Monitoring report form (Version 03.1)

Monitoring report

Title of the project activity	**LA CASCADA 2.3 MW HYDROELECTRIC PROJECT**
Reference number of the project activity	1411
Version number of the monitoring report	1.0
Completion date of the monitoring report	15 February 2013
Registration date of the project activity	27 January 2008
Monitoring period number and duration of this monitoring period	Monitoring Period n. 3 From 1 June 2011 to 31 December 2012 Duration of 579 days
Project participant(s)	Prestadora de Servicios Públicos La Cascada S.A. E.S.P. And MGM Carbon Portfolio S.a.r.l.
Host Party(ies)	Colombia
Sectoral scope(s) and applied methodology(ies)	Sectoral Scope 1: Energy Industries Methodology: AMS.I.D., ver 10.
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	5,139 CERs/year 8,152 CERs during the Monitoring Period
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	8,296 CERs

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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La Cascada is a run of river small hydroelectric generating plant, with a capacity of 2.3 MW of energy generation located in San Roque Jurisdiction, Antioquia Department, Colombia Republic utilizing water from the Guacas River.

The project activity contemplates the production of clean hydroelectric power that will be supplied to the national interconnected system. The project will help to reduce Colombian CO2 emissions from petroleum and coal consumption for electricity generation, which would have occurred otherwise in the absence of the project activity.

The project has a total head of 100 m and a design flow rate of 3.0 m3/s. The hydroelectric power station has a power house with a horizontal axis Francis-type turbine connected to a generator with capacity to generate up to 2.57 MVA at 4.16 kV.

The electricity is delivered to the grid through a substation with a power transformer of 2.6 MVA (4.16 KV/44kV) and a transmission line with a length of approximately 560 m.

The following table shows a description of the equipment installed in the plant:

Characteristic	Value
Generator capacity	2.57 MVA
Generator power factor	0.9
Generator net capacity	2.31 MW
Hydraulic turbine	Francis, horizontal axis One unit
Turbine capacity	2.4 MW

The construction of the facility started in December 2006 and was completed and fully commissioned in July 2007, at which point it started commercial operations. The power plant has been generating electricity since then. No events or situations occurred during the monitoring period, which may impact the applicability of the methodology.

A.2. Location of project activity

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The project activity is located in San Roque Jurisdiction, Antioquia Department, Colombia Republic, and utilizing water from the Guacas River. The river basin of the Guacas stream is located in the northeast of Antioquia Department, on the eastern slope of the central mountain range covering the territory of San Roque Jurisdiction; with a utility area of 63 km2 before its opening to the Nus River.

The project geographical localization is 6.51° N and 74.92° W at 700 m of the small town Providencia**.**

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	Prestadora de Servicios Públicos La Cascada S.A. E.S.P. (private)	No
Switzerland	MGM Carbon Portfolio, S.a.r.l. (private)	No
United Kingdom of Great Britain and Northern Ireland	MGM Carbon Portfolio, S.a.r.l. (private)	No

A.4. Reference of applied methodology

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The methodology used in this project activity is AMS-I.D: Grid Connected Renewable Electricity Generation (Version 10).

A.5. Crediting period of project activity

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Fixed term of 10 years, going from 27 January 2008 up to 26 January 2018.

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

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The purpose of the project activity is to build a small hydroelectric power plant, with a total installed capacity of 2.3 MW. The substation, used to connect the power plant to the national grid, has a power transformer of 2.6 MVA (4.16 KV/44kV), a connection module and 44 kV transmission line of approximately 560 m long.

The diversion is done by wall dam on the main stream. A lateral intake over the left bank takes the water to be turbinated. After this, an open water channel of about 80 m long, conducts the water to the compensation tank. A sand trap retains sand grains over 1 mm. After moving through the compensation tank, water moves through the pressure conduit, a 58 m initial concrete box culvert, at low pressure, which is connected to a 307 m penstock, leading to the power house. The discharge is conducted to the stream by a stone lined open channel.

