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

CONTENTS

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

MONITORING REPORT
Version 1, 05/05/2011

LA CASCADA 2.3 MW HYDROELECTRIC PROJECT
UNFCCC # 1411
Monitoring period number 2 (01/09/2009 - 31/5/2011)

SECTION A. General description of the project activity

A.1. Brief description of the project activity:

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 CO_2 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 m^3/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.
The emission reductions achieved by the implementation of the project activity for the monitoring period, **1 September 2009 - 31 May 2011 are 11,159 tCO_2**.

A.2. Project Participants

Name of Party involved	Private and/or public entity(ies) project participants (as applicable)	Party involved wishes to be considered as project

		participant (Yes/No)
Colombia (Host)	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.3. Location of the project activity:

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.

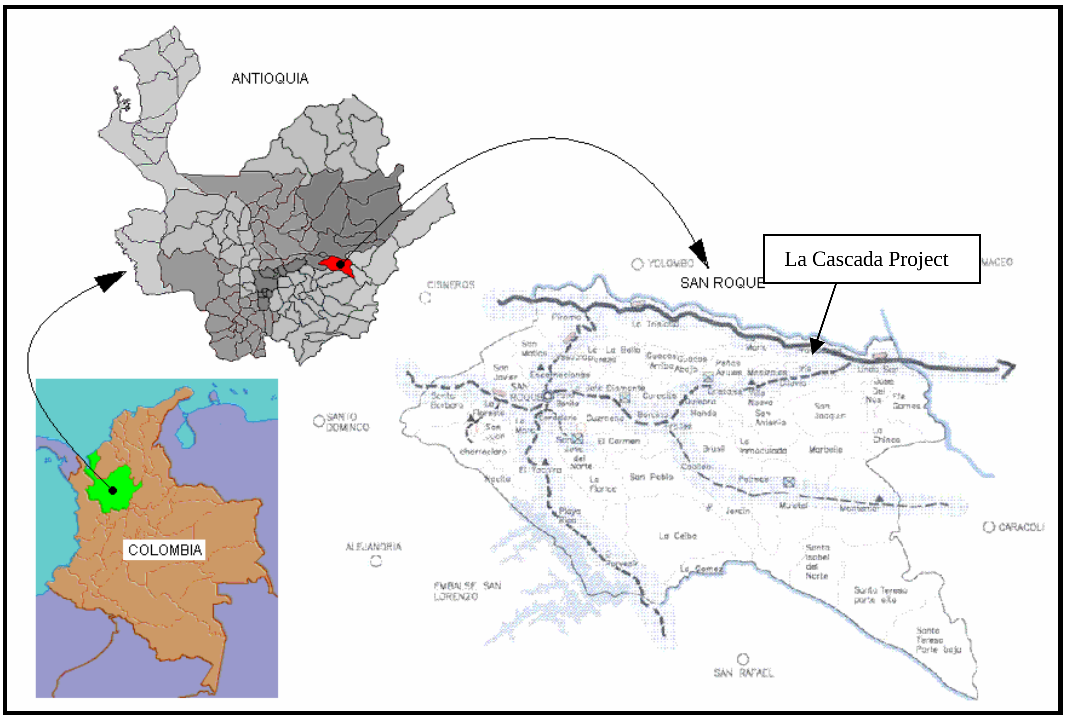
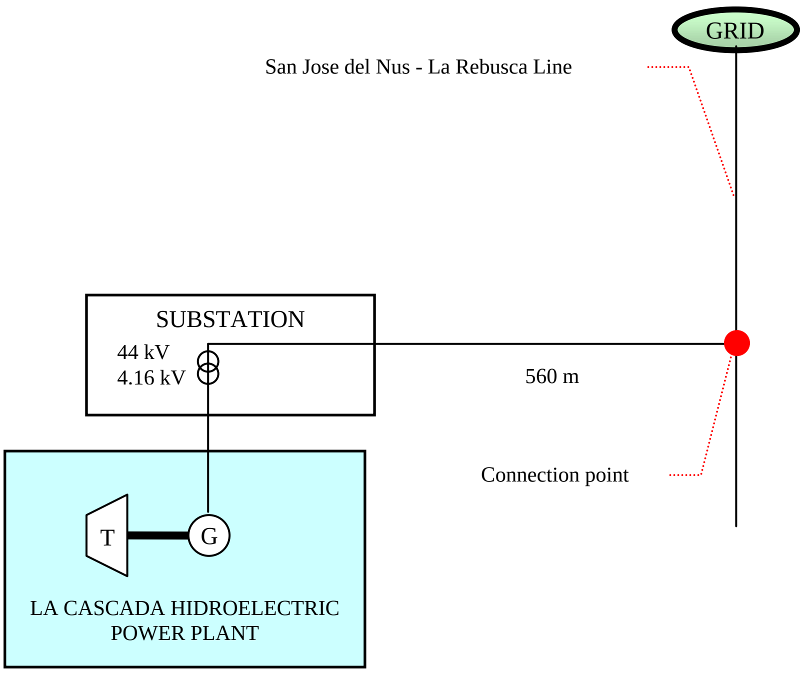


