Monitoring report form

(Version 05.1)

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	Santa Ana Hydroelectric Plant	
UNFCCC reference number of the project activity	0275	
Version number of the monitoring report	04	
Completion date of the monitoring report	29/08/2017	
Monitoring period number and duration of this monitoring period	Monitoring period # 8 (from 01/08/2012 to 31/07/2015)	
Project participant(s)	Empresa de Acueducto y Alcantarillado de Bogotá (EAAB – ESP) EDF Trading Limited MGM Carbon Portfolio, S.a.r.l	
Host Party	Colombia	
Sectoral scope(s)	1: Energy industries (renewable - / nonrenewable sources).	
Selected methodology(ies)	AMS-I.D. Ver. 7 - Renewable electricity generation for a grid.	
Selected standardized baseline(s)	No applicable	
Estimated amount of GHG emission reductions or net GHG removals by sinks for this monitoring period in the registered PDD	61,927 tCO2e	
Total amount of GHG emission reductions or net GHG removals by sinks achieved in this monitoring period	GHG emission reductions or net GHG removals by sinks reported up to 31 December 2012	GHG emission reductions or net GHG removals by sinks reported from 1 January 2013 onwards
	2,213 tCO2e	26,542 tCO2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The city of Bogotá has three principal sources of drinking water: Tibitoc, La Regadera, and Chingaza. The treated water flow at the Chingaza system is conducted through an alternate tunnel named Usaquén, which leads the treated water from the Wiesner treatment plant, located in La Calera, to Santa Ana and Suba tanks, located in north of Bogotá, and others small storage tanks in the city through Rosales tunnel.

In order to take advantage in height difference between the Wiesner treatment plant and Santa Ana water tank, as well as the water flow delivered to the city through the Santa Ana and Suba control structures, Santa Ana Hydroelectric Plant was built on lands property of EAAB (between the years 2001 and 2003). In the power plant, the water is derived from the main conduction pipeline (potable water supply system) in a point adjacent to the flow control system, using an accessory that drives the water through a closed steel pipeline, to a pressurized conduction penstock and up to the distributor where the flow is directed to horizontal Francis turbine. The turbine is hosted in a powerhouse, with their respective generator, valves and control panels. A power substation is located at Usaquen substation. As the project plants work as a run-of-river type, taking water from an existing water supply system was not necessary to build a reservoir.

The power plant was designed to turbine a water flow of 13.5 m3/s, with an effective power rating of 13.43 MW and a net head of 105.9 m, which could generate 90 GWh/year approximately. However, the reduction in water demand of the city, the implementation of different measures to increase efficiency in its use, as well as measures to ensure availability of the required water supply for the city, have reduced the energy generation expectations.

The power generated by Santa Ana Hydroelectric Plant is delivered to the national interconnected system of Colombia in accordance to power market regulations and environmental and operational authorizations. A key objective of the project is to reduce greenhouse gas emissions in the grid.

The project began operations in June 2005 and operates continuously until today. Its CDM crediting period of 10 years started in August 2005. During last monitoring period, the power plant generated and delivered an average of 65.48 GWh to the national interconnected system of Colombia, reducing 28,755 tCO2e.

A.2. Location of project activity

The Santa Ana Hydroelectric Plant is located at north east of Bogotá city, Colombia, at coordinates:
110,324.65 North
105,849.56 East

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 whether the Party involved wishes to be considered as project participant (yes/no)
Colombia (host)	Public entity: Empresa de Acueducto y Alcantarillado de Bogotá (EAAB – ESP).	No
United Kingdom of Great Britain and Northern Ireland	Private entity: EDF Trading Limited MGM Carbon Portfolio, S.a.r.l	No
Switzerland	Private entity: MGM Carbon Portfolio, S.a.r.l	No

A.4. Reference of applied methodology and standardized baseline

The following approved baseline and monitoring methodology has been applied to the project activity:

AMS-I.D "Renewable electricity generation for a grid" Version 7.

The applied methodology AMS-I.D version 7 does not refer to additional methodologies or tools, therefore no additional methodologies or tools have been applied.

A.5. Crediting period of project activity

01/08/2005 – 31/07/2015 (10 years fixed)

A.6. Contact information of responsible persons/entities

Name of the person responsible for the monitoring report: Ms. Martha Patricia Cruz Moreno
Name of entity: Empresa de Acueducto y Alcantarillado de Bogotá E.S.P-EAAB
Phone: (571) 3447000 Ext.7061
E-mail: Martha.Cruz@acueducto.com.co
Project participant.

SECTION B. Implementation of project activity

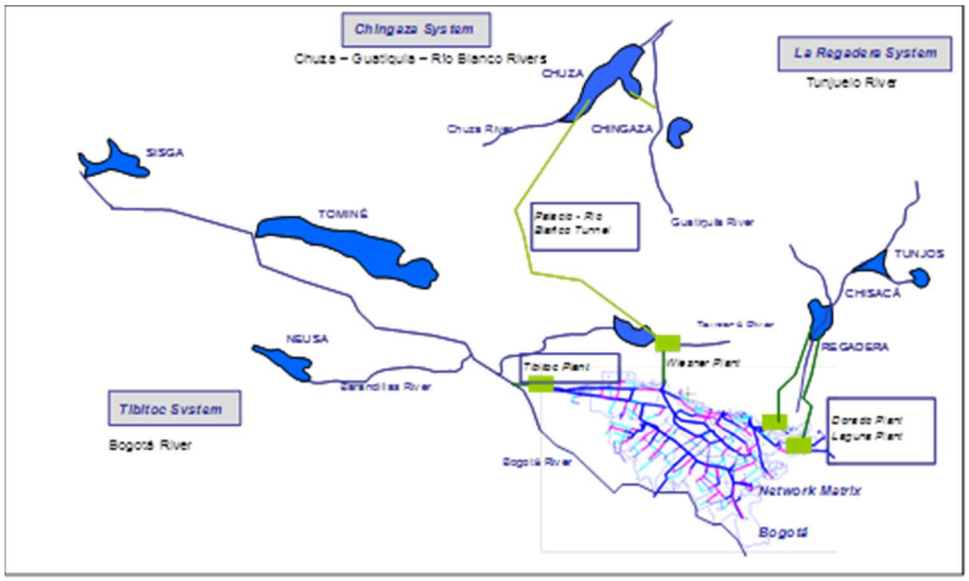
B.1. Description of implemented registered project activity

Context

The water supply system of Bogotá City also supplies surrounding municipalities as follows: in the north, Gachancipá, Tocancipá, Sopó, Cajicá, Chia and Cota`s industrial area; in the east, La Calera; in the west, Funza, Madrid and Mosquera; in the south, Soacha. The population served is close to 8 million people, representing nearly of 1,898,000 users and require an average daily flow of 15 m³/s of water approximately.

