PROJECT DESIGN DOCUMENT FORM
FOR SMALL-SCALE CDM PROJECT ACTIVITIES (F-CDM-SSC-PDD)
Version 04.1

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	Suba and Usaquen hydroelectric CDM umbrella project
Version number of the PDD	04.0
Completion date of the PDD	25/04/2014
Project participant(s)	Empresa de Acueducto y Alcantarillado de Bogotá E.S.P-EAAB.
Host Party(ies)	Colombia
Sectoral scope(s) and selected methodology(ies)	Sectoral scope(s): 1 : Energy industries (renewable - / non-renewable sources) Methodology applied: AMS-I.D - Grid connected renewable electricity generation. Version 17.
Estimated amount of annual average GHG emission reductions	10,424 tCO_2

SECTION A. Description of project activity
A.1. Purpose and general description of project activity

The project activity contemplates the production of clean hydroelectric power using a flow of water by means of the installation of two small run-of-river hydroelectric plants (Suba and Usaquen) with a total installed capacity of 4.85 MW[1] (rated capacity of generators[2]), in the water supply system of Bogota, Department of Cundinamarca[3]. The energy generated will be sold to the National Interconnected System of Colombia.

For each power plant to be installed, the water will be derived from the main conduction pipeline (potable water supply system) in the point adjacent to the flow control valve. The derivation will be made by the installation of an accessory, driving 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 turbines. Each turbine will be hosted in a power house, with their respective generators, valves and control panels. A power substation will be located besides each power house. As the project plants are run-of-river hydro taking water from an existing water supply system, it is not necessary to build a reservoir.

The entire project will generate electricity for the Colombian power grid without greenhouse gases (GHG) emissions. The power plants (Suba and Usaquen) will have a total effective capacity of 3.77 MW[4] (rated capacity of turbine-generator system); with an estimated power supply to the grid of 27,349 MWh per year (both power plants)[5]. Thus, the project will increase the supply of electricity to the grid, partially displacing thermal generation with a renewable source of energy, and consequently reducing GHG emissions. The project will reduce 10,424 tCO_2e/year and approximate reduction of 72,968 tCO_2e for the entire first crediting period (7 years).

The project is being implemented by Empresa de Acueducto y Alcantarillado de Bogotá (EAAB), a public utility created in 1995 with the purpose of managing the water supply and wastewater treatment in Bogotá. The design, engineering, construction and installation of the project is carried out by the engineering company Consorcio Generación Bogotá.

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[1] This value is determined according to the provisions of "General guidelines to SSC CDM methodologies" in which the rated/installed capacity for renewable electricity generating units that involve turbine-generator systems shall be based on the installed/rated capacity of generator according to the manufacturer´s specification. Please refer rated capacity at equipment's nameplate.

[2] Please refer specifications determined on the nameplate for each generator (Generators INDAL).

[3] Initially the studies developed by EAAB, considered the construction of 3 small run-of-river hydroelectric plants called Suba, Usaquen and Ventana being the last one the largest with an estimated power capacity of 4.2 MW. All provisions to prove the CDM requirements were initially fulfilled for all power plants (e.g LoA, CDM prior consideration form, project title, among others), however after completing the technical studies, it was determined that for the project characteristics, construction of the project Ventana would cost more than budgeted (an increase of approximately 184% over the initial capex) and only would be possible after execution of maintenance of the potable water tunnels in 2018. Given the above, the company decided not to carry out the project Ventana (decision legalized with the Contract Amendment No.2 signed on June 14, 2011) and continue the execution of the other two power plants only (Suba and Usaquen) in accordance with the initial provisions.

[4] This value corresponds to the effective power ratings which is the maximum output of the system turbine-generator-connection (the turbine capacity is smaller than the generator and transformer capacity) based on the installed/rated capacity of turbines, generator and transformers considering their efficiencies according to the manufacturer´s specification. Please refer to the spreadsheet "Effective power ratings" on file "140113_EAAB emission reductions calculation V2_Revisión 3".

5 Please refer the spreadsheet "Power generation" on file "1401132_EAAB emission reductions calculation V2_Revisión 3".

The participants of the project recognize that this project activity is helping Colombia to fulfil its goals of promoting sustainable development. Furthermore, the project is in line with host-country specific clean development mechanism (CDM) requirements because it:

- Contributes to local environmental sustainability;
- Contributes towards better working conditions and increases employment opportunities in the area where the project is located replacement of fossil fuels for energy generation, resulting in the reduction of GHG and other pollutants that affect people's health;
- Increases of electricity generation from renewable sources;
- Increases of the reliability of the Colombian Power System;
- positive social impacts due to new employment during the construction, operation, and maintenance of the project activity;
- Adequate and sustainable use of hydrological resources;
- Contributes to development of technological capacity because all technology, man power and technical maintenance will be provided locally in the country;
- Additional public revenue which will generate local and national benefits;
- Increases the contribution of small scale hydroelectricity projects to electricity generation in the region, and therefore, it may encourage other similar companies that want to replicate this kind of projects.

A.2. Location of project activity
A.2.1. Host Party(ies)

Colombia

A.2.2. Region/State/Province etc.

Department of Cundinamarca

A.2.3. City/Town/Community etc.

Bogota

A.2.4. Physical/ Geographical location

The project is composed by two hydroelectric power plants which will use potable water in different points along the potable water supply system of Bogota. The points of use are located in Bogota, Department of Cundinamarca. The coordinates for the physical location of each hydroelectric power plant (Cartesian coordinate system) are:

Coordinates (Cartesian coordinate system)				Town	Department
Suba hydroelectric power plant	Power house	Lat	4.7120°	Bogota	Cundinamarca
		Long	-74.0836°		
Usaquen hydroelectric power plant	Power house	Lat	4.6920°	Bogotá	Cundinamarca
		Long	-74.0381°		

The geographical project location is showed in the following figure:

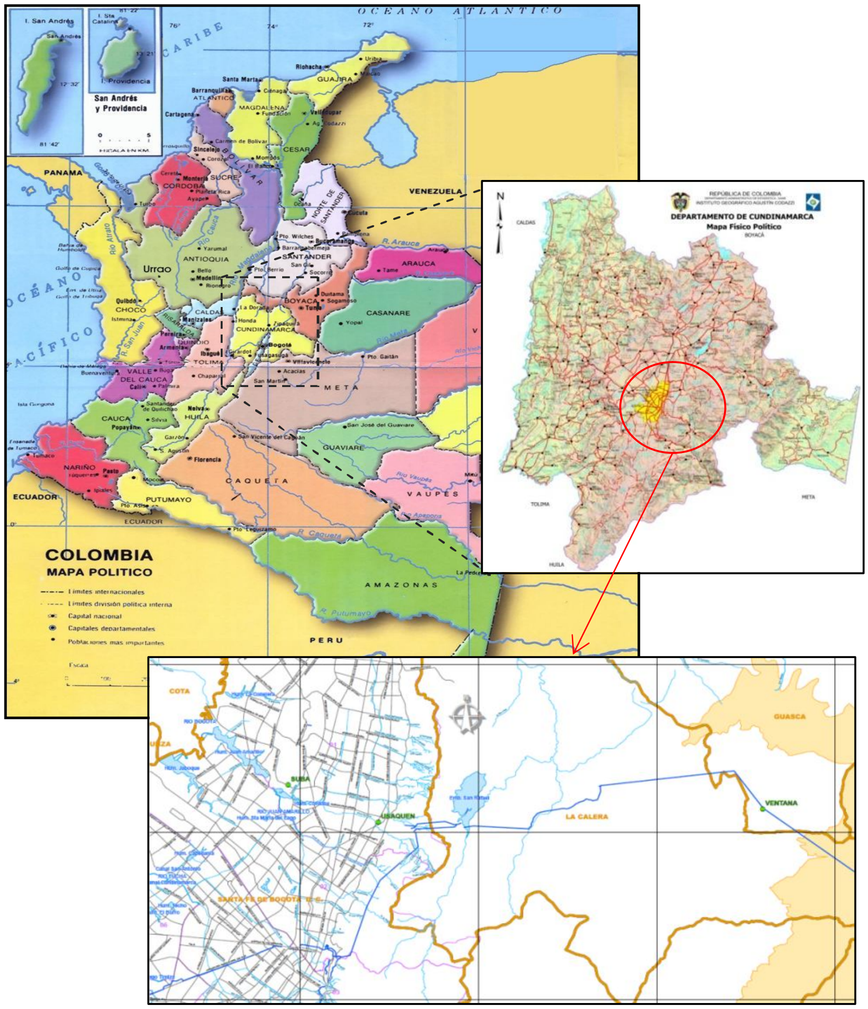

Figure: Geographical project location

A.3. Technologies and/or measures

Type and category of the project:

The project to be implemented by EAAB is considered renewable energy generation and falls under the following type and category:

- As the project considers energy generation, is a "small scale" (having less than 15 MW of installed capacity) with a total installed capacity of 4.85 MW[6] (rated capacity of generators[7]), and falls under CDM sectoral scope 1 (energy industries - renewable/non-renewable sources), type I renewable energy

[6] This value is determined according to the provisions of "General guidelines to SSC CDM methodologies" in which the rated/installed capacity for renewable electricity generating units that involve turbine-generator systems shall be based on the installed/rated capacity of generator according to the manufacturer´s specification.