Figure 1: Colombia, Antioquia Department and San Roque

A.4. Technical description of the project

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. A dissipation structure to return the water to the stream channel was constructed as well.

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 (cosine ø)	0.9
	Rated capacity	2.31 MW
	Nominal tension	4.16 kV

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

The methodology applied to the registered CDM project activity is *AMS-I.D (version 10): "Grid Connected Renewable Electricity Generation"*.
The methodology also refers to the *"Tool for demonstration and assessment of additionality"*.

A.6. Registration date of the project activity:

The project was registered by the CDM Executive Board on January 27th, 2008.

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

The crediting period of the project activity is January 27th 2008 to January 26th 2018 (fix)

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

The monitoring report was completed by:

MGM International S.A.
Junín 1655, 1º B
C1113AAQ
Buenos Aires, Argentina
Tel.: (54 11) 5219-1230
dezcurra@mgminter.com

SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

Event	Date
Construction start date	December 2006
Equipment purchase	January-March 2007
Letter of approval	April 2007
Operation start date	17 July 2007
Validation	November 2007
Registration	27 January 2008

The project is fully implemented and operational since July 2007.
No events or situations occurred during the monitoring period, which may impact the applicability of the methodology.

B.2. Revision of the monitoring plan

NA.

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

NA.

B.4. Notification or request of approval of changes

NA.

SECTION C. Description of the monitoring system

Under the monitoring plan, which was outlined in accordance with the requirements of AMS-I.D Version 10, the variables to be monitored during the crediting period are:

- Electricity generation from the proposed project activity.
- Data needed to recalculate the OM.
- Data needed to recalculate the BM.

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.

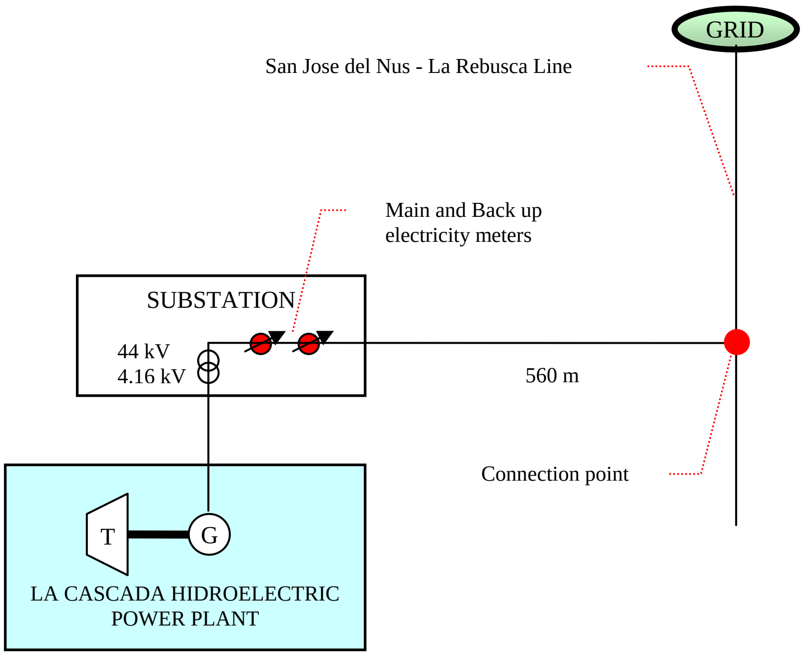
Both meters comply with standards ANSI C12.20-1998 "American national standard for electrical meters, 0.2 and 0.5 accuracy classes for current classes 2 and 20" and IEC 60687 "Alternating current static watt-hour meters for active energy (classes 0.2 S and 0.5 S)".