The three main systems that supply water to Bogotá and surrounding municipalities are:

Chingaza System (at east) which is associated with Francisco Wiesner treatment plant, Tibitoc System (at north) which is associated with the Tibitoc treatment plant and La Regadera System (at south) which is associated with El Dorado, Vitelma and Laguna treatment plants (the last two used only as a contingency system). The following figure represents the water supply system of Bogotá.



Source: EAAB

The Chingaza system is located at northeast of the city at the top of the east mountain range. It encompasses the Chuza reservoir, some catchment wells (e.g Blanco river system) and San Rafael reservoir, which receives water from the Chuza reservoir through an overflow structure located before the treatment plant, so as a minimum input from Teusacá River's upper basin.

The Chuza reservoir, which mainly regulates the flow of Guatiquía and Chuza rivers, is conducted to the treatment plant through a tunnels system leading the pressurized water to a control valve, which passes the water from a regulated flow to a free flowing condition. The reservoir of San Rafael is used during contingency periods, when there is suspension of supply from the Chuza reservoir, especially during inspection and maintenance operations between Chuza reservoir and the treatment plant Francisco Wiesner, whose output supplies approximately 70% of total city water demand.

The northern supply system encompasses Bogota river and a group of reservoirs that allow the regulation flow of this river and the Aposentos's reservoir (that regulates the Teusacá river`s flow downstream). The water collected by pumping is treated at the Tibitoc plant, whose output supplies approximately 28% of total city water demand.

A group of reservoirs that regulate the Tunjuelo river flow upper basin forms the southern supply system. The treatment plants associated are El Dorado, Vitelma and La Laguna. The output of this system supplies the remaining 2% of total city water demand [1]. Information regarding storage capacity and treatment of the water supply systems is detailed as follows.

Supply System	Reservoirs (millions of m^3)		Treatment Plants (m^3/s)	
Tibitoc	Tominé	690	Tibitoc	10.5
	Sisga	102		
	Neusa	102		
	Aposentos	0.8		
Chingaza	Chuza	257	Francisco Wiesner	14
	San Rafael	75		
La Regadera	Chisacá	6.7	El Dorado	1.6
	La Regadera	3.3	La Laguna	0.45
	Los Tunjos	2.4	Vitelma	1.5

Source: EAAB

[1] The Yomasa treatment plant is also considered part of the southern supply system that captures water from a creek that bears its name and has a treatment capacity of 0.025 m^3/s.

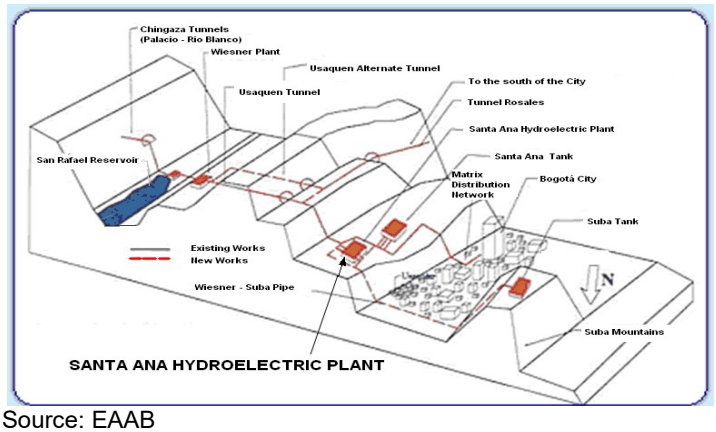
Location

The treated water flow in the Chingaza system is conducted through a tunnel known as Usaquen´s alternate tunnel. It is a conventional concrete covered tunnel, with 2.5 km length, which leads the treated water from the Wiesner plant, located in La Calera, to the Santa Ana and Suba tanks[2], located in the north of Bogotá, and to others storages tanks located in center, south east and south west of the city, through Rosales´s tunnel.

In order to take advantage of the difference in height between Wiesner plant and Santa Ana tank, as well as the water flow delivered to the city through the Suba and Santa Ana control structures, the Santa Ana Hydroelectric Plant was built between 2001 and 2003.

The Santa Ana Hydroelectric Plant began operations on June 10th, 2005 but its crediting period started on August 1th, 2005. It is located in northern Bogotá, at 119th street at top east, in the place known as “Santa Ana Complex”.

The feeding flow for the Suba and Santa Ana control structures[3], in normal operation is approximately 70% of treated flow at the Wiesner plant, which corresponds to 55% of the city demand, and provides the aqueduct service to the north, north east and north west of Bogotá. The plants to produce electric energy delivered into the national interconnected grid through local distribution system use the water flow that is normally transported by the potable water supply system of Bogotá. The following figure shows the location of the power plant.



Source: EAAB

Implemented project activity

The implementation of the power plant was in the key component of the potable water supply system of Bogota (PRS Santa Ana) considering all necessary precautions to ensure that the water supply service will not be affected (considering that the water supply is a priority over power generation). In the power plant installed (at the PRS) the water is derived from the main conduction pipeline (potable water supply system) in a point adjacent to the flow control valve. The derivation is made by an accessory (derivation pipeline) installed to drive the water through a closed steel pipeline to a pressurized conduction penstock and up to the distributor where the flow is directed to the turbines intake valves.

In the case of the PRS Santa Ana (located at the northeast of Bogota), the water deviation is from the control structure Santa Ana, upstream Santa Ana tank (the power plant was installed in parallel to the current dissipation pressure system composed by a Pratt valve). The plant has a pressure pipe for the conveyance of water (flow diversion), a hydraulic turbine and a return pipe to deliver the water to the original flow (acting as a by-pass).