Equipment	**Characteristic**	
Turbine	**Units**	**1**
	Type	**Francis horizontal axis**
	Nominal Power	**2.4 MW**
	Flow Rate	**3 m^3/s**
	Net Design head	**100 m**
Generator	**Units**	**1**
	Type	**Synchronic, horizontal axis**
	Nominal Power	**2.57 MVA**
	Power factor	**0.9**
	Rated Capacity	**2.31 MW**
	Nominal Tension	**4.16 kV**

B.2. Post registration changes

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

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Not Applicable

B.2.2. Corrections

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Not Applicable

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

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Not Applicable

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

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Not Applicable

B.2.5. Changes to start date of crediting period

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Not Applicable

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

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Not Applicable

SECTION C. Description of monitoring system

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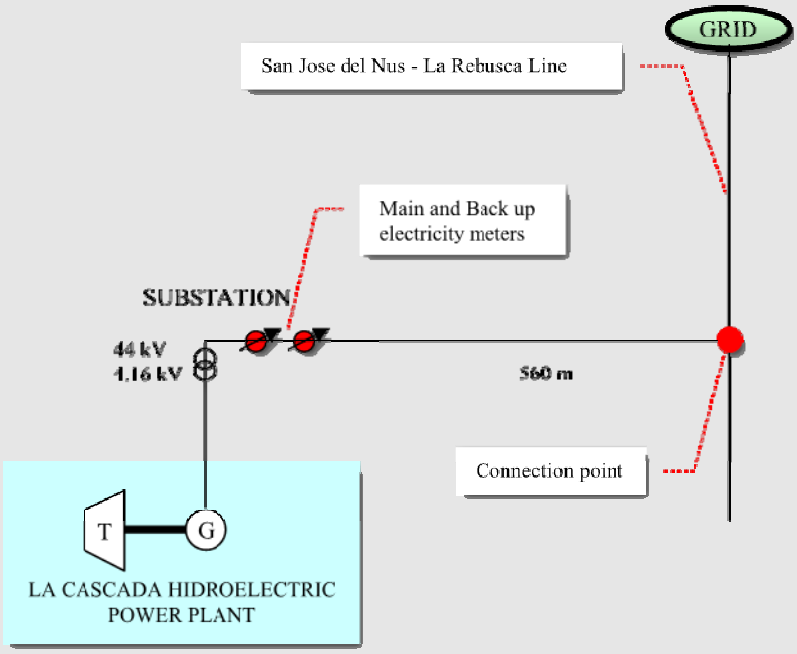
. The electricity generation meters are installed in the plant substation, at the point where the power plant is connected to the national grid. Therefore, the electricity that is measured is the net amount of electricity exported to the grid. Energy measurement are carried out through two energy meters manufactured by Power Measurement, reference ION 8600B (main - code PT-0611A-452-01) and ION 8600C (backup - code PT-0611A-447-01), of 0.2 accuracy. Both meters are connected to an Automatic Control System through a communication network, which allows its access for visualization of energy measures, and by modem, to the electrical distributing company, Empresas Públicas de Medellín S.A. E.S.P. (Utility Company of Medellín). The net electricity delivered to the grid is recorded in an hourly basis and reported once per month for invoicing. The internal memory in the acquired meters is able to record the history of measured values during an average period of six months.

. QA/QC Procedures: Energy meters are mounted on a self-supported panel with sealed door and cover to avoid possible connections access by non-authorized personnel. Both meters comply with standards ANSI C12.20-1998 “American national standard for electrical meters, 0.2 and 0.5 accuracy classes for current classes 2 and 20” and IEC 60687 “Alternating current static watt- hour meters for active energy (classes 0.2 S and 0.5 S)”. The user guide from the manufacturer (see

extract below), confirms the accuracy is adjusted and guaranteed from the factory. A verification before installation is recommended, which was done at EE.PP.M laboratory in June 2007. The file "CERTIFICADO CALIBRACIÓN CONTADORES.pdf" shows the calibration protocols used for the meters and the results. Extract from the user guide Schneider Electric: "Verifying Accuracy: All ION8600 meters are tested and verified at the factory according to IEC (International Electrotechnical Commission) standards; however, before a new revenue meter is installed it is important to perform a final accuracy verification. ION meters are digital and do not require calibration, only verification of their accuracy. This chapter outlines a procedure for accuracy testing ION8600 meters.

. Introduction The revenue-accurate ION meter is digital and therefore needs no servicing. It is tested for accuracy at the factory and remains accurate for the life of the meter. In contrast, electro-mechanical meters need mechanical adjustment before installation and periodic calibration thereafter. This procedure of 'calibration testing' is unnecessary for digital meters."