[7] Please refer specifications determined on the nameplate for each generator (Generators INDAL).

project, category I.D grid connected renewable energy generation, according to the Appendix B of the Simplified Modalities and Procedures for Small Scale CDM project activities.

Technology/measure of the project:

The project activity contemplates the production of clean hydroelectric power using the water from the potable water supply system of Bogotá (in two different points); therefore the technology/measure for the project corresponds to the equipment used for water diversion and energy generation/transmission. From a technical point of view, the project will have the following characteristics:

Water capture (Intake): The potable water supply system of Bogota is currently composed of three subsystems: supply, treatment and distribution. The supply subsystem collects, transports and stores untreated water. The water is stored through small reservoirs that supply the water treatment plants. This subsystem treats the water so that it may be delivered to users in the required quality. The main treatment plants are Wiesner, Tibitoc and Dorado, providing the 98% of the water required by the city and surrounding municipalities.

The distribution subsystem is responsible for transporting the treated water from the treatment plants to its final users. As this subsystem controls the water flow, it is responsible for controlling the hydraulic energy of the water (potential and kinetic), through structures that reduce pressure (PRS). PRS use dissipation valves to reduce water pressure in the system and regulate the flow to the storage and distribution tanks. PRS use pressure reducing valves with electric and manual controls. EAAB identified the PRS that have adequate hydraulic conditions to make small hydroelectric uses by the replacement of the dissipation valves with turbines that could turn the hydraulic energy of the water into electricity.

Considering all the above information, the project the project will perform the same work of the dissipation valves of two PRS (of the potable water supply system of Bogota) by two hydraulic turbines (the valves remain in stand by with periodic operation during scheduled and unscheduled shutdowns of the turbines). The PRS included in the project are Suba and Usaquen (each PRS will host one turbine)[8].

As the implementation of the power plants will be developed into a key component of the potable water supply system of Bogota, its design considered all necessary precautions to ensure that the service will not be affected (considering that the water supply is a priority over power generation); Thus, for the plant load factor estimation, the hydraulic studies considered the hourly behavior of the water level in the system and the hourly behavior of the water demand in Bogotá taking into account information from different points in the water supply system[9]. The capacity has been assessed to determine the optimal power of the power plants considering the flows and heads available, based on the records of the operation of the substations Usaquen y Suba. The feasibility determined the recommended capacity to be installed in each power plant (in generator terminals)[10].

8 Please refer preliminary assessment "Condiciones técnicas, económicas y regulatorias de aprovechamientos hidroeléctricos en el sistema de acueducto de Bogotá", Juan Carlos Sanchez Martinez, EAAB, May 02, 2005.

9 The hydraulic studies are explained in the feasibility reports "PCH-USQ-GE-VAR-003 V0.2 feasibility" and "PCH-SUB-GE-VAR-004 v0.0 feasibility", Chapter 6, 2010. Consorcio Generación Bogotá. In addition, the calculations rationales are compiled in the spreadsheets "Evaluación energética PCH Usaquen-Anexo 2" and "310812 Evaluación energética PCH Suba - Anexo 2".

10 The capacity determination studies are explained in the feasibility reports "PCH-USQ-GE-VAR-003 V0.2 feasibility" and "PCH-SUB-GE-VAR-004 v0.0 feasibility", Chapter 9, 2010. Consorcio Generación Bogotá. In addition, the calculations rationales are compiled in the spreadsheets "Evaluación energética PCH Usaquen-Anexo 2" and "310812 Evaluación energética PCH Suba - Anexo 2".

Water conduction (from water supply system to the project): For each power plant to be installed (at each PRS) the water will be derived from the main conduction pipeline (potable water supply system) in a point adjacent to the flow control valve. The derivation will be made by the installation of an accessory (derivation pipeline), driving 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 Suba[11] (located at the northwest of Bogota), the water deviation will be from the control structure upstream the Suba tank and parallel to the valves house which contains two polijet valves (the power plant will be installed in parallel to the current dissipation pressure system) in order to take advantage of approximately 45.36 m to 52.18 m net head and 5.64 m³/s of potable water flow (design flow). The plant will have 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). The project scheme for Suba power plant is showed in the following figure:

Figure: Project Outline - Suba power plant

In the case of the PRS Usaquen[12] (located at the northeast of Bogota), the water deviation will be from the control structure Usaquen, downstream the control station Santa Ana (the power plant will be installed in parallel to the current dissipation pressure system called valves house) in order to take advantage of

[11] Document PCH-SUB-GE-VAR-005 “Informe de diseño PCH Suba”, 2010. Consorcio Generación Bogota.
[12] Document PCH-USQ-GE-VAR-004 “Informe de diseño PCH Usaquen”, 2010. Consorcio Generación Bogota

approximately 71.50 m net head and 2.85 m³/s of potable water flow (design flow). As in the PRS Suba, the power plant Usaquen will have 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). The project scheme for Usaquen power plant is showed in the following figure:

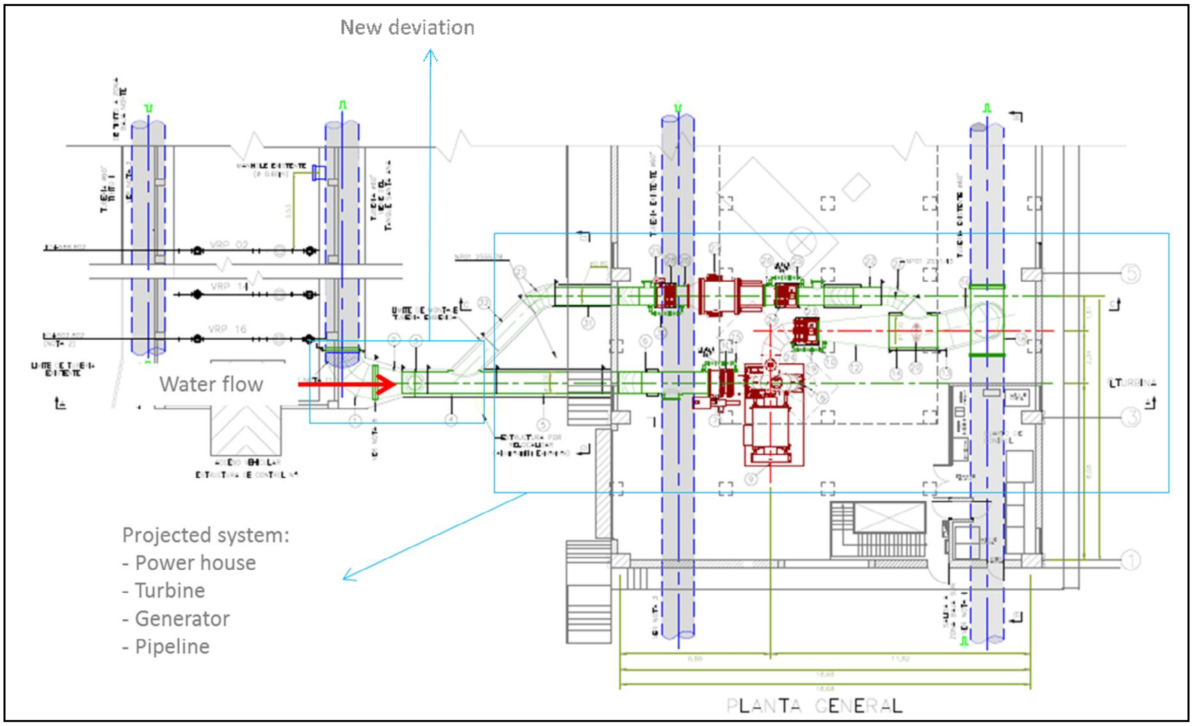

Figure: Project Outline - Usaquen power plant

Power generation: At the end of each penstock will be located the power house. For Suba power plant, will be required the construction of a surface powerhouse and the installation of a hydro-pneumatic control system (e.g. to handle overpressure during turbine startups). The power house will have one horizontal axis Francis type turbine (hydraulic reaction turbine in which the flow exits the turbine blades in an axial direction) connected to respective synchronous generator. The discharge will be made to the original conduction pipeline. The technical specifications for the equipment are showed in the following figure:

POWER PLANT SUBA		
Rated power		
Rated power turbine Gugler	2,645	kW
Rated power generator Indar	2,850	kW
Rated power isolation transformer	3,000	kVA
Efficiencies		
Turbine efficiency at nominal power	91.40	%
Generator efficiency at nominal power	95.84	%
Isolation transformer efficiency at nominal power	98.71	%
Connectivity efficiency	97.50	%
Effective power rating		
Effective power rating	**2,229.90**	**kW**

Figure: Technical specifications for major equipment - Suba power plant

In Usaquen power plant, as the turbine-generator will be located in the site where the pumping system of Usaquen was previously located, it will not be necessary to build a powerhouse but a hydro-pneumatic control system will be installed to ensure a smooth operation. In the existing building will be one horizontal axis Francis type turbine (hydraulic reaction turbine in which the flow exits the turbine blades in an axial direction) connected to respective synchronous generator. As the other case, the discharge will be made to the original conduction pipeline. The technical specifications for the equipment are showed in the following figure:

POWER PLANT USAQUEN		
Rated power		
Rated power turbine Gugler	1,810	kW
Rated power generator Indar	2,000	kW
Rated power isolation transformer	2,000	kVA
Efficiencies		
Turbine efficiency at nominal power	90.50	%
Generator efficiency at nominal power	95.68	%
Isolation transformer efficiency at nominal power	98.67	%
Connectivity efficiency	99.98	%
Effective power rating		
Effective power rating	**1,546.13**	**kW**

Figure: Technical specifications for major equipment - Usaquen power plant

<u>Power transmission:</u> Each electrical substation will be located close to the power house. In the courtyard will be located the transformers and the switching equipment required for the connection to the electrical network. Given the characteristics of the net, generators will be used in a synchronous continuous operation, which allows the regulation of the line voltage and supply the reactive power required. The equipment will be geared with a static excitation system brushless (which requires less maintenance). The synchronization of the two units with the National Interconnected System of Colombia will be manual and/or automatic as a function of voltage, frequency and phase sequence. The connection of the stator of each generator will be star type with neutral grounded.

In Suba power plant, the connection to the National Interconnected System will be at the Morato substation (11.4 kV), owned by CODENSA (local power utility). The technical specifications for the power plant connection are showed in the following figure[13]:

[13] For a fully description of the connection, please refer the one-line diagram "210211 One-line diagram - Connection power plant Suba" - EAAB.

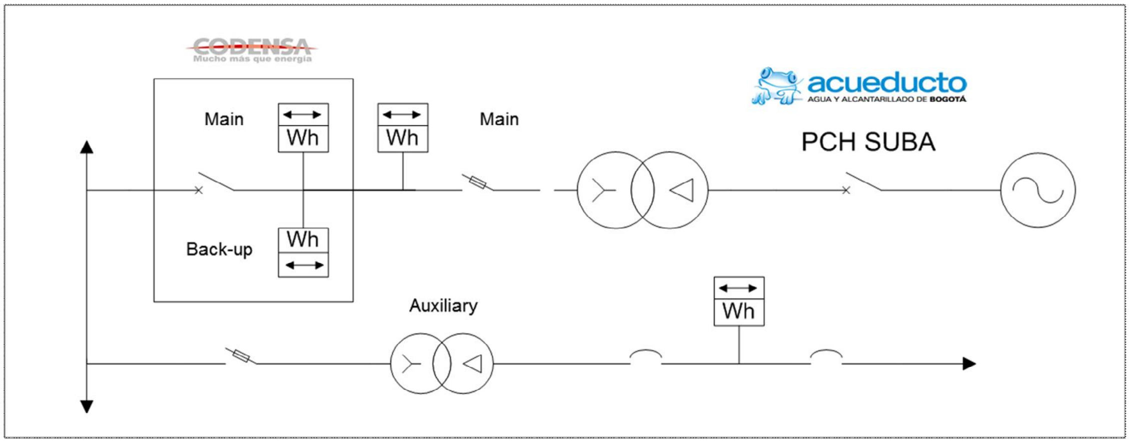

Figure: Technical specifications for connection - Suba power plant

In Usaquen power plant, the connection to the National Interconnected System will be made at the Usaquen substation (11.4 kV) owned by CODENSA (local power utility). The technical specifications for the power plant connection are showed in the following figure[14]:

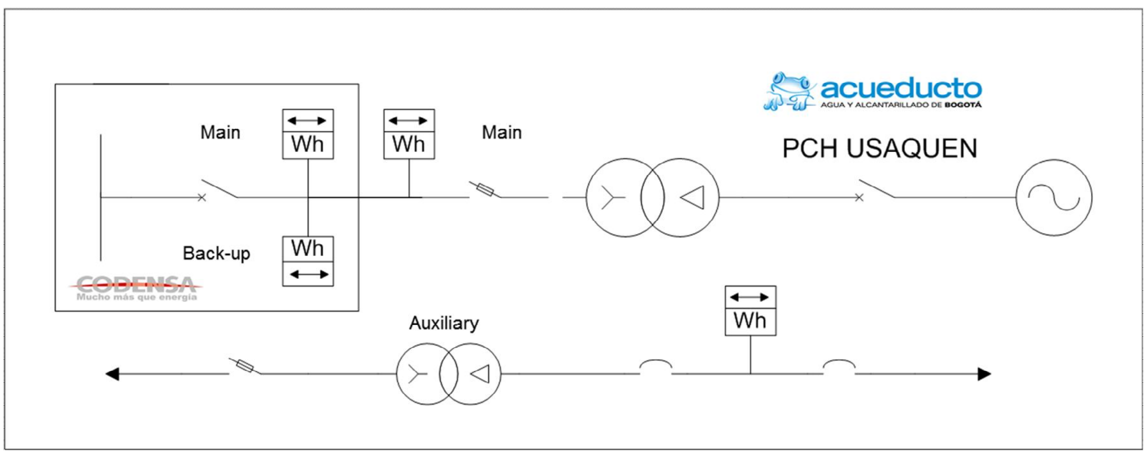

Figure: Technical specifications for connection - Usaquen power plant

For energy delivery will not be necessary to install a transmission line. The National Dispatch Center (XM) will confirm the quantity of energy to be delivered by the project activity; Codensa will be in charge of the central control point of the meter readings.

Project monitoring technology

For the power plants (Suba and Usaquen), the monitoring technology will be in compliance with national regulations (Resolution 025, 1995 - Measurement Code). Each energy measurement will be 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

[14] For a fully description of the connection, please refer the one-line diagram "210211 One-line diagram - Connection power plant Usaquen" - EAAB.

60687 “Alternating current static watt-hour meters for active energy (classes 0.2 S and 0.5 S)”. The power meters will be installed in the substation of each power plant.

Meters will be connected to an automatic control system and by modem to the power utility. Data storage will be made by internal memory. The internal memory of the meters is able to record several months of measurements. The long term data archiving will be made by data transfer to a local PC by telemetry/telephone or to the control centre managed by the operator through a specific communication channel (telephone line/modem). Data will be backed-up every month in magnetic media and stored for verification. Only authorized software will be available to handle monitored information. The meters will be installed on a protection panel with a sealed door and cover to avoid possible manipulation by non-authorized personnel.

