MONITORING REPORT

July 14, 2010
Version 1

Empresas Públicas de Medellín E.S.P

La Vuelta and La Herradura Hydroelectric Project

(UNFCCC #0735)

Verification period:
1 January 2009 - 31 December 2009

Project Participants (host)
Empresas Públicas de Medellín E.S.P.
Carrera 58 N° 42-125, Medellín, Antioquia, Colombia
www.eeppm.com

Prepared by
MGM International
www.mgminter.com

Table of Contents

MONITORING REPORT

La Vuelta and La Herradura Hydroelectric Project

1. INTRODUCTION

The purpose of the present monitoring report is to perform the verification of the emission reductions achieved by the implementation of the project activity for the period **1 January 2009 - 31 December 2009**.

The report also shows the Monitoring and Verification Plan for data collection and auditing followed by *Empresas Públicas de Medellín E.S.P.* in order to determine real and credible emission reductions.

The project activity development applies the approved CDM methodology *ACM0002 (version 6): "Consolidated baseline methodology for grid-connected electricity generation from renewable sources"*. The project was registered by the CDM Executive Board on January 15th, 2007. It can be found in http://cdm.unfccc.int/Projects/DB/DNV-CUK1161865279.03/view.html

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

The project is fully implemented and operational and this is the third verification performed under the CDM.

2. DESCRIPTION OF THE PROJECT ACTIVITY

The purpose of the project activity is to build a hydroelectric power plant with a total installed capacity of 31.5 MW, in order to take advantage of the capacity of La Herradura River, by installing two hydroelectric plants in a chain: *La Vuelta Hydro plant* and *La Herradura Hydro plant.*

The project would displace other generation sources connected to the local grid that use fossil fuels to produce energy. The project provides clean energy and reduces CO_2 emissions in Colombia.

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

Table 1: Technical characteristics of La Vuelta and La Herradura Hydroelectric Project. Operative Data.

Hydro Plant / Characteristic	La Vuelta	La Herradura
Installed Capacity	11.7 MW	19.8 MW
Mean flow	12.3 m^3/s	14.0 m^3/s
Fall	112 m	220 m
Hydraulic turbine	Francis, horizontal axis	Francis, horizontal axis
	One unit	Two units

Table 2: Design data of La Vuelta and La Herradura Hydroelectric Project turbines.

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	Francis, horizontal axis
	One unit	Two units

The difference between reported operative data (table 1) and design data (table 2) is because turbines manufacturers put in the nameplates the information at laboratory conditions where the equipment is calibrated. At operative level data are adjusted to the environmental conditions of the place where the generation plants are to be installed.

Capacity: Data on installed capacity in the nameplates of the generation units are design data. The installed capacity when the units are registered in XM is defined in accordance to the operative conditions that the agent considers optimal, after on-site tests are carried out.

Mean Flow: The mean flow in the nameplates is the maximum operative mean flow of the turbines. The mean flow to design the plant is obtained from historic data and/or flow estimates for the place where the hydroelectric plants are going to be installed.

Head or fall: The fall considered by the manufacturers is that for the maximum head corresponding to the maximum water level and for one unit generating at its maximum capacity. The project owner takes as head, the one that corresponds to the normal water level (not the maximum) and with all the units generating at effective capacity.