Scheme of the monitoring points: The following scheme shows the power plant, the substation and the metering points:



For the calculation of the combined margin emission factor, historical data on the most relevant variables are obtained through:

UPME: info for the starting date of the plants;

XM through NEÓN and PARATEC applications: data on net electricity generation, fuel type, fuel consumption and heat rates of the power plants connected to the grid.

Emission reductions calculation procedure: For this specific project, the methodology is applied through a spreadsheet model. The staff responsible for project monitoring completes the electronic worksheets on a monthly basis. The spreadsheet automatically provides annual totals in terms of GHG reductions achieved by the project.

The model contains a series of worksheets with different functions: Data entry sheets (Electricity Generation and Grid Emission Factor)

Result sheet (Emission Reductions) There are cells where the user is allowed to enter data. All other cells contain computed values that cannot be modified by the staff.

All the monitoring data is archived for two years following the end of the crediting period

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:	**OXID**
Unit:	-
Description:	Oxidation Factor
Source of data:	IPCC Guidelines for National Greenhouse Inventories: Reference Manual Volume 3 (1996)
Value(s) applied):	Coal: 0.98 Natural Gas: 0.995
Purpose of data:	Baseline
Additional comment:	Values updated to 1 in IPCC 2006.

Data / Parameter:	**CEF $_{CO2}$**
Unit:	Ton CO_2/TJ
Description:	Fuel CO_2 emission factor
Source of data:	FECO Cupme Fuel emission factors
Value(s) applied):	Coal: 97.26 Natural Gas: 55.1
Purpose of data:	Baseline
Additional comment:	

D.2. Data and parameters monitored

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

Data / Parameter:	**EG_y**
Unit:	MWh
Description:	Electricity Generation by the Plant
Measured/ Calculated / Default:	Measured
Source of data:	Prestadora de Servicios Públicos La Cascada S.A. E.S.P
Value(s) of monitored parameter:	26,000

Monitoring equipment:	<table><tr><th>Main</th><th>Backup</th></tr><tr><td>Serial: PT-0611A-452-01</td><td>Serial: PT-0611A-447-01</td></tr><tr><td>Type: ION 8600B</td><td>Type: ION 8600C</td></tr><tr><td>Manufacturer: Power Measurement</td><td>Manufacturer: Power Measurement</td></tr><tr><td>Class: 0.2</td><td>Class: 0.2</td></tr></table> Electricity meters were calibrated at EE.PP.M laboratory in June 2007. The file “CERTIFICADO CALIBRACIÓN CONTADORES.pdf” shows the calibration protocols used to calibrate the meters and the results. The user guide from the supplier (see extract), confirms the accuracy is adjusted and guaranteed from the factory. A verification (not calibration) before installation is recommended, which was done at EPM laboratories. Extract from the user guide Schneider Electric: “Verifying Accuracy: All ION8600 meters are tested and verified at the factory according to IEC (International Electrotechnical Commission) standards; however, before a new revenue meter is installed it is important to perform a final accuracy verification. ION meters are digital and do not require calibration, only verification of their accuracy. This chapter outlines a procedure for accuracy testing ION8600 meters. Introduction The revenue-accurate ION meter is digital and therefore needs no servicing. It is tested for accuracy at the factory and remains accurate for the life of the meter. In contrast, electro-mechanical meters need mechanical adjustment before installation and periodic calibration thereafter. This procedure of ‘calibration testing’ is unnecessary for digital meters.”
Measuring/ Reading/ Recording frequency:	Hourly Measured
Calculation method (if applicable):	Not Applicable
QA/QC procedures:	Verified with EPM during invoicing procedure
Purpose of data:	baseline
Additional comment:	

Data / Parameter:	**EF_{OM}**
Unit:	Ton CO_2/MWh
Description:	Operation Margin grid emission factor (EF OM)
Measured/ Calculated / Default:	calculated

Source of data:	XM through NEÓN and PARATEC applications, data on net electricity generation, fuel type, fuel consumption and heat rates.
Value(s) of monitored parameter:	2011: 0.4621 2012: 0.5024
Monitoring equipment:	Not Applicable
Measuring/ Reading/ Recording frequency:	Not Applicable
Calculation method (if applicable):	According to the tool for the calculation of the emission factor for an electricity system
QA/QC procedures:	his variable is calculated, not measured, and therefore does not need specific quality control procedures.
Purpose of data:	Baseline
Additional comment:	