A.4. Parties and project participants

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Colombia (host) accessed the Kyoto Protocol on 2001	*Empresa de Acueducto y Alcantarillado de Bogotá E.S.P-EAAB. (Public Company)*	*NO*

A.5. Public funding of project activity

The project activity does not involve the use of public funding from Annex I Parties.

A.6. Debundling for project activity

Appendix C of the Simplified Modalities and Procedures for Small-Scale CDM project activities (M&P) states that “Debundling” is defined as the fragmentation of a large project activity into smaller parts. In addition, establishes that a project activity can be a debundled component of a large project activity if there is a registered small scale CDM project activity or an application to register another small scale CDM project activity:

- With the same project participants;
- In the same project category and technology/measure; and
- Registered within the previous 2 years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small scale activity at the closest point.

After a review of the small scale CDM project activities registered or under application to register at the website http://cdm.unfccc.int/Projects/projsearch.html, considering as host country Colombia in the searcher, the project participant has determined that the project "Suba and Usaquen hydroelectric CDM umbrella project" is not a de-bundled component of a large project activity, as there are not a small scale CDM project activity registered within the previous 2 years or application to register of another small scale CDM project activity with the same project participant, in the same project category and technology/measure and whose project boundary is within one kilometer radius of this project activity (at the closest point). Thus, the project participant confirms that the project "Suba and Usaquen hydroelectric CDM umbrella project" is not a part of any large project, and therefore is not a debundled component of a large project activity.

SECTION B. Application of selected approved baseline and monitoring methodology
B.1. Reference of methodology

The following approved baseline and monitoring methodology is applicable to the project activity:
- Type I.D. (Reference AMS-I.D.) – *"Grid connected renewable electricity generation"* – Version 17. For the power generation using renewable sources that supply electricity to and/or displace electricity from an electricity distribution system.

The following tools are applicable to the project activity:
- Methodological tool *"Tool to calculate the emission factor for an electricity system"* - for the calculation of emissions factor – Version 04.0.
- Methodological tool *"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"* - for the calculation of project emissions from fossil fuel combustion – Version 2.

B.2. Project activity eligibility

Appendix B of the simplified M&P for small-scale CDM project activities provides indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories. As per the M&P, the project activity falls under the following approved small scale methodology: AMS-I.D- *"Grid connected renewable electricity generation" version 17* – for the renewable energy generation.

According to the provisions above, the project activity has an installed/rated capacity less than 15 MW (the total installed capacity[15] of 4.85 MW where the rated capacity of each component is 2.85 MW for Suba power plant and 2.0 MW for Usaquen power plant) and reduces less than 60.000 tCO2/y, therefore remains under the limits for small scale CDM project activities (type I).

B.3. Project boundary

According to AMS-I.D version 17, the project boundary for a small-scale hydroelectric project that provides electricity to a grid encompasses the physical, geographical site of the renewable generation source and all power plants connected physically to the electricity system that the CDM project power plant is connected to. Therefore, for the project the boundary encompasses the water conduction systems, the new turbine generators, equipment required to export the electricity to the grid (transformers, substation, etc) and the grid. A representation of the project boundary can be seen in the figure below.

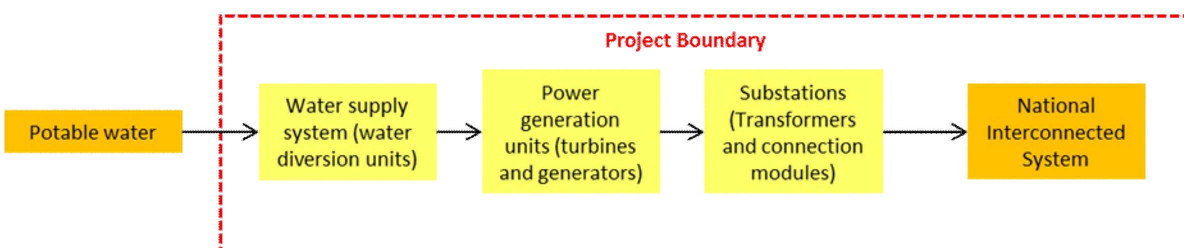

Figure: Project boundary definition

[15] Considering the rated capacity of generators.

The baseline includes emissions related to the electricity produced by the facilities and power plants to be displaced by the proposed project. This involves emissions from displaced fossil fuel used in the power plants connected to the National Interconnected System of Colombia. In terms of greenhouse gases emissions, the project boundary considers only emissions of CO_2.

	Source	Gas	Included?	Justification / explanation
Baseline	Energy generation in the National Interconnected System of Colombia	CO_2	YES	According to AMS.I.D version 17, only CO_2 emissions from electricity generation using fossil fuels should be accounted for.
		CH_4	NO	Only CO_2 emissions are taken into account
		N_2O	NO	Only CO_2 emissions are taken into account
Project Activity	Energy generation in the project power plants	CO_2	NO	The emissions are excluded according to AMS.I.D version 17. (There will be only renewable energy generation).
		CH_4	NO	The emissions are excluded according to AMS.I.D version 17. (There will be only renewable energy generation).
		N_2O	NO	The emissions are excluded according to AMS.I.D version 17. (There will be only renewable energy generation).

Table: Sources of GHG emissions

There are no greenhouse gas emissions occurring within the proposed CDM project activity boundary as a result of the implementation of the proposed CDM project activity that contribute more than 1% of the overall expected average annual emissions reductions and which are not addressed by the applied methodology.

B.4. Establishment and description of baseline scenario

The methodology AMS.I.D Version 17 indicates that:

"the baseline scenario is that the electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources into the grid".

The project activity is based on the construction of a two new power plants associated to the water supply system of Bogota, that will be integrated to the National Interconnected System of Colombia, therefore the baseline scenario identified corresponds to the continuation of the current situation in which the electricity that would have been generated by the project activity would be supplied by the operation of power plants that are currently connected to the grid, the addition of new generation capacity[16] and energy imports. Both aspects are reflected in the combined margin (CM). This system is composed of a combination of power plants that consume fossil fuels and plants that use renewable energy sources (mainly hydro).

According to paragraph 89 of "Clean development mechanism validation and verification standard", version 05.0 (CDM-EB65-A04-STAN), given that the applied methodology establishes the baseline scenario conditions, the analysis of different alternatives is not necessary.

16 The national and sectoral policies relevant to the baseline scenario are: Law 142 of 1994 (Public Services Law) and Law 143 of 1994 (Electricity Law).These laws regulate the electricity sector in Colombia determining aspects regarding the operation and expansion of electric generation in the national system.

B.5. Demonstration of additionality

CDM prior consideration

After seriously considering the benefits of the CDM in the decision to proceed with the project activity, the project developer developed continuing and real actions to secure CDM status in parallel to its implementation. In the following table is presented a detailed timeline for the project.

CDM Actions prior to the project start date / Continuing actions to secure the CDM project status	
Date	**Key event**
July 13, 2009	The Project Idea Note for the hydroelectric project activities of the EAAB denominated Ventana, Suba and Usaquen was submitted to the local Designated National Authority (DNA) of Colombia to request the “No Objection Letter”.
August 24, 2009	The EAAB received from the local DNA the “No Objection Letter” for the project activities.
September 17, 2009	The EAAB decided to start applying for CDM to decrease the risk and improve the financial return of the projects.
October 01, 2009	The EAAB decided to include the CDM component in the public tender IT-794-2009 (process to hire a technical project developer).
December 02, 2009	The EAAB notified the UNFCCC Secretariat and the local DNA of the commencement of the project activity and their intention to seek the CDM status.
December 24, 2009	The contract No.1-01-26300-1063-2009 was signed between the contractor Consorcio Generación Bogotá and EAAB (in this contract was established as a starting date the signature of the Work Initiation Act).
February 08, 2010	Technical supervision activities started after Consorcio Interventoria PCH Acueducto signed the Work Initiation Act.
March 01, 2010	The preoperative stage (feasibility and design of the projects) started after Consorcio Generación Bogota (CGB) signed the Work Initiation Act.
July 20, 2010	The contractor Consorcio Generación Bogota (CGB) delivered the latest version of the project feasibility reports and started with development of the detailed engineering designs to get the EAAB approval and start construction. This action corresponds to the project investment decision time.
November 25, 2010	The cooperation agreement between EAAB and Inter-American Development Bank (IADB) was executed, to support EAAB with the preparation of the CDM PDD.
December 13, 2010	EAAB decided to start construction of the power plants (by Contract Amendment No.1 signed on December 13, 2010) once the technical supervisor "Consorcio Interventoría PCH Acueducto", approved the designs and technical studies, by communication INT-EAAB/PCH-053 issued on December 06, 2010.
January 2011	The construction of the power plants Suba and Usaquen started.
May 30, 2011	EAAB decides to suppress all activities associated with the implementation and operation of the PCH Ventana (the decision is legalized with the Contract Amendment No.2. signed on June 14, 2011).
July 11, 2011	EAAB requested to the Inter-American Development Bank (IADB) support for the preparation of the CDM PDD through the IADB consultants.
July 19, 2011	The first CDM local stakeholder consultation (with local and national authorities) was held and inputs were incorporated in the project.
August 27, 2011	The second CDM local stakeholder consultation (with communities and authorities of Bogota in the influence area of the projects Suba and Usaquen) was developed and inputs were incorporated in the project.
August 29,	The CDM consultant started the work on the PDD with the submission of the LAE (Especific Activities