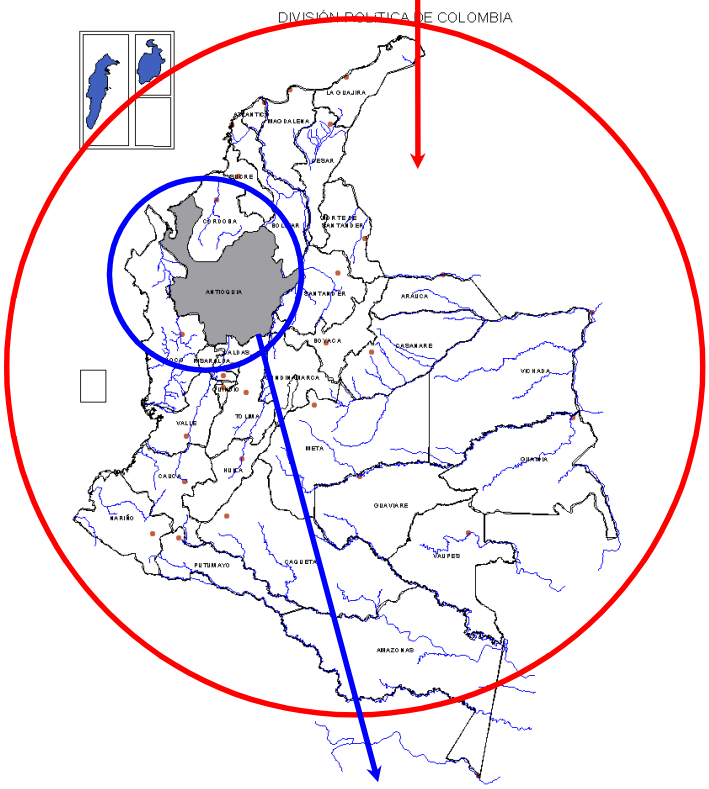
3. PROJECT LOCATION

The Republic of Colombia is located in Northern South America, bordering the Caribbean Sea, between Panama and Venezuela and bordering the North Pacific Ocean, between Ecuador and Panama. The project, which uses water from La Herradura River, is 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. In this area of approximately 230 km^2, important municipalities, such as Dabeiba, Mutatá, Chigorodó, Apartadó, and Turbo are located (See Figure 1).

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 km^2, which contributes to a mean flow of 14 m^3/s at catchment point. The construction is located in Frontino and Cañasgordas jurisdictions.

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 m^3/s at catchment point.


The islands of Malpelo, Providencia, and San Andrés are not shown.
Santa Marta
Barranquilla
Cartagena
Caribbean Sea
0 150 300 km
0 150 300 mi
PANAMA
Coveñas
Turbo
Cucuta
VENEZUELA
North Pacific Ocean
Medellín
Ibagué
BOGOTÁ
Buenaventura
Cali
Tumaco
Pasto
Mitú
ECUADOR
BRAZIL
Amazon
PERU
Leticia


