in the market for each hour. Once the 10% marginal plants have been established, the spreadsheet calculates the associated emissions of the system on an hourly basis and the corresponding operating margin emission factor (see spreadsheet “Operating Margin_LVLH_2010” and “Operating Margin_LVLH_2011”).

For the calculation of the Build Margin, information about date of commissioning of new power plants to the national generation system is provided by XM, based on the registration of new generators. This information is utilized by EE.PP.M.to identify the set of power plants involved in the BM calculations (see spread sheet “Build Margin_LVLH_2010_2011”).

Environmental management plan:
It is important to note that this environmental management plan was not included as part of the monitoring plan in the PDD. This is an independent initiative taken by EE.PP.M that contributes to sustainable development of the region.

La Vuelta and La Herradura hydroelectric plants apply an environmental management plan that includes actions towards mitigating the negative impacts on environment during construction and operation of the plants. In addition, EE.PP.M developed a discretionary environmental management plan that involves physical-biotic and social aspects to protect natural resources and to promote a sustainable development of the hydroelectric complex. The plan consists of:

Management of Environmental Impacts:

- The Environmental Licenses consider concessions and permits of spills and river banks occupation and adaptation of the internal ways of the hydroelectric plants. To achieve this, the information requirements of the Corporación Autónoma Regional Corpourabá (Autonomous Regional Corporation of Corpourabá) need to be met regarding environmental monitoring programs.
- Report on turbinated flows once every three months to the Corporación Autónoma Regional Corpourabá (Autonomous Regional Corporation of Corpourabá).
- Monitoring and control of the flow designated for energy generation and for water consumption.
- Inspection and maintenance of domestic wastewater treatment systems belonging to the hydroelectric system facilities.
- Monitoring of domestic wastewater treatment systems in order to verify the efficiency and the compliance with the estimated removal percentages in accordance with the environmental law.
- Implementation of a solid wastes management system including different containers corresponding to different type of solid wastes. Moreover, tows and sheets soaked with oils are delivered to a third party for treatment and final disposal in accordance with the applicable law.
- Visits from officials of the Corporación Autónoma Regional Corpourabá (Autonomous Regional Corporation of Corpourabá) to follow up on the application of the plan and to identify opportunities for improvement.

<u>Additional discretional programs of environmental management</u>

Process of Environmental Impacts Management:

- Hydrologic monitoring: rainfall, runoff, transport of sediments and water quality of the main source.
- Water quality monitoring of the sources that supply drinking water to the facilities of the hydroelectric complex.

Process of Conserving Natural Resources

- Geomorphological study of La Herradura River and its river dynamics in order to implement measures to control the critical factors that generate the torrential conditions and the high production of sediments in the basin.
- In 2007, the recovery of several points of erosion of the La Herradura River basin was initiated. In this regard, 22,500 m2 of affected areas due to erosion were identified as part of the program to implement activities tending to protect the surface, control of runoff and stabilization of the areas in order to control the supply of sediments that affect the machines that generate energy.

SECTION D. Data and parameters

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

(Copy this table for each piece of data and parameter.)

Data / Parameter:	Data / Parameter:
OXIDcoal	OXIDcoal
Data unit:	Data unit:
Source of data used:	IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual Volume 3 (1996)
Value(s):	0.98
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline
Additional comment:	Update in IPCC 2006 to 1

Data / Parameter:	$OXID_{NG}$
Data unit:	-
Description:	Natural gas oxidation factor
Source of data used:	IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual Volume 3 (1996)
Value(s):	0.995
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline
Additional comment:	Update in IPCC 2006 to 1

D.2. Data and parameters monitored

(Copy this table for each piece of data and parameter.)

Data / Parameter:	EG_y
Data unit:	MWh
Description:	Electricity generation by the plant
Measured /Calculated /Default:	Measured
Source of data:	EE.PP.M
Value(s) of monitored parameter:	2010: 181,325 (LV: 64,642 + LH: 116,683) 2011: 185,176 (LV: 77,094 + LH: 108,082) See table in section E.1 for details