2011	List) from IADB and approval of EAAB.
April 25, 2011	The project developer EAAB began planning the validation process with the DOE.
April 16, 2012	The project was submitted to the local Designated National Authority to request the "National Approval Letter".
March 01, 2013	Expected date to start operation with Suba and Usaquen power plants.

Table: Timeline for the project activity

Additionality analysis

According to the "Guidelines on the demonstration of additionality of small-scale project activities" version 09.0, project participants are required to provide an explanation to show that the project activity would not have occurred in the absence of the CDM due to at least one of the barriers identified. Evidence to why the proposed project is additional has to be offered under the following categories of barriers: (a) investment, (b) technological, (c) prevailing practice and (d) other barriers. For the project activity a barrier analysis is carried out in order to demonstrate project additionality, and was done based on information from the time when the decision was taken considering the context situations and information from the project sponsors and official sources. Of the barriers listed above, the project participant has decided to demonstrate the additionality of the project activity by investment barrier and the barrier due to prevailing practice as is shown below.

Investment barrier:

This investment barrier analysis has been developed to demonstrate the impact of the CDM incomes in the financial project additionality considering the approaches and criteria defined by UNFCCC in the "Guidelines on the assessment of investment analysis" version 5 of July 15, 2011, applying data and information available during implementation and commissioning of the project.

The power plants Suba and Usaquen will be implemented as a run of river type by using a flow of water in the existing infrastructure in the potable water supply system of Bogota, but considering that these are different that those installed in the riverbed of a river because the first one uses a treated water flow for human consumption. This kind of projects are not the least-cost options for grid energy production in terms of investment per Megawatt given its small generation capacity, especially in the reformed wholesale markets such as the one established in Colombia since 1990s which benefits energy generation at large scale. In addition, these projects will be developed into a key component of the potable water supply system of Bogota, thus cannot provide firm and reliable energy to the national interconnected system since they face problems due to shortages of water availability for generation as a result of the necessary prevision to ensure that the water supply service will not be affected (considering that the water supply for human consumption is a priority over power generation). Thus, the high dependency of the water availability (e.g in adverse weather conditions such as "El Niño") and the cost-benefit relation associated with small scale generation are discouraging investment in this kind of energy generation.

The conditions above can be seen in the "Reference Expansion Plan Generation – Transmission 2012 – 2025" of Colombia in which is indicated that there is no energy projects with this kind of generation (by using the infrastructure of a water supply system) registered in the country. As a result of the previous conditions, the development of this type of projects faces adverse conditions to assure their development, therefore, for Suba and Usaquen hydroelectric CDM umbrella project, the financial viability was the main condition to continue

with the project implementation, and conditions as the expected energy sale price, the technical feasibility to produce energy and the availability of hydraulic flows to the new plants, were duly assessed.

The assessment was based on the assumptions related to the expected electricity prices used to incorporate the revenues from electricity sales into the financial analysis. These conditions were based on the expected behavior of electricity prices in the Colombian Electricity Market. In addition, the Internal Rate of Return (IRR) assessment was linked to the projected electricity generation, which is directly related to the available water flow rate for energy generation in the potable water supply system and the amount of electricity that this water flow could produce at each power plant.

For both power plants considered by the project (Suba and Usaquén), the company has invested in the installation of all necessary infrastructure to deviate the water from the potable water supply system of Bogota to each power house, the acquisition of turbines and generators for electricity generation and all equipment necessary to control all operational parameters. The following table shows a detailed description of the project costs (separately for each power plant):

Suba and Usaquen hydroelectric CDM umbrella project	
	Project cost (US$)[17]
Suba hydroelectric plant	
Supply, installation and testing of electrical, electronic and mechanical equipment.	4,586,188
Civil works (structures and architectural)	772,453
Designs and engineering	465,443
Supervision and project management	426,008
Others (tax, administrative, others)	546,856
Total cost	**6,796,948**
Usaquen hydroelectric plant	
Supply, installation and testing of electrical, electronic and mechanical equipment.	3,133,018
Civil works (structures and architectural)	292,954
Designs and engineering	419,510
Supervision and project management	376,608
Others (tax, administrative, others)	358,402
Total cost	**4,580,492**
TOTAL	**11,377,440**

The yearly operation and maintenance costs for the project activity are:

Yearly operation and maintenance costs at Suba and Usaquen hydroelectric CDM umbrella project	
Costs (yearly value)	**Project cost (US$/year)[18]**
Suba hydroelectric power plant[11]	
Initial operation and administration (only for the first year)*	128,405
Maintenance variable	45,862
Usaquen hydroelectric power plant[12]	
Initial operation and administration (only for the first year)*	128,405
Maintenance variable	31,330

[17] Cost considering the following documents: Contract No.1-01-26300-1063-2009 and Contract No.1-01-26300-1092-2009.
[18] Cost considering the following documents: Contract No.1-01-26300-1063-2009 and Contract No.1-01-26300-1092-2009.

Labor and administrative cost (for each power plant)	51,652

* For power plants Suba and Usaquen, the value for initial operation and administration is applied only for the first year (according to the contract between CGBOG and EAAB), since the power plants will be operated in the following years directly with personnel of EAAB.

Table: Project cost considering the information provided by the project manager

Because of the high cost of the project and the financing structure of 100% with equity, the project developer decided to apply for CDM to decrease the risks and improve the investment return. The financial analysis for the return of the project was calculated using the following parameters and assumptions:

Parameter	Suba	Usaquen	Source/Comment
Electricity tariff (US/kWh)[19]	0.04864	0. 04864	Value based on the price determined according to market conditions for 2009 and validated on the feasibility report. Value determined previous to the moment for the decision making.
Load plant factor	87.09%	76.32%	Feasibility reports "PCH-USQ-GE-VAR-003 V0.2 feasibility" and "PCH-SUB-GE-VAR-004 v0.0 feasibility", Chapter 6 (hydraulic study) and chapter 9 (capacity and power study), 2010. Consorcio Generación Bogotá.
Total investment (US$)	6,796,948	4,580,492	Contract No.1-01-26300-1063-2009; Contract No.1-01-26300-1092-2009.

Table: Financial analysis assumptions

The selection of the appropriate analysis method for this project activity is based on the benchmark analysis according to the "Guidelines on the assessment of investment analysis" version 05 and the "Tool for the demonstration and assessment of additionality" version 7.0.0. Therefore the most suitable financial evaluation is the internal rate of return (IRR) of equity, when is compared to the benchmark IRR based on parameters from the guideline.

The guideline determines a default values for the approximate expected return on equity for this kind of projects and host country Colombia. In this case, as there is only one project developer (EAAB), for both projects can be used the expected returns established on the appendix "Default values for the expected return on equity" determined to group 1, sectoral scope energy industries, which corresponds to 12%[20]. This represents that EAAB looks for an IRR that exceeds the CDM benchmark and approaches to the rate of return needed for its cost of equity in their investments.