[2] The storage capacity of Santa Ana tank is 30,000 m^3 and Suba tank is 90,000 m^3

[3] The hydroelectric plants to produce power normally use the flow required by Santa Ana and Suba tanks. However, when the turbo group in the plants is unavailable (in the event of failure, low flow or maintenance) a multijet valve installed in a parallel pipe will conduct the flow automatically. In the event that the turbo group and multijet valve are unavailable, the flow may be conducted through a derivation of high pressure.

In Santa Ana power plant, the turbine-generator is located in the site where the control structure was previously located, but it was necessary the installation of a hydro-pneumatic control system to ensure a smooth operation. The powerhouse contains one horizontal axis Francis type turbine (hydraulic reaction turbine in which the flow exits the turbine blades in an axial direction) connected to their respective synchronous generator. The discharge is made into the original conduction pipeline. The technical specifications for the installed equipment are as follows:

Power plant specifications		
Plant Design Flow	13.5	m3/s
Net Design Head	105.90	m
Power turbine (Francis Neirpic)	13,434	kW
Synchronous generator	16,380	kVA
Power isolation transformer	15,000	kVA

Source: EAAB

For power transmission, the electrical substation was located at the Usaquén substation (11.4 kV) owned by CODENSA (local power utility). In the courtyard was located the transformer and the switching equipment required for the connection to the electrical network. Given the characteristics of the net, the generator is used in a synchronous continuous operation, which allows the regulation of the line voltage and supply the reactive power required (the equipment is geared with a static excitation system brushless, which requires less maintenance). The connection to the National Interconnected System (NIS) is made at the Usaquén substation and the synchronization of the unit with the NIS can be made manual and/or automatic as a function of voltage, frequency and phase sequence. The connection of the generator stator is star type with neutral grounded.

To delivery power generated was not necessary the installation of a dedicated transmission line (National Dispatch Center confirms the quantity of energy delivered by the project activity; Codensa is in charge of the central control point of the meter readings).

For energy measurement, the monitoring technology complies with national regulations (Resolution 025, 1995 - Measurement Code). Energy measurement is made through two bidirectional energy meters of 0.2 accuracy, which 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 power meters are installed in the substation of the power plant. Data storage is made using an internal memory, recording for several months of measurements, backed-up every month in magnetic media, and stored for verification. Only authorized personnel/software is able to handle monitored information.

Expected operation

The Santa Ana power plant was designed to generate around 90 GWh per year with a 13.5 m^3/s water flow (considering the Chingaza System - Wiesner Plant expansion project there will be capacity to treat 21 m^3/s water flow[4] approximately). However, the reliable generation flow was significantly reduced compared to the design flow of the plant, due mainly to the reduction in the trend of water consumption in the city since the late nineties[5], which was of 17.6 m^3/ s in 1996 to about 10 m^3/s in recent years.

The reduction in city water demand, due to efficiency measures in water use promoted by EAAB, as well as the adoption of measures to ensure the water supply required for the city, reduced the generation expectations of the power plant.

One of the most important measures taken by EAAB to ensure a reliable supply of water required to meet the demand of the city, an overlapped goal with any other objective, was the Vulnerability Mitigation Program implementation of the water supply systems. This program was designed to identify any potential risks that could affect the drinking water supply to the city, including activities such as Chingaza Tunnels Maintenance and

[4] EAAB. Designs for Construction of the Usaquen Alternate Tunnel and Santa Ana Hydroelectric Plant. Report No. 5. Optimization of the Central. Contract No.1-02-4000-0122-96. Contractor: INGETEC S.A.

[5] EAAB. Expansion Plan of Water Supply System of the Bogota City and its Neighbor Municipalities. Report. No. 4. Optimal Dispatch Adjustment of the Plants. Contract No. 2-02-25300-332-2004. Contractor: INGETEC S.A.

Coating Program[6] (which seeks to mitigate as much as possible their risk of detachment coating the tunnels with conventional concrete[7]).

In order to make the coating and maintenance activities of the Chingaza tunnels there has to be a change in the operation of the water supply systems, from a normal operation condition to a situation including the implementation of those activities. Initially, the coating program of the tunnels considered:

- First, shutting down the Chingaza tunnels for complete inspection and maintenance during a certain period per year. This operation reduces the total flow of water from Chingaza System.
- Second, increasing the potable water supply from the Tibitoc System to compensate the loss of supply from Chingaza System.

During the months established for maintenance of the tunnels, it is necessary to reduce the treated flow provided by the Wiesner plant to Santa Ana and Suba tanks, limited by the ability of the San Rafael reservoir and operating conditions of the aqueduct system.

When considering a scenario of reduced water flow available for generation (below the minimum flow required for operating the power plant[8]) because of the annual maintenance activities in the Chingaza tunnels, it is not allowed to operate the hydroelectric plant. As a result, it is estimated that over the 10-year term of the Chingaza tunnels maintenance and coating program, the annual generation of Santa Ana power plant will be reduced in terms of their GWh per year.

Despite the above, the available flows for generation in the power plants depend on the magnitude and spatial distribution of potable water demand in Bogota and the optimal release from treatment plants. In all cases, EAAB is giving priority to the coverage, quality and security of water service, considering the behavior of water sources, the operation of production systems and water distribution and maintenance requirements of these systems.

Due to maintenance needs and dynamics of proper operation of the water system, covering activities for Chingaza tunnels can be made in one or two periods per year, each period lasting two to three months depending on the backup capacity of San Rafael reservoir and climate factors in the maintenance period. Considering the above, the of power generation in the Santa Ana power plant is reviewed yearly and determined according to the operation of the water distribution system[9].

Actual operation

For the period from 01/08/2012 to 31/07/2015, the average monthly demand for potable water was 15.4 m^3/s approximately and produced by the water supply systems as follows:

1. Chingaza System: 10.045 m^3/s.
2. Tibitoc System: 4.98 m^3/s.
3. La Regadera System: 0.388 m^3/s.
4. Others: 0.018 m^3/s.

The following table contains the average monthly entrance flow of the Santa Ana System[10] (flow measured over the finish line to the turbine and that feeds the Santa Ana and Suba control structures and the northeast line).