<table>
<tr><td>Monitoring equipment:</td><td>
<table>
<tr><th>Plant</th><th></th><th>Serial</th><th>Type</th><th>Class</th><th>Cal. Freq</th><th>Last Calib.</th></tr>
<tr><td rowspan="2">La Vuelta</td><td>Main</td><td>36099685</td><td>SL761A061</td><td>0.2S</td><td>4 y</td><td>07Sep2009</td></tr>
<tr><td>Back Up</td><td>36099687</td><td>SL761A061</td><td>0.2S</td><td>4 y</td><td>07Sep2009</td></tr>
<tr><td rowspan="2">La Herradura</td><td>Main</td><td>36099681</td><td>SL761A061</td><td>0.2S</td><td>4 y</td><td>07Sep2009</td></tr>
<tr><td>Back Up</td><td>36099684</td><td>SL761A061</td><td>0.2S</td><td>4 y</td><td>07Sep2009</td></tr>
</table>
</td></tr>
<tr><td>Measuring/ Reading/ Recording frequency:</td><td>Hourly measurements and monthly recording</td></tr>
<tr><td>Calculation method (if applicable):</td><td>N.A</td></tr>
<tr><td>QA/QC procedures:</td><td><u>Calibration of meters:</u>
Electricity meters were calibrated at EE.PP.M laboratory before being installed in the plant. Calibration tasks follow national standards and are in accordance with the calibration instructive specified in Colombian standard NTC 4,856 for electricity metering devices. The required calibration frequency is approximately every 4 years. However, calibration has been performed every year in situ.
EE.PP.M has adopted its own procedure based on the Colombian technical norm NTC-ISO-IEC 17,025 and NTC 4,856, under the so-called “Instructive to perform on-site electricity meter tests with a pattern metering device” (DIS-EM-LE-IN-009-01). This procedure is carried out to verify that the meters are working properly with the corresponding accuracy. They are also checked for alarms.</td></tr>
<tr><td>Purpose of data:</td><td>Baseline</td></tr>
<tr><td>Additional comment:</td><td>N.A</td></tr>
</table>

Data / Parameter:	***n***
Data unit:	-
Description:	Identification of the power plants for the OM
Measured /Calculated /Default:	Estimated
Source of data:	EE.PP.M.
Value(s) of monitored parameter:	See files: “Operating Margin_LVLH_2010” and “Operating Margin_LVLH_2011”
Monitoring equipment:	Yearly
Measuring/ Reading/ Recording frequency:	N.A
Calculation method (if applicable):	According to the tool for the calculation of the emission factor for an electricity system
QA/QC procedures:	This variable is calculated, not measured, and therefore does not need specific quality control procedures.
Purpose of data:	Baseline. Identification of plants to calculate OM emission factor.
Additional comment:	N.A

Data / Parameter:	***m***
Data unit:	-
Description:	Identification of the power plants for the BM

Measured /Calculated /Default:	Estimated
Source of data:	EE.PP.M.
Value(s) of monitored parameter:	See file “Build Margin_LVLH_2010_2011”
Monitoring equipment:	Yearly
Measuring/ Reading/ Recording frequency:	N.A
Calculation method (if applicable):	According to the tool for the calculation of the emission factor for an electricity system
QA/QC procedures:	This variable is calculated, not measured, and therefore does not need specific quality control procedures.
Purpose of data:	Baseline. Identification of plants to calculate BM emission factor.
Additional comment:	N.A

Data / Parameter:	***GEN***
Data unit:	MWh
Description:	Electricity generated by each power plant (n or m) of the Colombian SIN
Measured /Calculated /Default:	Measured
Source of data:	CND
Value(s) of monitored parameter:	See file “Build Margin_LVLH_2010_2011”
Monitoring equipment:	Yearly
Measuring/ Reading/ Recording frequency:	N.A
Calculation method (if applicable):	According to the tool for the calculation of the emission factor for an electricity system
QA/QC procedures:	This variable is calculated, not measured, and therefore does not need specific quality control procedures.
Purpose of data:	Baseline.
Additional comment:	N.A

Data / Parameter:	***SCi***
Data unit:	*tonne fuel/MWh*
Description:	*Specific consumption of power plant for the fuel i*
Measured /Calculated /Default:	Measured
Source of data:	CND
Value(s) of monitored parameter:	See file “Build Margin_LVLH_2010_2011.xls”
Monitoring equipment:	Yearly
Measuring/ Reading/ Recording frequency:	N.A

Calculation method (if applicable):	According to the tool for the calculation of the emission factor for an electricity system
QA/QC procedures:	*These data will be updated when it is necessary. Information cross-check shall be used to assure and control quality, taken into account, e.g., annual fuel consumption published by UPME.*
Purpose of data:	Baseline.
Additional comment:	N.A