DIVISIÓN POLITICA DE COLOMBIA

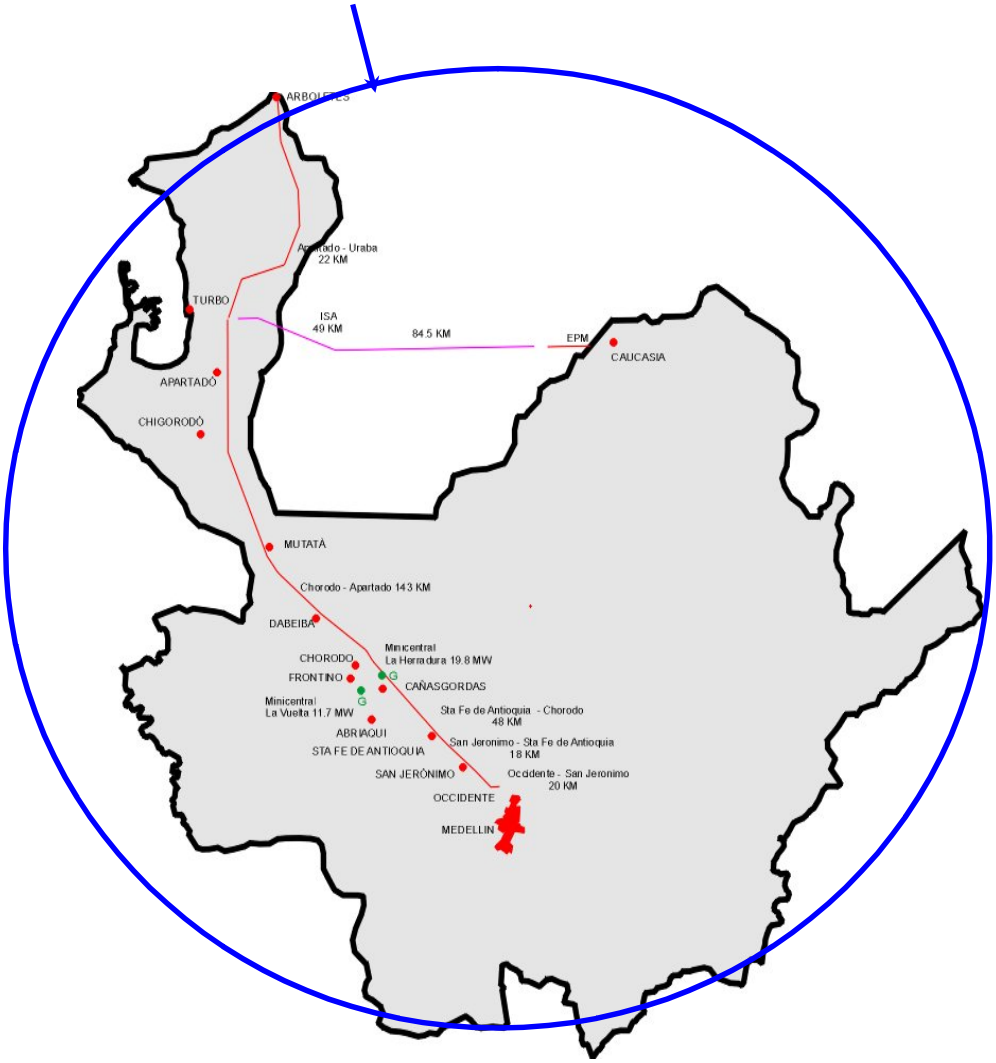


Figure 1: Colombia (above) and Antioquia Department (below)
Geographic coordinates: Approx. 6ºN, 76ºW
Source: http://www.eia.gov/cia/publications/factbook/geos/co.html
Green dots represent La Vuelta and La Herradura power plants location

4. APPLIED METHODOLOGY

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"*.

The electricity grid mix of Colombia is dominated by hydro plants (65.6%) and to a lesser extent by thermal plants (34.4%). Power plants are dispatched according to their generation costs, the least-cost plants enter first, while the plant dispatched later to cover the demand sets the marginal price of electricity.

In the context of the renewable project activity, only baseline emissions are considered in the calculation of emission reductions. Leakage emissions are not to be included under this

methodology and as the power density of the project is greater than 10 W/m^2 (1,893 W/m^2 for La Vuelta and 6,199 W/m^2 for La Herradura) then methane emissions are to be disregarded.

Baseline emissions are calculated applying the combined margin emission factor (CM), calculated as the combination of the operating margin (OM) and the build margin (BM). The chosen method to calculate the OM is **option c) Dispatch Data Analysis (DDA)** of ACM0002 Version 6 that provides a more accurate calculation. Moreover, **Option 2** of the methodology is selected to calculate the BM.

The weights applied to the OM and the BM in order to calculate the CM are 0.5 and 0.5 respectively.

5. MONITORING PLAN IMPLEMENTATION

Under the monitoring plan, which was outlined in accordance with the requirements of ACM0002 Version 6, the variables to be monitored during the crediting period are:

- Electricity generation from the proposed project activity.
- Data needed to recalculate the OM, if needed, based on the choice of the method to determine the OM, consistent with the consolidated baseline methodology.
- Data needed to recalculate the BM, if needed, consistent with the consolidated baseline methodology.
- For new hydroelectric projects, the surface area of reservoir at the full reservoir level.

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"* (Measurement Team) is in charge of taking the measurements. The Measurement Team is responsible for reporting to XM on the Generation Boundaries, the boundaries between the agents and the large energy clients supplied by EPM. 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* software.

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

EVLT1001 LA VUELTA
EHRD1001 LA HERRADURA

And in these codes are the official data reported to XM.

The following two sub-sections of this report show variables monitored and also not monitored parameters used to calculate the emission reductions from the CDM project.

5.1 - Variables under monitoring

For the calculation of the combined margin emission factor historical data on the most relevant variables are obtained through an online service based on databases of the wholesaler energy market. The ASIC (*Administrador del Sistema de Intercambios Comerciales* – Administrator of

the Commercial Transactions System) provides information to the generators supported on the largest Data Warehouse of the energy sector of Colombia. As a result, the search for information is done online in a more consistent and faster way.

The following table shows those variables that were monitored during the crediting period, how they were monitored and the quality assurance procedures applied during their monitoring.