[19] The power tariff is based on a study conducted by the contractor Consorcio Generación Bogota during the feasibility stage. The study considers the power tariff under two scenarios. The first scenario corresponds to the tariff offered by the local power utility EMGESA according to the power purchase conditions that currently exist for the Hydroelectric Santa Ana property of EAAB (this power plant is similar to the project plants) which is a low scenario, while the second scenario corresponds to the tariff in the energy exchange market, in which large generators participate. For the financial analysis was selected the power tariff of the second scenario (value for energy contract prices during 2009 according to "System operation and administration of the Colombian electricity market report 2009" prepared by Compañía de Expertos en Mercados S.A. E.S.P which is responsible for issuing plans and assuring a reliable performance of grid (Please refer http://www.xm.com.co/Informe%20Mensual%20Anlisis%20del%20Mercado/03_Informe_Precios_y_Transacciones_TXR_12-2010.pdf). This approach is considered realistic and conservative.

[20] According to the clarification CDM-EB73-A08-CLAR, the EAAB can apply for their projects a default value for the expected return on equity of 12%.

The assessment of the projects was developed considering each power plant being installed separately, thus the IRR results when the sale of carbon credits is not considered into the projects (considering revenues in a 20 years basis[21]) are:

Parameter	Suba	Usaquen
IRR without CDM	10.55%	8.66%

These IRR values are lower than the benchmark of 12%[22] (rate of return required by the shareholders to move forward with the project development according to the CDM regulation applicable); this means that the project activity is not viable and demonstrates that the CDM is necessary in order to make the investment more profitable and closer to the benchmark.

When the incomes from the sale of CERs are included in the projects cash flow, the IRR is improved to:

Parameter	Suba	Usaquen
IRR with CDM	12.51%	10.74%

The inclusion of the CDM benefits helped the return to meet or exceed the threshold to move forward on the project. The improvement from the CERs to the operating cash flows over time was also seen as essential to provide some cushion to any unforeseen costs or risks involved in the operation of the project during the first years (where lack of experience could cause a reduction in the estimated return on investment); thus, the access to the CDM is crucial for the projects implementation and success.

An additional sensitive analysis has been performed to show when the project activity would pass the benchmark or become more favorable, considering reasonable variations of the critical assumptions. Main costs such as turnkey contract, operation and maintenance, energy tariff and annual electricity generation were considered for reasonable variations (under a +/-10% basis). The variation of the project IRR is shown below:

Parameter	SUBA		USAQUEN	
	IRR without CERs	IRR with CERs	IRR without CERs	IRR with CERs
TK Contract	10.55%	**12.51%**	8.66%	10.74%
(+) 10%	9.66%	11.59%	7.87%	9.85%
(-) 10%	11.49%	**13.57%**	9.56%	11.69%
Fixed O&M Costs	10.55%	**12.51%**	8.66%	10.74%
(+) 10%	10.40%	**12.38%**	8.45%	10.54%
(-) 10%	10.70%	**12.64%**	8.87%	10.93%

[21] A shorter assessment period (20 years) has been chosen according to the paragraph 3 of the "Guidelines on the assessment on investment analysis" version 5, in comparison with the project time life. As the period chosen presents a shorter period than the technical lifetime, a fair value of each project activity assets at the end of the assessment period has been included in the analysis.

[22] The Regulatory Commission of Drinkable Water and Basic Sanitation (which is in charge of the supervision and control of the public services companies such as EAAB) has established the discount rate applicable to the public services of aqueduct and waste water treatment (and related activities). As the project considers the replacement of the dissipation valves with turbines (in the potable water supply system of Bogotá), the new components will be responsible for controlling the hydraulic energy of the water reducing the water pressure in the system and regulating the water flow to the storage and distribution tanks in the distribution subsystem; so the new equipment to be installed will be part of the Bogota´s water supply system. Therefore the rate defined by regulation for aqueduct and waste water treatment services and related activities must be considered by the project activity (related to the water supply) in their final decision.

Energy Sale Price ($/MWh)	10.55%	**12.51%**	8.66%	10.74%
(+) 10%	11.71%	**13.60%**	9.90%	11.81%
(-) 10%	9.21%	11.37%	7.36%	9.52%
Energy Generation (GWh annually)	10.55%	**12.51%**	8.66%	10.74%
(+) 10%	11.71%	**13.79%**	9.90%	11.98%
(-) 10%	9.21%	11.18%	7.36%	9.30%

Table: Sensitive analysis

The sensitive analysis demonstrates that even considering a significant variation of the mentioned parameters, without CDM revenues the IRR in both projects never exceeds the benchmark. The sensitivity analysis shows that it will not be possible to get the project IRR above the benchmark value and make it possible only if the CDM revenues are included too (under favourable market conditions of CERs price). It is true that the project activity is much less financially attractive without the CDM revenues, therefore the additional revenues from the CDM have helped to overcome the threshold to move forward with the projects.

As it can be observed in the following table, when the sale price of the CERs is considered in a range between the current values and the average values observed during previous years, we can observe that the power plants becomes more financially attractive. According to the above it was necessary to prepare a sensitive analysis (for CERs prices). The next table shows a sensitive analysis regarding expected CERs prices without variations of the critical assumptions.

CERs prices to be delivered on December 2016 (observed prices during 2009)[24]		**IRR considering CERs revenues**	
		SUBA	**USAQUEN**
14.00 €/tCO_2e	20.3 US$/t$CO_2$e	11.81%	10.00%
16.00 €/tCO_2e	23.2 US$/t$CO_2$e	11.99%	10.19%
18.00 €/tCO_2e	26.1 US$/t$CO_2$e	**12.16%**	10.38%
20.00 €/tCO_2e	29 US$/t$CO_2$e	**12.34%**	10.56%

The expected price of the CERs represents to the EAAB´s Executive Board a key factor in their investment evaluation decision since the inclusion of CERs can be considered as cushion for the company cash flow and also as an essential income to provide some backup to any unforeseen risks involved within the operation of the project. To conclude, as it has been demonstrated in this investment analysis, the effect of the CERs contribution is financially significant and determinant for the financial feasibility of the projects, since:

1. The CERs provide stability and certainty to the equity's cash flow while reducing its financial risk, and increasing the IRR without CERs from 10.55% to 12.51% for SUBA power plant and 8.66% to 10.74% for USAQUEN power plant (accounting in both cases for CERs under current market prices).
2. It is shown that the CERs contribute to a significant increase in equity value and, in a case in which CER market prices would return to levels prior to 2009, to surpass the benchmark IRR level (with possible variations in project aspects as was demonstrated above) .
3. The project developer also took into account the local and global environmental benefits of the clean energy project and the learning-by-doing in the areas of energy generation and in the application of the CDM. The possibility of applying CDM was promoted by the Ministry of the Environment as an alternative to address the financial barriers to implementation, and to assist in addressing the plant annual operating costs.

[24] Reference: www.barchart.com/quotes/futures/CQZ14 (conversion rate €/US of 1.45 according to http://es.exchange-rates.org/HistoricalRates/A/EUR/31-12-2009). Value determined at the moment for the decision making.

B.6. Emission reductions
B.6.1. Explanation of methodological choices

Baseline Emissions

For AMS.I.D version 17, the baseline is the MWh generated by the renewable generating units and delivered to the national grid multiplied by the emissions factor of the national electricity system (measured in tCO_2e/MWh), as follows:

$$BE_y = EG_{BL,y} * EF_{CO_2,grid,y}$$

Where:

BE_{yy}	Baseline emissions in the year *y* (tCO_2e)
$EF_{CO2,grid,y}$	CO_2 emission factor of the grid in year y (tCO_2e/MWh)
$EG_{BL,Y}$	Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year *y* (MWh)

Calculation of $EG_{BL,y}$

The net electricity export/supplied to a grid is the difference between the measured quantities of the grid electricity export and the import and is determined as the measured quantities of the grid electricity delivered to this, minus the auxiliary electricity consumption, technical losses and electricity imports from the grid to each project power plant.