Data / Parameter:	**HR_i**
Data unit:	energy units per MWh
Description:	Heat rate of the power plant j using the fuel i
Measured /Calculated /Default:	Calculated
Source of data:	XM and UPME information
Value(s) of monitored parameter:	See file "Build Margin_LVLH_2010_2011.xls"
Monitoring equipment:	N.A
Measuring/ Reading/ Recording frequency:	N.A
Calculation method (if applicable):	According to the tool for the calculation of the emission factor for an electricity system
QA/QC procedures:	This variable is calculated, not measured, and therefore does not need specific quality control procedures.
Purpose of data:	Baseline
Additional comment:	N.A

Data / Parameter:	***NCVi***
Data unit:	*TJ/ ktonne fuel*
Description:	*Net Calorific Value of fuel i consumed in each power plant*
Measured /Calculated /Default:	Measured
Source of data:	*Plant management or IPCC guidelines*
Value(s) of monitored parameter:	See file "Build Margin_LVLH_2010_2011.xls"
Monitoring equipment:	N.A
Measuring/ Reading/ Recording frequency:	N.A
Calculation method (if applicable):	According to the tool for the calculation of the emission factor for an electricity system
QA/QC procedures:	These data will be updated when it is necessary. Information cross-check shall be used to assure and control quality.
Purpose of data:	Baseline
Additional comment:	N.A

Data / Parameter:	***COEFi***
Data unit:	*tCO2 per kton or GJ*

Description:	*Emission coefficient of each fuel i*
Measured /Calculated /Default:	*Calculated*
Source of data:	*EE.PP.M*
Value(s) of monitored parameter:	See file "Build Margin_LVLH_2010_2011.xls"
Monitoring equipment:	N.A
Measuring/ Reading/ Recording frequency:	N.A
Calculation method (if applicable):	According to the tool for the calculation of the emission factor for an electricity system
QA/QC procedures:	These data will be updated when it is necessary. Information cross-check shall be used to assure and control quality.
Purpose of data:	Baseline
Additional comment:	N.A

Data / Parameter:	***Fi***
Data unit:	*tCO2*
Description:	*Quantity of fuel i consumed by each power plant*
Measured /Calculated /Default:	*Calculated*
Source of data:	*EE.PP.M*
Value(s) of monitored parameter:	See file "Build Margin_LVLH_2010_2011.xls"
Monitoring equipment:	N.A
Measuring/ Reading/ Recording frequency:	N.A
Calculation method (if applicable):	According to the tool for the calculation of the emission factor for an electricity system
QA/QC procedures:	These data will be updated when it is necessary. Information cross-check shall be used to assure and control quality.
Purpose of data:	Baseline
Additional comment:	N.A

Data / Parameter:	**EF_{OM}**
Data unit:	tCO_2/MWh
Description:	Operating Margin emission factor (OM)
Measured /Calculated /Default:	Calculated
Source of data:	EE.PP.M based on XM and UPME information
Value(s) of monitored parameter:	2010: 0.2996 2011: 0.4498
Monitoring equipment:	N.A
Measuring/ Reading/ Recording frequency:	N.A
Calculation method (if applicable):	According to the tool for the calculation of the emission factor for an electricity system

QA/QC procedures:	This variable is calculated, not measured, and therefore does not need specific quality control procedures.
Purpose of data:	Baseline
Additional comment:	N.A

Data / Parameter:	**EF_{BM}**
Data unit:	tCO_2/MWh
Description:	Build Margin emission factor (BM)
Measured /Calculated /Default:	Calculated
Source of data:	EE.PP.M. based on XM and UPME information
Value(s) of monitored parameter:	2010: 0.2465 2011: 0.1197
Monitoring equipment:	N.A
Measuring/ Reading/ Recording frequency:	N.A
Calculation method (if applicable):	According to the tool for the calculation of the emission factor for an electricity system
QA/QC procedures:	This variable is calculated, not measured, and therefore does not need specific quality control procedures.
Purpose of data:	Baseline
Additional comment:	N.A

Data / Parameter:	**EF_{CM}**
Data unit:	tCO_2/MWh
Description:	Colombian grid emission factor (EF): Combined Margin emission factor (CM)
Measured /Calculated /Default:	Calculated
Source of data:	EE.PP.M.
Value(s) of monitored parameter:	2010: 0.2731 2011: 0.2848
Monitoring equipment:	N.A
Measuring/ Reading/ Recording frequency:	N.A
Calculation method (if applicable):	According to the tool for the calculation of the emission factor for an electricity system
QA/QC procedures:	This variable is calculated, not measured, and therefore does not need specific quality control procedures.
Purpose of data:	Baseline
Additional comment:	N.A

Data / Parameter:	**Electricity imports to the electricity system**
Data unit:	MWh
Description:	Electricity imports to the electricity system

Measured /Calculated /Default:	Calculated
Source of data:	CND
Value(s) of monitored parameter:	See file “Operating Margin_LVLH_2010” and “Operating Margin_LVLH_2011”
Monitoring equipment:	N.A
Measuring/ Reading/ Recording frequency:	N.A
Calculation method (if applicable):	According to the tool for the calculation of the emission factor for an electricity system
QA/QC procedures:	This variable is calculated, not measured, and therefore does not need specific quality control procedures.
Purpose of data:	Baseline
Additional comment:	N.A

D.3. Implementation of sampling plan

>>
There is no sampling involved in the monitoring of the proposed project activity.