[6] The Chingaza tunnels are: Siberia (3 km), Palacio - Blanco River / free flow (10 km), Palacio - Blanco River / under pressure (18.4 km), El Faro (0.97 km). Total: 32.4 km

[7] Ibid. Report No. 3. Rehabilitation Program, Vulnerability Supply System and Service Life of Assets.

[8] The Santa Ana Hydroelectric Plant could generate using flows > 3.7 m3/s and < 5.2 m3/s but is a special operation in which it is required to control vibrations in the turbo group to approach the cavitation region.

[9] Power Generation - Technical Reports (Prepared yearly). Corporate Management System Master, Aqueduct Network Matrix Direction.

[10] The Santa Ana system is a drinking water pipeline that feeds three derivations: entrance to the Santa Ana tank, entrance to Suba tank and the northeast line. The first two correspond to the average flow available for generation whiles the third not. This is because the northeast line diverts around the 1.5% flow of Santa Ana system and this flow doesn´t go through the turbine because is necessary the Wiesner plant pressure to supply drinking water at the north east area of the city. The flow meter of the Santa Ana system is located between the end of the Usaquén´s alternate tunnel and Santa Ana Hydroelectric Plant.

Year	Month	Projected generation flow (m^3/s)	Real generation flow (m^3/s)
2012	Aug	6.40	6.07
	Sep	6.40	6.06
	Oct	7.20	0
	Nov	7.20	0
	Dec	7.20	0
2013	Jan	7.20	6.30
	Feb	7.20	7.79
	Mar	7.20	7.51
	Apr	7.20	7.74
	May	7.20	7.65
	Jun	7.20	7.63
	Jul	7.20	7.60
	Aug	7.20	7.63
	Sep	7.20	7.74
	Oct	6.50	7.66
	Nov	6.00	6.51
	Dec	6.00	5.64
2014	Jan	5.00	5.17
	Feb	5.00	0
	Mar	5.00	0
	Apr	7.50	0
	May	7.50	5.75
	Jun	5.00	5.39
	Jul	5.00	5.12
	Aug	5.00	4.46
	Sep	7.50	4.91
	Oct	7.50	4.98
	Nov	7.50	5.31
	Dec	7.50	5.33
2015	Jan	4.70	6.11
	Feb	4.40	0
	Mar	4.40	6.55
	Apr	4.70	6.62
	May	5.00	6.32
	Jun	5.00	5.97
	Jul	4.70	5.03

Source: EAAB Technical Report - Power Generation (2012, 2013, 2014 and 2015)

As shown, Santa Ana power plant had throughout the year flow available for generation, but this flow not necessarily was conducted through the turbine due to different problems in the technical systems or changes in the operational sceneries of the water supply system that prevented the generation, despite the availability of water. More information regarding events that affected the project operation during the period can be seen on the technical operation reports.

B.2. Post-registration changes

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

There are no temporary deviations from registered monitoring plan or applied methodology during this monitoring period.

B.2.2. Corrections

There are no corrections to the registered project during this monitoring period.

B.2.3. Changes to start date of crediting period

There are no changes to the start date of the crediting period.

B.2.4. Inclusion of a monitoring plan to the registered PDD that was not included at registration

There are no needs to include a monitoring plan to the registered PDD.

B.2.5. Permanent changes from registered monitoring plan, applied methodology or applied standardized baseline

There are no permanent changes from registered monitoring plan or applied methodology during this monitoring period.

B.2.6. Changes to project design of registered project activity

There are no changes to the project design of the project activity approved or submitted during this monitoring period.

B.2.7. Types of changes specific to afforestation or reforestation project activity

The project does not consider afforestation or reforestation activities.

SECTION C. Description of monitoring system

Technical operation of monitoring

Santa Ana hydroelectric plant fed into the national interconnected system the power generated through the local distribution system [11] in compliance with the provisions of the applicable regulations (Resolution 003 of 1994, Resolution 025 of 1995, Resolution 070 of 1998 and Resolution 106 of 2006 issued by the Energy and Gas Regulatory Commission -CREG)[12].

The administration, operation and maintenance of grid assets is performed according to the contract signed between EAAB – ESP and CODENSA[13], which complies with CREG Resolutions 003 of 1994, 082 of 2002 and 070 of 1998.

The daily measurement of the power generated is realized in the electrical substation owned by CODENSA, through the energy meters located in the commercial frontier (main and backup). These meters meet all technical requirements set by CREG (Resolutions 025 of 1995 and 006 of 2003) and provisions of the System Manager Exchange Commercial (ASIC).

[11] According to the contract signed between EAAB – ESP and the operator of the local grid Comercializador y Distribuidor de Energía S.A – EMGESA. Contract No. 9-99-25400-566-2004. Object: "Establish the scope of the commitments and responsibilities of the parties, connecting the Santa Ana Hydroelectric Plant to the local distribution system of CODENSA as well as set the parameters and terms and criteria to govern legal relations management and commercial skills of the contracting parties stages of testing commissioning and commercial operation of the pre-mentioned connection and define the commitments and responsibilities regarding the replacement maintenance and ownership of the assets of connecting parts". Duration: 25 years.

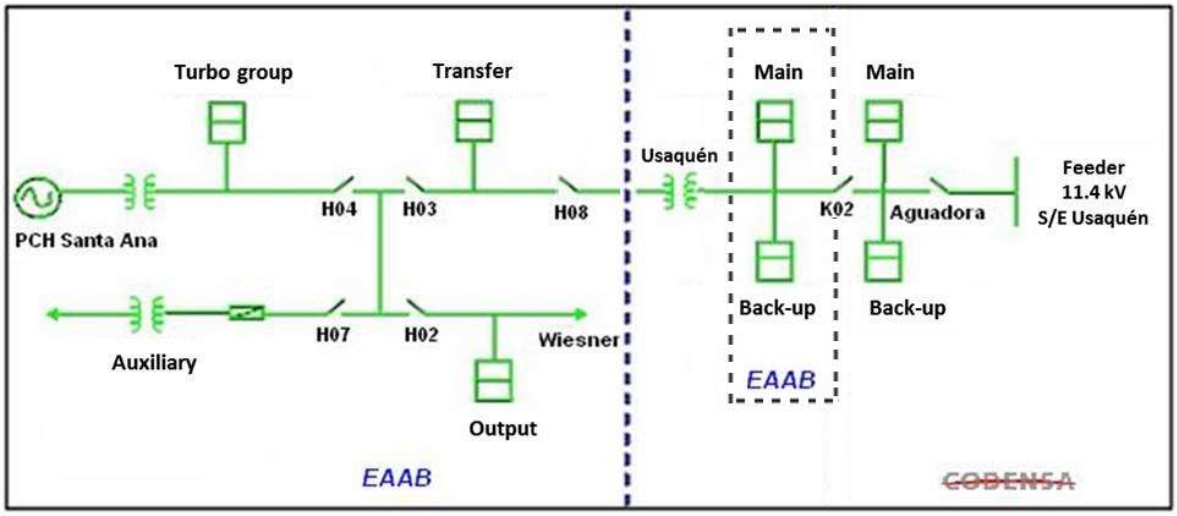
[12] The Electric Power and Gas Regulatory Commission is the national authority that regulates the sector of electric power and gas.