Calculation of $EF_{CO2,grid,y}$

The emission factor must be calculated in a transparent and conservative manner as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures described in the “Tool to calculate the emission factor for an electricity system” version 04.0. The calculation is based on data from official sources (where available) and made publicly available. According to the tool, the calculation of the emission factor is developed through the following six steps:

Step 1: Identifying the relevant electricity systems.
Step 2: Choose whether to include off-grid power plants in the project electricity system.
Step 3: Select a method to determine the operating margin (OM).
Step 4: Calculate the operating margin emission factor according to the selected method.
Step 5: Calculate the build margin (BM) emission factor.
Step 6: Calculate the combined margin (CM) emission factor.

Step 1: Identify the relevant electricity power systems

The Colombian electricity distribution network is composed by 61 energy generators, 11 transmission operators, 57 net operators and 117 traders. The net capacity of the National Interconnected System is 13,456 MW, where the hydropower generation represents 63.4%, thermal generation represents 32.3% and the minor generators and cogeneration 4.2%. The National Dispatch Centre (NDC) of Colombia is part of XM (Compañía de Expertos en Mercados S.A. E.S.P.) and is responsible for the operation ensuring a reliable

performance of the national grid. The following figure shows the distribution of the National Interconnected System of Colombia.

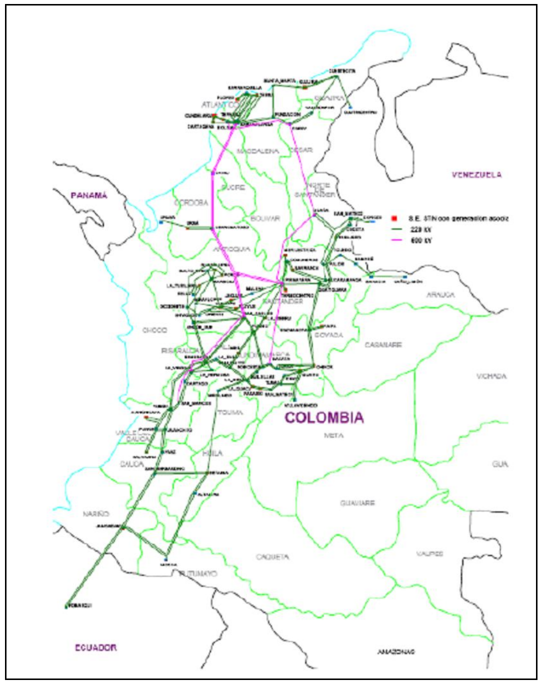

Figure: National Interconnected System of Colombia

Step 2: Choose whether to include off-grid power plants in the project electricity system

Project participants may choose one of the options below for calculating the operating margin and build margin emission factors:

Option I: Only power plants inside the grid are included in the calculation.
Option II: Power plants in and outside the grid are both included in the calculation.

For this project, Option I has been chosen and therefore only grid power plants are included in the emission factor calculation.

Step 3: Select a method to determine the operating margin (OM)

The tool provides four alternative methods for calculating the operating margin emission factor: (a) Simple OM, (b) Simple adjusted OM, (c) Dispatch analysis or (d) Average OM. For the project, the Operating Margin will be calculated using the simple adjusted method. This decision is based on the data requirements and availability of information from official sources, in this case the CND and UPME (Unidad de Planeación Minero Energética). Using this method the emission factor can be calculated using either of the two following data vintages:

- *Ex-ante*: based on the 3-year generation-weighted average by using the most recent data available at the time of submitting the PDD to the DOE for validation. If this option is used there will be no need for monitoring and recalculating the emission factor during the crediting period.

- *Ex-post*: The emission factor should be updated for the year in which the power plant displaces grid electricity. This emission factor should be updated annually for the rest of the crediting period during the monitoring.

For this project the *ex-ante* vintage has been selected, and therefore this remains unchangeable over the crediting period. The option was chosen in order to use a fixed emission factor (there will be no need for monitoring and recalculating the emission factor during the crediting period) given the availability of public information of the last 3-year generation from official sources (available at the beginning of the validation process).

Step 4: Calculate the operating margin emission factor according to the selected method

The simple adjusted OM emission factor ($EF_{OM,adjusted,y}$, expressed in tCO_2/MWh) is a variation of the simple operating margin, where power plants (including imports) are separated in *low cost/must run* plants (*k*) and other sources (*m*).

$$EF_{grid,OM\text{-}adj,y} = (1-\lambda_y) \cdot \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} + \lambda_y \cdot \frac{\sum_k EG_{k,y} \times EF_{EL,k,y}}{\sum_k EG_{k,y}}$$

Where:

$EF_{grid,OM\text{-}adj,y}$	Simple adjusted operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
λ_y	Factor expressing the percentage of time when *low-cost/must-run* power units are on the margin in year *y*
$EF_{ELm,y}$	CO_2 emission factor of power unit m in year *y* (tCO_2/MWh)
$EF_{EL,k,y}$	CO_2 emission factor of power unit k in year *y* (tCO_2/MWh)
$EG_{,m,y}$	Net quantity of electricity generated and delivered to the grid by power unit m in year *y* (MWh)
$EG_{,k,y}$	Net quantity of electricity generated and delivered to the grid by power unit *k* in year *y* (MWh)
m	All grid power units serving the grid in year *y* except low-cost/must-run power units.
k	All *low-cost/must run* grid power units serving the grid in year *y*
y	The relevant year as per the data vintage chosen in step 3

Where λ_y is:

λ_y = Number of hours low cost/must run plants are in the margin in year y / 8760 hours

According to methodology Lambda (λ_y) should be calculated as follows:

- Step i) Plotting a load duration curve. Collect chronological load data (typically in MW) for each hour of the year *y*, and sort the load data from the highest to the lowest MW level. Plot MW against 8,760 hours in the year, in descending order.

- Step ii) Collecting power generation data from each power plant / unit. Calculating the total annual generation (in MWh) from low-cost/must-run power plants / units.
- Step iii) Filling the load duration curve. Plot a horizontal line across the load duration curve such that the area under the curve (MW times hours) equals the total generation (in MWh) from lowcost/ must-run power plants / units (i.e. $\Sigma_k EG_{k,y}$).
- Step iv) Determining the "Number of hours for which low-cost/must-run sources are on the margin in year *y*". First, locate the intersection of the horizontal line plotted in step (iii) and the load duration curve plotted in step (i). The number of hours (out of the total of 8,760 hours) to the right of the intersection is the number of hours for which low-cost/must-run sources are on the margin. If the lines do not intersect, then one may conclude that low-cost/must-run sources do not appear on the margin and λ_y is equal to zero.

Determination of $EF_{EL,m,y}$

The $EF_{EL,m,y}$ emission factor has been calculated based on the available information applying the following options:

- Option A1: If for a power unit *m* data on fuel consumption and electricity generation is available, the emission factor ($EF_{EL,m,y}$) was determined as follows:

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_{m,y}}$$

Where:

$EF_{EL,m,y}$	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh).
$FC_{i,m,y}$	Amount of fossil fuel type *i* consumed by power unit m in year *y* (mass or volume unit).
$NCV_{i,y}$	Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/mass or volume unit).
$EF_{CO2,i,y}$	CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ).
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh).
m	All power units serving the grid in year *y* except *low-cost/must-run* power units.
i	All fossil fuel types combusted in power unit *m* in year *y*.
y	The relevant year as per the data vintage chosen in Step 3

- Option A.2: If for a power unit *m* data on electricity generation and types of fuels is available, the emission factor ($EF_{EL,m,y}$) was determined as follows

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \times 3.6}{\eta_{m,y}}$$

Where:

$EF_{EL,m,y}$	CO_2 emission factor of the power unit *m* in year *y* (tCO_2/MWh).

$EF_{CO2,m,i,y}$	Average CO_2 emission factor of fuel type *i* used in power unit *m* in year *y* (tCO_2/GJ)[25].
$\eta_{m,y}$	Average net energy conversion efficiency of power unit *m* in year *y* (%)
m	All power units serving the grid in year *y* except *low-cost/must-run* power units.
y	The relevant year as per the data vintage chosen in Step 3.

- Option A3. If for a power unit m only data on electricity generation is available, an emission factor of 0 tCO2/MWh can be assumed as a simple and conservative approach.

Determination of $EG_{m,y}$

For grid power plants, $EG_{m,y}$ should be determined as per the provisions in the monitoring tables. For this approach (simple adjusted OM) to calculate the operating margin, the subscript m refers to the power plants/units delivering electricity to the grid, not including low-cost/must-run power plants/units, and including electricity imports to the grid. Electricity imports should be treated as one power plant m. The same approach applies for the subscript k which refers to the power plants/units delivering electricity to the grid, including low-cost/must-run power plants/units, and including electricity imports to the grid.