Data / Parameter:	**EF_{BM}**
Unit:	Ton CO_2/MWh
Description:	Build Margin grid emission factor (EF OM)
Measured/ Calculated / Default:	calculated
Source of data:	XM through NEÓN and PARATEC applications, data on net electricity generation, fuel type, fuel consumption and heat rates.
Value(s) of monitored parameter:	2011: 0.1260 2012: 0.1684
Monitoring equipment:	Not Applicable
Measuring/ Reading/ Recording frequency:	Not Applicable
Calculation method (if applicable):	According to the tool for the calculation of the emission factor for an electricity system
QA/QC procedures:	his variable is calculated, not measured, and therefore does not need specific quality control procedures.
Purpose of data:	Baseline
Additional comment:	

D.3. Implementation of sampling plan

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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

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

BEy(*tonCO*2 /*yr*) = *EFy*(*tonCO*2 /*MWh*) · *EGy*(*MWh*/*yr*)

BE11 = 0.2941 * 10,256 = 3,016 tCO_2

BE12 = 0.3354 * 15,744 = 5,281 tCO_2

BEy = 8,296 tCO2

Where *EGy* is the project generation and *EFy*, is the grid emission factor calculated as the weighted average of the Operating Margin emission factor (*EFOMy*) and the Build Margin emission factor *(EFBMy*).

Emission factor Calculation

The emission factor is calculated as a Combined Margin, consisting on an Operating Margin and a Build Margin emission factors. Both, the Operating Margin and the Build Margin emission factors are updated annually.

Operating Margin Calculation

According to the methodology and as explained in the PDD, it was calculated applying the Simple Adjusted method (option B) and updated annually *ex-post*:

$$EF_{OM} = (1-\lambda)\frac{\sum_{i,j} F_{i,j} \times COEF_i}{\sum_j GEN_j} + \lambda \frac{\sum_{i,k} F_{i,k} \times COEF_i}{\sum_k GEN_k}$$

Where:

λ	Lambda factor: fraction of time during low-cost/must-run sources are on the margin
$F_{i,j}/F_{i,k}$	mount of fuel *i* consumed by relevant power sources *j*/*k* (in energy unit)
GEN_j/GEN_k	Electricity delivered to the grid by power sources *j*/*k* (MWh)
$COEF_i$	CO2 emission coefficient for fuel *i* (tCO2e/energy unit)

For the group of small power plant whose consumption is not available, fuel consumption for each plant was calculated based on their heat rate as follows:

$F_{i,\,j-k}$ (*MBTU*) = $GEN_{\,j-k}$ (*MWh*) × $HR_{i,\,j-k}$ (*MBTU* / *MWh*)

The CO_2 emission coefficient $COEF_i$ is obtained as follows: $COEF_i = CEF_i \times OXID_i$

Where $CEF_{i\,CO2}$ emission factor per unit of energy of the fuel *i* (tCO_{2e}/energy unit) $OXID_i$ Oxidation factor of fuel *i* (%)

Year 2011 OM: **0.4621** tCO_2/MWh

Year 2012 OM: **0.5024** tCO_2/MWh

Please refer to spreadsheet “EF calculations_La Cascada 1-1.xlsx”

Build Margin Calculation

According to the methodology and as explained in the PDD, this factor is updated annually *ex-post*:

$$EF_{BM} = \frac{\sum_{i,m} F_{i,m} \times COEF_i}{\sum_m GEN_m}$$

Where $F_{i,m}$, $COEF_i$ and GEN_m are analogous to the variables described above for the operating margin emission factor determination

Year 2011 BM: **0.1260** tCO_2/MWh

Year 2012 BM: **0.1684** tCO_2/MWh

Please refer to spreadsheet “EF calculations_La Cascada 1-1.xlsx”

Combined Margin Calculation

Applying a 0.5 weight for both the operating margin and the build margin, the combined margin emission factors for the Colombian grid is:

EFCM = 0.5× *EFOM* + 0.5× *EFBM*

Year 2011 CM: **0. 0.2941** tCO_2/MWh

Year 2012 CM: **0.3354** tCO_2/MWh

Please refer to spreadsheet “EF calculations_La Cascada 1-1.xlsx”

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

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No project emissions are considered in the present project.

E.3. Calculation of leakage

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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)
Total	8,296	0	0	8,296

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)	8,152	8,296

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

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PDD estimations and actual values are very similar, being the actual values less than 2% higher than the PDD estimations.

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)	8,152	0

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Document information

Version	*Date*	*Description*
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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