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.

A color-coded key is used to facilitate data input. The key for the code is as follows***:***

- ***Input Fields:*** Pale yellow fields indicate cells where project operators are required to supply data input, as is needed to run the model;
- ***Result Fields:*** Green fields display result lines as calculated by the model.

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 determined at registration and not monitored during the monitoring period, including default values and factors

Data / Parameter:	***OXID***
Data unit:	-
Description:	Oxidation factor
Source of data used:	IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual Volume 3 (1996)
Value(s):	Coal: 0.98 Natural gas: 0.995
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline
Additional comment:	Updated in IPCC 2006 to 1

Data / Parameter:	CEF_{CO2}
Data unit:	tonne CO_2/TJ
Description:	CO_2 emission factor
Source of data used:	FECOCupme Fuel Emission factors
Value(s):	Coal: 97.26 Natural gas: 55.1
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline
Additional comment:	

D.2. Data and parameters monitored

Data / Parameter:	EG_y
Data 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:	26,150 See table in section E for monthly data
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline
Monitoring equipment (type,	

<table>
<tr>
<td>accuracy class, serial number, calibration frequency, date of last calibration, validity)</td>
<td>
<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.”
</td>
</tr>
<tr><td>Measuring/ Reading/ Recording frequency:</td><td>Hourly measured</td></tr>
<tr><td>Calculation method (if applicable):</td><td>NA</td></tr>
<tr><td>QA/QC procedures applied:</td><td>Verified with EPM during invoicing procedure</td></tr>
</table>

Data / Parameter:	**EF_{OM}**
Data unit:	tCO_2/MWh
Description:	Operating Margin grid emission factor (EFOM)
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:	2009: 0.6086 2010: 0.6353
Indicate what the data are used for (Baseline/ Project/	Baseline

Leakage emission calculations)	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	NA
Measuring/ Reading/ Recording frequency:	NA
Calculation method (if applicable):	According to the tool for the calculation of the emission factor for an electricity system
QA/QC procedures applied:	This variable is calculated, not measured, and therefore does not need specific quality control procedures.

Data / Parameter:	**EF_{BM}**
Data unit:	tCO_2/MWh
Description:	Build Margin grid emission factor (EFBM)
Measured /Calculated /Default:	Calculated
Source of data:	UPME data for starting date, XM through NEÓN and PARATEC applications, data on net electricity generation, fuel type and heat rates.
Value(s) of monitored parameter:	2009: 0.3050 2010: 0.2041
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	NA
Measuring/ Reading/ Recording frequency:	NA
Calculation method (if applicable):	According to the tool for the calculation of the emission factor for an electricity system
QA/QC procedures applied:	This variable is calculated, not measured, and therefore does not need specific quality control procedures.

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

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

$$BE_y(tonCO_2/yr) = EF_y(tonCO_2/MWh) \cdot EG_y(MWh/yr) \quad (1)$$

BE_{09} = 0.4568 x 4,957 = 2,264 tCO_2
BE_{10} = 0.4197 x 14,651 = 6,149 tCO_2

BE_{11} = 0.4197 x 6,542 = 2,746 tCO_2

BE_y = 11,159 tCO_2

Where EG_y is the project generation 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}).

Net generation of the plant during the monitoring period

Net generation (MWh)	2009	2010	2011
January		672	1,284
February		488	1,012
March		612	1,384
April		680	1,416
May		1,194	1,446
June		1,513	
July		1,485	
August		1,535	
September	1,260	1,576	
October	1,298	1,645	
November	1,379	1,590	
December	1,020	1,661	
Total per year	**4,957**	**14,651**	**6,542**
Total		**26,150**	

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.

It is important to point out that ex-post grid emission factor for year 2009 was applied only for the months corresponding to 2009. Ex-post grid emission factor for year 2010 was applied for the whole 2010 and the months corresponding to 2011 monitoring period. The reason for this is that data required to calculate the emission factor for the year 2011 is not yet available.

For that reason, operation data for year 2010 were used for the calculation of the emission factor and applied to the whole 2010 period and part of 2011 for emission reduction calculations.

This option is considered in the methodology, as follow:

"Ex post option: If the ex post option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring. If the data required to calculate the emission factor for year y is usually only available later than six months after the end of year y, alternatively the emission factor of the previous year y-1 may be used. If the data is usually only available 18 months after the end of year y, the emission factor of the year proceeding the previous year y-2 may be used."