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

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

>>
They are calculated applying the combined margin emission factor calculation and the energy generated by the plants:

$$BE_{sp,y}(tonCO2 / yr) = EF\ (tonCO_2 / MWh) \cdot EG_{spy}\ (MWh / yr) \qquad (1)$$

BEy_{2010} = 0.2731 x 181,325 = 49,510.78 tCO2

BEy_{2011} = 0.2848 x 185,175 = 52,728.82 tCO2

Where EG_y is the project generation (comprising “La Vuelta” and “La Herradura” plants) and EF_y, is the grid emission factor calculated as the weighted average of the Operating Margin emission factor (EF_{OMy}) and the Build Margin emission factor (EF_{BMy}).

Generation of the plants for years 2010 and 2011

Year	Month	Net Generation of the plants (MWh)		
		La Vuelta	La Herradura	Total
2010	January	3601.44	6705.32	10306.76
	February	2104.50	5958.27	8062.77
	March	518.80	5302.57	5821.36
	April	4503.88	9790.14	14294.02
	May	7547.03	13540.28	21087.31
	June	7392.97	13102.92	20495.89
	July	7373.51	13152.42	20525.93
	August	7729.62	10396.57	18126.19

	September	6081.02	5608.04	11689.06
	October	7577.73	12250.48	19828.21
	November	5419.48	9602.67	15022.14
	December	4792.02	11273.28	16065.30
	TOTAL	**64,642.00**	**116,682.95**	**181,324.95**
2011	January	6566.66	11389.66	17956.32
	February	4017.21	8257.22	12274.43
	March	7106.50	12029.46	19135.96
	April	5256.27	9562.42	14818.68
	May	6977.00	9887.61	16864.61
	June	6837.63	7780.70	14618.33
	July	7715.89	260.42	7976.31
	August	7123.30	13237.64	20360.93
	September	6103.47	12220.27	18323.74
	October	7090.34	10236.39	17326.73
	November	6871.88	7701.14	14573.01
	December	5427.61	5519.16	10946.77
	TOTAL	**77,093.75**	**108,082.08**	**185,175.83**

Please refer to the spreadsheet "Operating Margin_LVLH_2010" and "Operating Margin_LVLH_2011" for the hourly generation of each plant. It can also be found in the web of XM http://informacioninteligente10.xm.com.co/pages/default.aspx.

Operating Margin (OM):
Year 2010 OM: 0.2996 tCO_2//MWh (please refer to "Operating Margin LVLH_2010.xls")

Year 2011 OM: 0.4498 tCO_2//MWh (please refer to "Operating Margin LVLH_2011.xls")

According to the data available for the Colombian electricity sector, the methodological choice selected to calculate the OM is the Dispatch Data Analysis (DDA), Option C of the methodology.

The operating margin is calculated on an hourly basis for each day of the year, for the set of power plants in the top 10% of grid system dispatch order during the hour h.

$$EF_{OM\_DispathDaa,y}(tonCO_2 / MWh) = \frac{E_{OM,y}(tonCO_2)}{EG_y(MWh)}. \quad (2)$$

where *EGy* is the generation of the project in year *y*, and $E_{OM,y}$ are the emissions associated with the operating margin calculated as,

$$E_{OM\_DispathDaa,y}(tonCO_2) = \sum_h EG_h(MWh) \bullet EF_{DD,h}(tonCO_2 / MWh) \quad (3)$$

where EG_h is the generation of the project in each hour *h* and $EF_{DD,h}$ is the hourly generation-weighted average emissions per unit of energy of the set of power plants (*n*) in the top 10% of grid system dispatch order during hour *h*.

$EF_{DD,h}$ is calculated on an hourly basis as follows:

$$EF_{DDh}(tonCO_2/MWh) = \frac{\sum_j EF_j \cdot GEN_{j,h}}{\sum_j GEN_{j,h}} \quad (4)$$

Where:
EF_j is the emission factor of the power plant j included in the top 10% of the dispatch order $GEN_{j,h}$ is the electricity generation of plant *j* in the hour *h* obtained from XM web site: http://informacioninteligente10.xm.com.co/pages/default.aspx.