[13] EAAB. Contract No. 1-99-26300-812-2009. Object: "Set the annual compensation that EAAB will pay to CODENSA for the management, operation and maintenance services (AOM) of connection assets owned of the latter and forming part of the electrical connection system of Santa Ana Hydroelectric Plant to CODENSA´s SDL and set CODENSA´s obligations in relation with AOM of these assets". Completion date: 24/12/2012. It is expected to automatic renewal.

The verification and validation of the daily measurement, done through the meters of commercial frontier, is performed by EAAB through automatic and electronic interrogation of the meters (main and backup) located in the electrical substation owned by EAAB – ESP, which do not have the formality of registration with the ASIC.

The meter's calibration meets all the requirements established in CREG Resolutions 070 of 1998 and 006 of 2003 and the Colombian Technical Standard NTC - ISO/IEC 17025.

The single line diagram of the Santa Ana power plant (see figure) shows the main line driving the electric power generated from the power plant to the commercial frontier power meter, which is delivered to the national grid. The additional lines are output energy lines: one to provide energy to the auxiliary services of the hydroelectric plant, and the other one, as an emergency line to supply energy to the Wiesner Plant. In none of the cases, the control system allows to import energy from other grid (that could be considered as energy generated by the Santa Ana)[14].



Source: EAAB

The power generated by the Santa Ana is commercialized by EMGESA[15] acting as a representative of the plant in the Wholesale Power Market of Colombia, as part of the marketing contract signed with EAAB[16]. The plant began commercial operations on 2005 after official registration of the commercial frontier in the ASIC[17] (Experts Market - XM).

The daily registration of power generation is made by EMGESA, through CAM[18] (*Compañía Americana de Multiservicios*), with information obtained by automatic and electronic interrogation of the commercial frontier meters[19]. Data is recorded by CAM in the ASIC and later communicated to both EAAB and CODENSA. This information is analyzed independently by EMGESA, CODENSA and EAAB in accordance with the procedures of

[14] The Clause 12 of the connecting contract for operation of the Santa Ana Hydroelectric Plant No. 9-99-25400-566-2004 signed on December 23, 2004 between the EAAB and the grid operator, CODENSA, expressed regarding new connections that "The EAAB-ESP cannot connect in parallel to the assets of connection object this contract, the grid that goes to the Wiesner Plant, unless the Wiesner Plant is disconnected from the La Calera Electrical Substation. It is also considered an emergency condition that must be informed to the Local Dispatch Center (LDC) of CODENSA S.A. E.S.P. and coordinated by the latter, following the rules of operation to assure the disconnection power from La Calera Electrical Substation. No other grid can be connected to the assets to this contract. If the EAAB – ESP fail to fulfill this part of the contract, CODENSA, assumes that the EAAB-ESP terminates the contract and will proceed to disconnect the connection point previously assigned".

[15] Electric Power Generating Company.

[16] Contract No. 1-99-26300-0530-2009. Object: "Acquisition by EMGESA S.A E.S.P. of all the energy generated by the power plant owned by EAAB". Duration: 2 years and 7 months. Start date: 01/09/2009 to 30/04/2012 and Contract No. 1-10-26300-0842-2011. Object: "Acquisition by EMGESA S.A. E.S.P. of all the energy generated by Santa Ana, Suba, Usaquen and Ventana Hydroelectric Plants owned by EAAB". Duration: 10 years. Start date: 01/05/2012 to 30/04/2022

[17] XM is a company of ISA that is created in 2005, responsible for managing the ASIC and the CND (Dispatch National Centre). It provides operation, administration and development services of the Wholesale Power Market of Colombia.

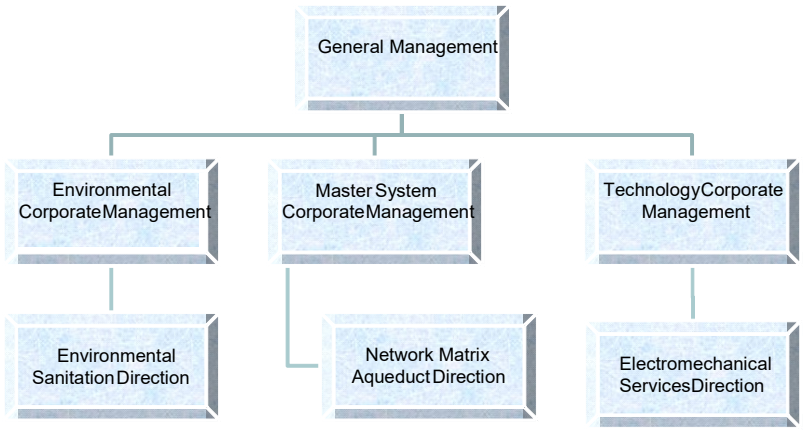
[18] Multi Services American Company.

[19] CAM is a company that provides services to EMGESA for interrogation and recording commercial frontier power meters. Additionally, CAM has accredited laboratory in Colombia for the revision of power meters.

verification and validation defined by each entity and by CREG Resolution 006 of 2003. The data registered in the ASIC is officially published on the website of XM and corresponds to the energy measured and delivered to the national grid through the local distribution system (http://www.xm.com.co/Pages/GestiondelaOperaciondelSIN.aspx). Additionally, the ASIC and other market agents checked once this information, which is available for consultation in the database administered by XM[20].