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
$F_{i,j}$ /$F_{i,k}$	Amount 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)
$COEF_i$	CO_2 emission coefficient for fuel *i* (tCO_2e/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:

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

The CO_2 emission coefficient $COEF_i$ is obtained as follows:

$$COEF_i = CEF_i \times OXID_i$$

Where

CEF_i	CO_2 emission factor per unit of energy of the fuel *i* (tCO_2e/energy unit)
$OXID_i$	Oxidation factor of fuel *i* (%)

Year 2009 OM: **0.6086** tCO_2/MWh
Year 2010 OM: **0.6353** tCO_2/MWh

Please refer to spreadsheet "EF simple adjusted 09-10"

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 2009 BM: **0.3050** tCO_2/MWh
Year 2010 BM: **0.2041** tCO_2/MWh

Please refer to spreadsheet "EF simple adjusted 09-10"

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:

$$EF_{CM} = 0.5 \times EF_{OM} + 0.5 \times EF_{BM}$$

Year 2009 CM: 0.4568 tCO_2/MWh
Year 2010 CM: 0.4197 tCO_2/MWh

Please refer to spreadsheet "EF simple adjusted 09-10"

E.2. Project emissions calculation

No project emissions are considered in the present project

E.3. Leakage calculation

No leakage emissions are considered in the present project

E.4. Emission reductions calculation / table

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

$$ER_y(tonCO_2 / yr) = BE_y(tonCO_2 / yr)$$

ER_{09} = 0.4568 x 4,957 = 2,264 tCO_2
ER_{10} = 0.4197 x 14,651 = 6,149 tCO_2
ER_{11} = 0.4197 x 6,542 = 2,746 tCO_2

ER_y = 11,159 tCO_2

	2009 Sep 1st-Dec 31st	2010 Jan 1st-Dec 31st	2011 Jan 1st-Apr 30th	Total
ER (tCO_2e)	2,264	6,149	2,746	**11,159**

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

Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reductions 09 (tCO_2e)	1,712 (four months)	2,264
Emission reductions 10 (tCO_2e)	5,136	6,149
Emission reductions 11 (tCO_2e)	2,140 (five months)	2,746

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

It is important to point out that the emissions calculated are higher in comparison with those estimated and included in the PDD.
The main reason for this is that the emission factor is monitored and varies from one year to another.

The actual generation of the plant was extremely similar to the forecast from the PDD as it can be seen in the following table:

Net generation (MWh)	PDD*	2009	PDD*	2010	PDD*	2011
January			*1,196*	672	*1,196*	1,284
February			*1,196*	488	*1,196*	1,012
March			*1,196*	612	*1,196*	1,384
April			*1,196*	680	*1,196*	1,416
May			*1,196*	1,194	*1,196*	1,446
June			*1,196*	1,513		
July			*1,196*	1,485		
August			*1,196*	1,535		
September	*1,196*	1,260	*1,196*	1,576		
October	*1,196*	1,298	*1,196*	1,645		
November	*1,196*	1,379	*1,196*	1,590		
December	*1,196*	1,020	*1,196*	1,661		
Total per year	**4,784**	**4,957**	**14,350**	**14,651**	**5,980**	**6,542**
Difference	**+ 3.6%**		**+ 2.1%**		**+ 9.4%**	

** PDD generation is 14,350 MWh/year which would be equivalent to 1,195.8 MWh/month*

The emission factor for year 2009 was 27.6 % higher than the ex-ante calculation from the PDD.
The emission factor for year 2010 was 17.2 % higher than the ex-ante calculation from the PDD.
As it is illustrated in the table below, the main reason for the EF increase was the lambda factor that reflects the composition of the generation during the year:

Factor	PDD*	2009	2010
$OM_{LC/MR}$	0.0015	0.0000	0.0000
$OM_{NO\ LC/MR}$	0.5806	0.6521	0.6695
Lambda	0.2367	0.0668	0.0511
OM	0.4446	0.6086	0.6353
BM	0.2715	0.3050	0.2041
CM	**0.3581**	**0.4568**	**0.4197**
Difference		**+ 27.6%**	**+ 17.2%**

** PDD figures are the average of years 2004, 2005 and 2006*

- - - - -

History of the document

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