Table 2: Data for Baseline Emissions calculation

1

Data variable	***Electricity Generation (EG)***
Data unit	MWh
Source	EE.PP.M
Measurement and recording frequency	Hourly measured. Monthly recorded. See table 4 in section 8.1 where the monitored values are.
Measurement procedures **And** **Comments about QA/QC**	**Measurement of Electricity Generation:** Electricity generation is measured by *electronic electricity meters*. The obtained values are cross-checked with the generation measured in terminals and vs. SCADA system ("Supervisory Control And Data Acquisition"). 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. **Quality Control and Quality Assurance:** <u>Calibration of meters:</u> Electricity meters were calibrated at EE.PP.M laboratory before being installed in the plant in 2004. The files *"PROTOCOLO MEDIDOR LA HERRADURA_2004"*, *"PROTOCOLO MEDIDOR LA VUELTA_2004"* show the calibration protocols used to calibrate the meters. 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 calibration frequency is approximately every 4 years. During 2008 another calibration was made *in-situ* (refer to *"CALIBRACIÓN EN SITIO-LA VUELTA Y LA HERRADURA-2008-02-13"*) 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 proofs 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.

	The patterns used to calibrate the electricity meters *in-situ* could be any of the following: • Portable Standard MTE Nº 16, 17, 18 (accuracy 0.05) • Calibration Bench LANDIS TALOGYR 6061 • Calibration Bench ZERA ED 6816

2

Data variable	***Colombian grid emission factor (EF): Combined Margin emission factor (CM)***
Data unit	tCO_2/MWh
Source	EE.PP.M.
Measurement and recording frequency	This variable is calculated as the weighted sum of OM and BM emission factors. Refer to section 7.1 for formulae. Annually updated and recorded. See spreadsheet *"LVLH Monitoring ER 2009.xls"* where combined margin is calculated.
Measurement procedures **And** **Comments about QA/QC procedures**	This variable is calculated, not measured, and therefore does not need specific quality control procedures.

3

Data variable	***Build Margin emission factor (BM)***
Data unit	tCO_2/MWh
Source	EE.PP.M.
Measurement and recording frequency	Refer to section 7.1 for formulae on calculation of this variable. Annually updated and recorded as per Option 2 of ACM0002 Version 6. See Spreadsheets *"Margen_Construcción_LVYLH_2009.xls"* Where data used and method of calculation is developed.
Measurement procedures **And** **Comments about QA/QC procedures**	This variable is calculated, not measured, and therefore does not need specific quality control procedures.

4

Data variable	***Operating Margin emission factor (OM)***
Data unit	tCO_2/MWh
Source	EE.PP.M
Measurement and recording frequency	This variable is calculated as per **option c) DDA** of methodology ACM0002 Version 6. Refer to section 7.1 for formulae applied. Annually updated and recorded. See spreadsheets *"Margen_Operación_LVLH_2009.xls"* Where data used and method of calculation is developed.
Measurement procedures **And** **Comments about QA/QC procedures**	This variable is calculated, not measured, and therefore does not need specific quality control procedures.

5.2 - Not monitored data

According to Annex 3 Baseline Data of the Registered PDD, the following data are considered fixed along the first crediting period and are therefore not monitored:

Table 3: Not monitored data

Item	**Description**	**Value/Unit**	**Source**
$OXID_{coal}$	Coal oxidation factor	0.98	IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual Volume 3 (1996)
$EF_{CO2coal}$	CO_2 emission factor for coal	94.6 ton CO_2/TJ	IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual Volume 3 (1996)
$OXID_{NG}$	Natural gas oxidation factor	0.995	IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual Volume 3 (1996)
EF_{CO2NG}	CO_2 emission factor for natural gas	56.1 ton CO_2/TJ	IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual Volume 3 (1996)

6. ENVIRONMENTAL MANAGEMENT PLAN

First, 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 develops 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 do the follow up of the application of the plan and to identify opportunities for improvement.

Additional discretional programs of environmental management

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

- Geomorphologic 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 m^2 of affected areas due to erosion were identified. It is necessary 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.