The emission factor of each power plant is calculated based on the heat rate and the fuel type used:

$$EF_j = HR_{i,j} \cdot EF_{CO2,i} \cdot OXID_i \quad (5)$$

Where:
EF_j: Emission factor of the power plant j (tCO_2/MWh)
$HR_{i,j}$: Heat rate of the power plant j using the fuel i reported to the UPME (energy units per MWh)
$EF_{CO2,i}$: is the CO_2 emission factor of the fuel i (tCO_2 per energy unit)
$OXID_i$: is the oxidation factor of the fuel i.

Build Margin (BM):

Year 2010 BM: 0.2465 tCO_2/MWh (please refer to "Build Margin LVLH 2010_2011.xls")
Year 2011 BM: 0.1197 tCO_2/MWh (please refer to "Build Margin LVLH 2010_2011.xls")

It is calculated as the generation-weighted average emission factor of a sample of power plants *n*, as follows:

$$EF_{BM}(tonCO_2/MWh) = \frac{\sum_j EF_{i,n,y} \cdot COEF_{i,n}}{\sum_j GEN_{n,y}} \quad (6)$$

Where
$F_{i,n,y}$: Amount of fuel *i* consumed by relevant power sources n (in energy unit)
$GEN_{n,y}$: Electricity delivered to the grid by power sources n (MWh)
$COEF_i$: CO_2 emission coefficient for fuel *i* (tCO_2e/energy unit)

For the group of small power plants whose consumption is not available, fuel consumption for each plant was calculated based on their heat rate as explained above for the OM.

The sample group *n* consists of either:

- The five power plants that have been built most recently, or
- The power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

From these two options, the sample group that comprises the larger annual generation was used, which corresponds to the second option.

Combined Margin (CM):
EF_y, is the grid emission factor (combined margin emission factor) calculated as the weighted average of the Operating Margin emission factor (EF_{OMy}) and the Build Margin emission factor (EF_{BMy}), as follows:

$$EF_y = w_{OM} \cdot EF_{OM,y} + w_{BM} \cdot EF_{BM,y} \quad (7)$$

EF_{2010} = 0.5 x 0.2996 + 0.5 x 0.2465 = **0.2731 tCO_2/MWh**
EF_{2011} = 0.5 x 0.4498 + 0.5 x 0.1197 = **0.2848 tCO_2/MWh**

The relative weights, w_{OM} and w_{BM}, are 0.5 according to the default value provided by the methodology.

Considering that there are neither project emissions nor leakage for the proposed project activity, the annual emission reductions are equal to:

$$ER_y\ (tonCO_2 / yr) = BE_y\ (tonCO_2 / yr) \quad (13)$$

ER_{2010} = 0.2731 x 181,325 = 49,510.78 tCO_2
ER_{2011} = 0.2848 x 185,175 = 52,728.82 tCO_2

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

>>
No project emissions are considered in the present project

E.3. Calculation of leakage

>>
No leakage emissions are considered in the present project

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)
2010	49,510.78	0.00	0.00	49,510.78
2011	52,728.82	0.00	0.00	52,728.82
Total	**102,239.59**	0.00	0.00	**102,239.59**

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)	137,590	102,239.59
Emission factor (t CO_2/MWh)	0.4128	2010: 0.2741 2011: 0.2848

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

>>

It is important to point out that the emissions calculated are lower than the estimates included in the PDD. The reason is that the emission factor used ex-ante to estimate the emission reductions presented in the PDD is higher than those factors calculated and used ex-post for the year 2010 and 2011.

The electricity generation of the project was higher than the average used in the PDD and the emission reductions obtained in the year 2010 are lower than those estimated in the registered PDD, as explained above, because of a lower emission factor.

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)	102,239.59	N.A

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

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for completing the CDM-MR-FORM
Organization name	EMPRESAS PÚBLICAS DE MEDELLÍN E.S.P.
Street/P.O. Box	Carrera 58 N° 42-125 / P.O. Box: 940
Building	
City	Medellín
State/Region	Antioquia
Postcode	Does not exist in Colombia
Country	Colombia
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Fax	
E-mail	
Website	www.epm.com
Contact person	Oscar Alonso Fernandez
Title	Engineer
Salutation	Mr.
Last name	Fernandez
Middle name	Alonso
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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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