Operational and administrative structure

The EAAB´s organizational structure[21] responsible of the administration, operation, maintenance and monitoring Santa Ana hydroelectric project during the crediting period is as follows:



Source: EAAB

As an operating point of the distribution system of the city's drinking water, the Network Matrix Aqueduct Direction is the responsible for the overall operation of the power plant and supervision of the power generation activities.

The Network Matrix Aqueduct Direction executes the operating activities of the Santa Ana power plant considering the planning, operation and maintenance of the water supply systems, as part of an Industrial Agreement signed between the Water Supply Direction and Network Matrix Aqueduct Direction. The Water Supply Direction joins the organization providing drinking water for the Network Matrix Aqueduct Direction.

Electromechanical Services Direction heads technical and commercial operation related to generation and energy selling. This direction is responsible for monitoring the power generated and delivered to the national grid, including activities related to maintenance of electrical, electronic and mechanical components and equipment (this maintenance is part of a service agreement signed between the Network Matrix Aqueduct Direction and the Electromechanical Services Direction).

The Environmental Corporate Management Office through Environmental Sanitation Direction heads the CDM component of the project and prepares the monitoring report with support of the Electromechanical Services and Network Matrix Aqueduct Directions.

Procedures for quality assurance

The quality management system of EAAB (including power generation activities) is certificated under ISO 9001 with the following scope: "*Planning, Design and Construction Management, Operation, Control and Maintenance of Water Utility Systems for the Conduction and Distribution of Drinking Water in Mains Pipes and Clean Development Mechanism (CDM) Management for the Main Water System*".

[20] Portal BI database is operated and managed by XM, there are stored all transactions of the Wholesale Power Market of Colombia.
[21] EAAB: Agreement 11 of 2007. By means of which is modified the Organizational Structure of Empresa de Acueducto y Alcantarillado de Bogotá - ESP and identify the functions of its dependencies.

During monitoring period, there were several activities related to the implementation of quality management system:

A. Planning process

The Network Matrix Aqueduct Direction defined the Action Plan of the respective year, in order to plan their activities. This plan document included aspects related to power generation, including an adjustment to the power generation planning for the year.

B. Business operations processes

The following table considers all activities related to power generation in accordance with the quality management system of EAAB.

Macro process	Process	Procedures	Directions	Format
Service Aqueduct	Distribution and Control of Main pipelines	Procedure MA0407P - Electric power generation.	Instructive MA0407I01 – Start-up and operation of small hydroelectric plant.	MA0407F04 -Data comparison.
			Instructive MA0407I02 - Measurement and data analyses.	
			Instructive MA0407I03 -Load rejection.	
			Instructive MA0407I04 - Results reconciliation.	

C. Resource management processes

1) Information management. For preparation and updating of documents in the quality management system the following procedure was applied:

Macro process	Process	Procedure
EE Management Strategy	**EE03** Planning and documentation management system.	**EE0302P** Process documentation.

2) Document management**.** Records generated are managed following the procedure:

Macro process	Process	Procedure
FI Information and Knowledge Management	**FI02** Document management.	**FI0203P** Flow and documentary record.

3) Control of Measurement Equipment**.** The control of measurement equipment is according to the procedure:

Macro process	Process	Procedure
MA Service of Aqueduct	**MA04** Distribution and Control Matrix Pipelines.	**MA0417P** Control of power generation measurement equipment.

D. Continuous improvement process.

1) Customer's care and satisfaction management**.** Satisfaction surveys are conducted with the Environmental Corporate Management (receives the information to prepare the monitoring report) and Electromechanical Services Direction (manages the marketing of power generated by the plant) applying the procedure:

Macro process	Process	Procedure
CE Evaluation, Improvement and Prevention	**CE02** Continuous improvement.	**CE0202P** Customer satisfaction.

2) Non-compliance treatment. In order to follow up the cases of non-compliant in power generation, is applied the procedure:

Macro process	Process	Procedure
CE Evaluation, Improvement and Prevention	**CE02** Continuous improvement.	**CE0203P** Non-compliance treatment.

3) Management system measurement. EAAB considered the use of indicators such as power generation, incomes generation from power sales, certified emission reductions (CERs) obtained and revenues from use of CERs, among others. Periodically, the monitoring plan execution and indicators are analyzed according with the procedure:

Macro process	Process	Procedure
CE Evaluation, Improvement and Prevention	**CE01** Management system evaluation	**CE0102P** Management system measurement.

4) Internal Audit. During the period under review an internal audit was performed following the procedure:

Macro process	Process	Procedure
CE Evaluation, Improvement and Prevention	**CE01** Management system evaluation	**CE0101P** Internal audit.

In addition, a certification audit was developed in order to maintain the scope of quality management system under ISO 9001.

The authority and responsibility roles

The authority and responsibility roles for different aspects associated with the monitoring of power generation data are as follows.

Activity		Authority	Responsibility
Measurement	Internal	Electromechanical Services Office Director	Plant Operator / Energy negotiator
	External	EMGESA	CAM
Registration	Internal	Electromechanical Services Office Director	Plant Operator / Energy negotiator
	External	EMGESA	CAM
Verification	Internal	Electromechanical Services Office Director	Control Center Chief/ Energy negotiator
	External	XM EMGESA CODENSA	CAM CODENSA EMGESA
Report	Internal	Electromechanical Services Office Director	Control Center Chief/ Energy negotiator
	External	EMGESA	CAM
Calibration and maintenance	Internal	Electromechanical Services Office Director	Control Center Chief/ Energy negotiator
	External	EMGESA CODENSA	CAM

Source: EAAB

Data collection

The instructive MA0407I02 “Measurement and Data Analysis" contains the monitoring instructions of the electric power generated and delivered daily by the power plant to the national grid.

✓ **Measurement**

The daily measurement of power generated and delivered to the grid is as follows:

EMGESA through CAM (subcontractor) performs the interrogation (continuous) of the power meters at the commercial frontier in the electrical substation, in accordance with the applicable regulation (CREG Resolution 006 of 2003 and subsequent regulations) and contractual requirements. CAM has personnel to attend reading operations at field and to operate the telemetry systems of the power meters (including attention of failures). To avoid the loss of data, the meters have a mass internal memory, which stores the power generation information up to 60 days. To access the information, CAM applies their internal procedure TM-PR-08.