Process of Voluntary Social Management:

MUNICIPALITY	DESCRIPTION	INVESTMENT (COP)
ABRIAQUI	Joint participation between Empresas Públicas de Medellín and Abriaquí Municipality in the development of Productive Projects	$ 26,350,000
	Transferences Law 99 - 1993	$ 210,140,187
CAÑASGORAS	Joint participation between Empresas Públicas de Medellín and Cañasgordas Municipality in the development of Productive Projects	$ 97,466,775
	Transferences Law 99 - 1993	$ 55,721,973
FRONTINO	Joint participation between Empresas Públicas de Medellín and Frontino Municipality in the development of Productive Projects	$ 45,988,750
	Transferences Law 99 - 1993	$ 60,821,578
OTHERS		
CORPOURABÁ	Transferences Law 99 - 1993	$326,683,738
	Execution of the agreement for the construction of erosion control works in the neighborhoods of Monos, corcovados and Cejen, in the municipality of Abriaquí	$ 427,000,000
	Design of a conduction channel in La Herradura River.	$133,000,000
TOTAL INVESTMENT		**$ 1,383,173,001**

The total investment carried out by EE.PP.M to develop the Environmental Management Plan and the additional discretional plans associated to the hydroelectric project during its operation phase adds up to 1,383 million Colombian pesos for 2009.

7. FORMULAS USED FOR CALCULATION OF EMISSION REDUCTIONS

The following table provides the formulas used for calculation of emission reductions:

Project emissions	
Variable	**Formulas**

Estimated CO_2 emissions, *PE*	No project emissions are considered in the present project.
Baseline emissions	
Variable	**Formulas**
Estimated CO_2 emissions in the baseline, *BE*	They are calculated applying the combined margin emission factor calculation and the energy generated by the plants: $BE_y(tonCO_2/yr) = EF_y(tonCO_2/MWh) \cdot EG_y(MWh/yr)$ 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}).
Leakage	
Variable	**Formulas**
Estimated CO_2 emissions, *LE*	No leakage is considered in the present project.
Emission Reductions	
Variable	**Formulas**
CO_2 emission reductions, *ER*	Considering that there are neither project emissions nor leakage for the proposed project activity, the annual emission reductions are equal to: $ER_y(tonCO_2/yr) = BE_y(tonCO_2/yr)$

7.1 Procedure for the Grid Emission Factor calculation:

Operating Margin (OM):

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*.

$$EF_{OM\_DispatchData,y}(tonCO_2/MWh) = \frac{E_{OM,y}(tonCO_2)}{EG_y(MWh)} \qquad (1)$$

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

$$E_{OM,y}(tonCO_2) = \sum_h EG_h(MWh) \cdot EF_{DD,h}(tonCO_2 / MWh) \quad (2)$$

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 the fuel consumed by the generation power plant in the hour *h* (informed by the dispatch data center, CND), times the emission factor of the fuel, divided by the electricity generation of the corresponding generation device in the hour *h*. The CND will provide the hourly generation of every power plant, including La Vuelta and La Herradura. The fuel consumed may be calculated as the product between the electricity generation of the plant and its associated specific consumption. Thus, the hourly generation-weighted average emissions per unit of energy are calculated as follows:

$$EF_{DD,h}(tonCO_2 / MWh) = \frac{\sum_{i,n}\left[F_{i,n,h}(kton) \cdot COEF_{i,n}(tonCO_2 / kton)\right]}{\sum_n GEN_{n,h}(MWh)} \quad (3)$$

The quantity of fuel consumed by each plant is calculated as follows:

$$F_{i,n,h}(kton) = GEN_{i,n,h}(MWh) \cdot SC_{i,n}(kton / MWh) \quad (4)$$

where $GEN_{i\,n,h}$ is the electricity generation of plant *n* consuming fuel *i* in the hour *h* and $SC_{i,n}$ is the specific consumption of power plant *n* consuming fuel *i* (mass or volume converted to kton). This approach is used because no official data are available for hourly fuel consumption of thermal power plants serving the system.

Additionally, the emission coefficient of each fuel is calculated as follows:

$$COEF_{i,n}(tCO_2 / kton) = NCV_i(TJ / Kton) \cdot EF_{CO_2 i}(tonCO_2 / TJ).OXID_i \quad (5)$$

where NCV_i is the net calorific value of the fuel *i*, $OXID_i$ is the oxidation factor of the fuel *i*, and $EF_{CO2,i}$ is the CO_2 emission factor per unit of energy of the fuel *i*.