In parallel, technical personnel of EAAB performs the automatic and electronic interrogation of the power meters located in the electrical substation using a JEAMREAD software. In case of emergency during monitoring (e.g. loss of communication, failure of some power meter, among other), the reading of the frontier power meters (main and back up) is performed by technical personnel of CAM by manual reading using an optical reader and a laptop to submit the information in accordance with provisions of the applicable regulation. The readings are compared with historical information to validate values (taken the most conservative).

✓ **Registration**

EMGESA performs the following activities in accordance with the applicable regulation (CREG Resolution 006 of 2003 and subsequent regulations):

- Meters reading at the commercial frontier.
- Recording of daily generation data in the website of XM (Experts Market) – www.xm.com.co
- Sending daily generation data by email to EAAB (at least every 24 hours).

EAAB performs the following activities (for supervision):

- Recording daily generation data on electronic format MA0407F04 “Data Comparison”.

✓ **Verification**

Every day, EAAB performs a verification of the daily generation through comparison of data from the meter in the commercial frontier with the data reported by EMGESA. This comparison is made using the format MA0407F04-01 “Data Comparison”.

If the daily generation data obtained from the meter does not have a deviation greater than 5% in comparison with generation data obtained by EMGESA in the commercial frontier, the data delivered and registered by EMGESA on the website of XM is validated by EAAB. Periodically EAAB verify if the daily generation data provided by EMGESA corresponds to the data recorded on the website of XM, in accordance with the applicable regulation (CREG Resolution 006 of 2003 and subsequent regulations).

If the deviation between the data reported by EMGESA and data verified by EAAB is greater than 5% or if the data reported by EMGESA not correspond to those information recorded on the website of XM, is applied the instructive MA0407I04 "Reconciliation of Results", in accordance with the applicable regulation (CREG Resolution 006 of 2003 and subsequent regulations). After conciliation process, EMGESA records the daily generation data on website of XM.

Finally, the EAAB verifies that daily generation data reported by EMGESA in the website of XM correspond to generation data listed in the monthly report that EMGESA delivers to EAAB (which relates the amount of energy generated, fees and costs of the period).

✓ **Report**

The report of electric power generated and delivered daily by the power plant to the national interconnected system correspond to the data officially registered and available for consultation on the website of XM (Portal BI).

The following table presents the MWh generated and delivered to the national interconnected grid of Colombia during the period 01/08/2012 – 31/07/2015.

Year	Power generation (kWh)
2012	5.039.937,00
2013	35.317.606,00
2014	11.028.924,00
2015	14.099.455,00
TOTAL	**65.485.922**

Source: XM, Portal BI data

E. Control and attention of non-predicted episodes

To prevent the occurrence of non-predicted episodes EAAB has a general procedure to perform a preventive maintenance service to all electromechanical equipment (including the power plant Santa Ana).

Macro process	Process	Procedure
M4 Maintenance management	**M4FM** Electromechanical Maintenance.	**M4FM0101** Electromechanical preventive maintenance.

To attend the situation due to non-predicted episodes, EAAB has a general procedure to perform a corrective maintenance service to all electromechanical equipment (including the power plant Santa Ana).

Macro process	Process	Procedure
M4 Maintenance management	**M4FM** Electromechanical Maintenance.	**M4FM0102** Electromechanical corrective maintenance.

SECTION D. Data and parameters

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

Data/parameter:	$EF_{grid,y}$
Unit	$kgCO_2e$ /KWh.
Description	CO_2 emission factor for electricity displaced from the grid.
Source of data	Resolution 181421 of 2005 issued by Ministry of Mines and Energy of Colombia.
Value(s) applied)	0.4392
Choice of data or measurement methods and procedures	Value fixed on the PDD registered.
Purpose of data	Used for calculation of baseline emissions.
Additional comments	Not applicable.

D.2. Data and parameters monitored

Data/parameter:	***EGSA***
Unit	MWh
Description	Electricity generated, provided to the Colombia National Interconnected System.

Measured/calculated/default	Measured.
Source of data	Daily records of commercial frontier meter, located in the Usaquén electrical substation.
Value(s) of monitored parameter	The values of energy generation measured and reported to the National Interconnected System are:

Year	Month	Power generation (kwh)	Contingencies / non-predicted events (significant power plant shutdown)*
2012	Aug	3.190.172	Normal operation with minor events
	Sep	1.838.416	Reduction in generation (maintenance in aqueduct lines)
	Oct	11.349	Suspension of generation to perform corrective maintenance to increase reliability of the equipment
	Nov	0	
	Dec	0	
2013	Jan	1.244.051	
	Feb	3.676.426	Normal operation with minor events
	Mar	4.143.818	Normal operation with minor events
	Apr	3.845.788	Normal operation with minor events
	May	3.990.054	Normal operation with minor events
	Jun	4.513.259	Normal operation with minor events
	Jul	2.143.906	Reduction in generation (maintenance in aqueduct lines)
	Aug	30.205	Suspension of generation (failure in turbine regulation system)
	Sep	3.772.614	Normal operation with minor events
	Oct	4.436.069	Normal operation with minor events
	Nov	1.885.735	Normal operation with minor events
	Dec	1.635.681	Normal operation with minor events
2014	Jan	1.822.362	Normal operation with minor events
	Feb	0	The power plant was suspended due to problems and mechanical evaluation (automatism, synchronization, UPS)
	Mar	0	
	Apr	0	
	May	1.097.844	Normal operation with minor events
	Jun	479.313	Reduction in generation (low water flow)
	Jul	131.348	Reduction in generation (low water flow)
	Aug	396.526	Technical problems (electric shot)
	Sep	1.501.897	Minor reparations
	Oct	745.049	Minor reparations
	Nov	2.486.210	Normal operation with minor events
	Dec	2.368.375	Normal operation with minor events
2015	Jan	807.907	Technical problems (escape in trinket mechanism)
	Feb	13.710	
	Mar	1.184.311	Normal operation with minor events
	Apr	3.068.201	Normal operation with minor events
	May	3.803.914	Normal operation with minor events
	Jun	2.679.450	Normal operation with minor events
	Jul	2.541.962	Normal operation with minor events
TOTAL		**65.485.922**	