As the CND provides the specific consumption (*SC*) or the heat rate (*HR*) for each power plant, the equations are simplified to:

$$EF_{DD,h}(tCO_2 / MWh) = \frac{\sum_{n,i} SC_{i,n}(kton/MWh) \cdot COEF_{i,n}\ (tonCO_2 / kton) \cdot GEN_{i,n,h}\ (MWh)}{\sum_n GEN_{n,h}(MWh)} \quad (6)$$

However, as EPM (who calculated the emission factors) does not manage fuel consumption of the plants or their heat rate, the emission factor for each of the plants is calculated with the following equation:

$$EF_j = HR_{i,j}, \cdot NCV_i \cdot EF_{CO_2,i} \cdot OXID_i \quad (7)$$

The emission factor is provided by UPME for each plant. EPM uses directly the following equation:

$$EF_{DD,h} = \frac{\sum_{j,n} EF_j \cdot GEN_{j,n,h}}{\sum_{j,n} GEN_{j,n,h}} \quad (8)$$

Build Margin (BM):

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

$$\frac{\sum_i F_{i,y} \times COEF_i}{\sum_m GEN_{m,y}}$$

Option 2 of the methodology ACM0002/version 06 is selected for the BM calculation. The sample group *m* 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 will be used. Power plant capacity additions registered as CDM project activities will be excluded from the sample group *m*.

Taking into account the considerations mentioned above, the BM will be calculated as a generation-weighted average emission factor of a sample of power plants *m*, as follows:

$$EF_{BM,y}(tonCO_2 / MWh) = \frac{\sum_{i,m} \left[F_{i,m,y}(kton) \cdot COEF_{i,m}(tonCO_2 / kton) \right]}{\sum_m GEN_{m,y}(MWh)}$$

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:

$$EF_y(tonCO_2 / MWh) = w_{OM} \cdot EF_{OM,y}(tonCO_2 / MWh) + w_{BM} \cdot EF_{BM,y}(tonCO_2 / MWh)$$

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

Please refer to the following section where the results of the calculation are presented.

8. EMISSION REDUCTIONS CALCULATION

It is important to point out that the emissions calculated are lower in comparison with those estimated and included in the PDD. The main reason for this 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 2009.

The emission reductions are calculated as per the formulae shown in the previous section. The following tables show the information related to the calculation of emission reductions:

8.1 - Power generation by La Vuelta and La Herradura hydroelectric plants:

Table 4: Generation of the plants for years 2009

Year	Month	Net Generation of the plants (MWh)		
		La Vuelta	La Herradura	Total
2009	January	1,677.76	12,364.35	**14,042**
	February	0	12,040.99	**12,041**
	March	6,778.06	12,885.25	**19,663**
	April	7,003.26	12,709.54	**19,713**
	May	7,192.24	10,508.96	**17,701**
	June	5,479.98	6,110.07	**11,590**
	July	6,104.16	8,809.88	**14,914**
	August	4,408.75	9,612.03	**14,021**
	September	4,180.92	9,416.04	**13,597**
	October	5,891.47	9,439.99	**15,331**
	November	7,074.25	11,135.23	**18,209**
	December	6,136.22	12,329.34	**18,466**
Total		**61,927.07**	**127,361.67**	**189,289**

8.2 - Grid emission factor calculation

Build Margin Calculation

Option 2 of ACM0002 version 6 is selected for BM calculation. This factor is updated annually *ex-post* so it was calculated for the year 2009. Refer to the corresponding file[1] to check the calculation of the build margin for that year.

The results are:

Year 2009 BM: 0.3838 tCO_2/MWh

Operating Margin Calculation

As explained previously, it was calculated applying the Dispatch Data Analysis (option C of ACM0002 Version 6). The result for the 2009:

Year 2009 OM: 0.2604 tCO_2//MWh

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 are:

Year 2009 CM: 0.3221 tCO_2/MWh

The weights used will remain fixed throughout the first crediting period, in line with what is indicated in the methodology.

8.3 - Obtained emission reductions

	MONITORED 2009	ESTIMATED PDD 2009	Difference
EMISSION REDUCTIONS (tCO_2e)	**60,970**	**68,795**	**-11.4 %**

The emission reductions obtained in the year 2009 are 11.4 % lower than those estimated in the registered PDD, mainly because of a lower emission factor.