*For detailed information regarding power plant shutdowns and non generation episodes, please refer section 3.3 of EAAB Technical Report - Power Generation 2012, 2013, 2014 and 2015

	The national dispatch centre (CND) of Colombia is part of XM (Compañía de Expertos en Mercados S.A. E.S.P.) which is responsible for issuing plans assuring a reliable performance of the national grid. The information system Portal BI stores all information regarding the national interconnected system of Colombia (Official data published yearly). The information of power generated by the power plants can be checked in the link: http://informacioninteligente10.xm.com.co/oferta/Paginas/HistoricoOferta.aspx?RootFolder=%2Foferta%2FHistorico%20Oferta%2FGeneraci%C3%B3n&FolderCTID=0x01200075F2CCF9F779EE4B93D2D54764CDB78A&View={9F21C71E-AD8F-4E3F-B2EA-0B38F49A9BA8}
Monitoring equipment	Electric power meters of commercial frontier localized in Usaquén electrical substation, owned by CODENSA: • Manufacturer: AMETEK • Type: JEMSTAR. • Model: JS-09R6010-CO. • Accuracy class: 0.2S. • Serial number: Main meter serial No.102013561; Back-up meter serial No.102013562. • Calibration certificates: CAM-IM1010-020007 issued on 27/10/2010 (main meter) CAM-IM1010-020003 issued on 26/10/2010 (back-up meter) CAM-IM1211-048887 issued on 27/11/2012 (main meter) CAM-IM1211-048888 issued on 27/11/2012 (back-up meter) CAM-IM1501-016400 issued on 30/01/2015 (main meter) CAM-IM1501-000038 issued on 30/01/2015 (back-up meter) • Tests performed at CAM Meters Laboratory following the Colombian Technical Standard NTC 4856. • Tests performed start; accuracy; constant verification; operation without charge. • Test results: EVC. Note: All meters were subjected to a quality control regime including maintenance and periodic calibration, as indicated in national regulation. Resolution CREG 025 of 1995 - Measurement Code, indicates that the owner of the measurement equipment needs to develop a regular maintenance and calibration program, thus the EAAB has established in the internal procedure M4MA0417P "Control of power generation measurement equipment" the need to calibrate energy measurement equipment every 2 years).
Measuring/reading/recording frequency:	Measuring frequency: Continuous (Automatic in real time) Reading frequency: Daily (data acquisition software) Recording frequency: Aggregated monthly (with annual chance).
Calculation method (if applicable):	–
QA/QC procedures:	For power plants operation: Instructive: MA0401I02 “Routine Santa Ana station”. Instructive: MA0417P “Control of electric power generation measurement equipment’s”. Procedure: MA0407P “Electric power generation” Instructive: MA0407I01 “Start-up and operation of small hydroelectric plant”. Instructive: MA0407I02 “Measurement and data analyses”. Instructive: MA0407I03 “Load rejection”. Instructive: MA0407I04 “Reconciliation of results”. Format: MA0407F04 “Data comparison”.

	For power plants maintenance: Procedure M4FM0101 “Preventive electromechanical maintenance”. Procedure M4FM0102 “Corrective electromechanical maintenance”.
Purpose of data:	Used for calculation of baseline emissions.
Additional comments:	Not applicable.

D.3. Implementation of sampling plan

Not applicable.

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

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

The baseline is the MWh produced by Santa Ana Hydroelectric Plant multiplied by the emission factor of the national interconnected grid of Colombia (measured in tCO_2e/MWh).

The baseline of Santa Ana Hydroelectric Plant uses the official emission factor of national interconnected grid defined in the Resolution 181421 of November 2005, issued by Ministry of Mines and Energy of Colombia and corresponding to 0.4392 kg CO_2e/kWh.

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

In accordance to the appropriate approved baseline methodology used in this CDM project activity, emissions by sources of GHG due to the project activity are zero.

E.3. Calculation of leakage

Leakage are considered only when transferring existing renewable energy technology from another activity.

Santa Ana Hydroelectric Plant is not transferring existing renewable energy technology from another activity since the energy generation equipment for the project was new and manufactured for specific site conditions. All of the equipment installed in the facility can be clearly tracked by the appropriate manufacturing nameplates, specifying brand, reference and year of manufacture among others. The appropriate existing records related to manufacturing contracts and placement orders with technology suppliers support all equipment. Therefore, there is no leakage associated to the Santa Ana Hydroelectric Plant.

E.4. Summary of calculation of emission reductions or net 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)	GHG emission reductions or net GHG removals by sinks (t CO_2e) achieved in the monitoring period		
				Up to 31/12/2012	From 01/01/2013	Total amount
Total	28,755	0	0	2,213	26,542	28,755

E.5. Comparison of actual emission reductions or net 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

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)	61,927	28,755

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

Not applicable.

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

Project participant and/or responsible person/ entity	☒ Project participant ☐ Person/entity responsible for completing the CDM-MR-FORM
Organization name	Empresa de Acueducto y Alcantarillado de Bogotá (EAAB – ESP)
Street/P.O. Box	Avenida Carrera 24 No. 37 - 15
Building	-
City	Bogotá
State/region	Cundinamarca
Postcode	-
Country	Colombia
Telephone	571 3447000
Fax	-
E-mail	Martha.Cruz@acueducto.com.co
Website	www.acueducto.com.co
Contact person	Martha Patricia Cruz
Title	Specialized Professional
Salutation	Mrs.
Last name	Cruz
Middle name	Patricia
First name	Martha
Department	Environmental Management
Mobile	57 3183774585
Direct fax	-
Direct tel.	571 3447000 Ext.7061
Personal e-mail	Martha.Cruz@acueducto.com.co

Project participant and/or responsible person/ entity	☐ Project participant ☒ Person/entity responsible for completing the CDM-MR-FORM
Organization name	Environmental Business and Technologies S.A.S
Street/P.O. Box	Calle 98A No. 51 – 37 Of 206
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Document information

Version	*Date*	*Description*
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: • Include provisions related to delayed submission of a monitoring plan; • Provisions related to the Host Party; • Remove reference to programme of activities; • Overall editorial improvement.
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 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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