The OM emission factor has been calculated using the data for the 3 last years (based on the ex-ante approach, therefore the emission factor of the operating margin must remain fixed over the crediting period). Energy imports are considered under the *low-cost/must-run* category. Calculations have been developed considering the public information of the Colombian electricity generation units available from official sources such as UPME and XM.

Step 5: Calculate the build margin (BM emission factor)

In terms of vintage of data, project participants can choose between one of the following two options:

Option 1: For the first crediting period, the build margin emission factor is calculated ex-ante based on the most recent information available on units already built for sample group m at the time of PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Option 2: For the first crediting period, the build margin emission factor shall be updated annually, ex-post, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated ex-ante, as described in option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

[25] According to the tool, when diverse types of fuels are used in one power plant, the fuel with less CO_2 emission factor is used to determine the $EF_{CO2,m,i,y}$.

For the project the BM emission factor has been calculated based on the vintage of date under option 1 (*ex–ante* approach). The option was chosen in order to use a fixed emission factor (there will be no need for monitoring and recalculating the emission factor during the first crediting period) given the availability of recent and public information from official sources at the time of PDD submission to the DOE for validation.

For the build margin calculation select the group of generating plants m those are available. Identify the five most recently built power stations and determine the most recent additions which represent 20% of generation. The option that comprises the larger annual generation should be chosen (power plants registered as CDM project activities should be excluded from the sample group m as long as the power plants in the sample group are not older than 10 years). For this calculation, the option that corresponds to the highest annual generation was the most recent power stations generating the 20% of the electricity (including the CDM power plants and plants with more than 10 years).

The build margin emission factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units *m* during the most recent year *y* for which electricity generation data is available. The calculation is shown below:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} . EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

Where:

$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit *m* in the year *y* (MWh)
$EF_{EL,m\,y}$	CO_2 emission factor for power unit *m* in the year *y* (tCO_2/ MWh)
m	Power units included in the build margin
y	Most recent historical year for which power generation data is available

The sample of the *m* power units group used for the BM emission factor calculation has been determined according to the tool's criteria, establishing that since $AEG_{SET-\geq 20\%}$ is greater than $AEG_{SET-5-units}$ and part of the power units started to supply electricity to the grid more than 10 years ago, the sample group of *m* power units used for the calculation is $AEG_{SET-\geq 20\%}$. The emission factor of each of the selected power units for the calculation has been obtained applying the previous steps.

Step 6: Calculate the combined margin (CM) emission factor

The calculation of the combined margin (CM) emission factor is based on one of the following methods:

(a) Weighted average CM; or
(b) Simplified CM.

The weighted average CM method (option A) should be used as the preferred option. The simplified CM method (option b) can only be used if:

- The project activity is located in a Least Developed Country (LDC) or in a country with less than 10 registered projects at the starting date of validation; and
- The data requirements for the application of step 5 above cannot be met.

For the CM calculation the option (a) has been chosen, thus the combined margin emission factor is calculated as a weighted average of the operating margin *(EF_{OM})* and build margin *(EF_{BM})* emission factors.

$$EF_{grid,CM,y} = w_{OM} . EF_{grid,OM,y} + w_{BM} . EF_{grid,BM,y}$$

Where:

$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$	Operating margin CO_2 emission factor in one year y (tCO_2/MWh)
ω_{OM}	Weighting of operating margin emissions factor (%)
ω_{BM}	Weighting of build margin emissions factor (%)

Generally a weighted coefficient of 50% is considered for both margins (ω_{OM} y ω_{BM}) for the first crediting period. In a second and third crediting period, a ω_{OM}= 0.25 and ω_{BM}= 0.75 would be considered, as mentioned in the tool to calculate the emission factor for an electricity system.

<u>Project emissions</u>

According to the methodology, project emissions for hydro power plants with no reservoir are zero.

<u>Leakage emissions</u>

In accordance to the applicable methodology, leakages are to be considered "if the energy generating equipment is transferred from another activity or if the existing equipment is transferred to another activity". Since there is no transfer of equipment from or to the project activity, no leakage emissions are considered.

<u>Emissions reductions</u>

The emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y$$

Where:

ER_y	Emission reductions in year y (tCO_2e/y)
BE_y	Baseline emissions in year y (tCO_2/y)
PE_y	Project emissions in year y (tCO_2e/y)
LE_y	Leakage emissions in year y ($t\ CO_2/y$)

The result of the application of the equations is presented in section B.6.3.

B.6.2. Data and parameters fixed ex ante

Data / Parameter	$EG_{m,y}$

Unit	MWh
Description	Net electricity generated by power units m in year *y*.
Source of data	NEON - Compañía de Expertos en Mercados S.A. E.S.P.
Value(s) applied	Please refer to file "060812_Emission Factor Calculation 2010 V3-Exante_Revision 1".
Choice of data or Measurement methods and procedures	The national dispatch centre (CND) of Colombia is part of XM (Compañía de Expertos en Mercados S.A. E.S.P.) and is responsible for issuing plans and assuring a reliable performance of the national grid. All information regarding the national interconnected system is handled and stored in the information system NEON. Official data published yearly. The information (of energy generated by power plants m) is available through the link: http://sv04.xm.com.co/neonweb/PrinNeon.asp[26]
Purpose of data	Estimation of national grid emission factor.
Additional comment	The information is based on the 3-year generation.

Data / Parameter	$EG_{k,y}$
Unit	MWh
Description	Net electricity generated by power units k in year *y*.
Source of data	NEON - Compañía de Expertos en Mercados S.A. E.S.P
Value(s) applied	Please refer to file "060812_Emission Factor Calculation 2010 V3-Exante_Revision 1".
Choice of data or Measurement methods and procedures	The national dispatch centre (CND) of Colombia is part of XM (Compañía de Expertos en Mercados S.A. E.S.P.) and is responsible for issuing plans and assuring a reliable performance of the national grid. All information regarding the national interconnected system is handled and stored in the information system NEON. Official data published yearly. The information (of energy generated by power plants k) is available through the link: http://sv04.xm.com.co/neonweb/PrinNeon.asp[27]
Purpose of data	Estimation of national grid emission factor.
Additional comment	The information is based on the 3-year generation.

Data / Parameter	$EF_{EL,m,y}$
Unit	tCO_2/MWh
Description	Emission factor of power units m in year *y*.
Source of data	Obtained multiplying the fossil fuel consumption of each thermal power plant m (reported in the information system NEON which is an official source) with the net calorific value and the CO_2 emission factor of each fossil fuel type consumed by each plant (obtained from IPCC 2006 Guidelines for National Greenhouse Gas Inventories using default values - lower limits of the 95% confidence intervals). The information (of fossil fuel consumption) is available through the link: http://sv04.xm.com.co/neonweb/PrinNeon.asp[28]
Value(s) applied	Please refer to file "060812_Emission Factor Calculation 2010 V3-Exante_Revision 1".

[26] To access information, it´s necessary to request a password to administrator of NEON.
[27] To access information, it´s necessary to request a password to administrator of NEON.
[28] To access information, it´s necessary to request a password to administrator of NEON.

Choice of data or Measurement methods and procedures	This information is provided by each generation facility connected to the national interconnected system and is compiled by the national dispatch centre (CND) of Colombia and the Unidad de Planeación Minero Energética (UPME) which is part of the Ministry of Mines and Energy of Colombia.
Purpose of data	Estimation of national grid emission factor.
Additional comment	More calculation details are provided in appendix 4.

Data / Parameter	$EF_{EL,k,y}$
Unit	tCO_2/MWh
Description	Emission factor of power units k in year *y*.
Source of data	Obtained multiplying the fossil fuel consumption of each thermal power plant k (reported in the information system NEON which is an official source) with the net calorific value and the CO_2 emission factor of each fossil fuel type consumed by each plant (obtained from IPCC 2006 Guidelines for National Greenhouse Gas Inventories using default values - lower limits of the 95% confidence intervals). The information (of fossil fuel consumption) is available through the link: http://sv04.xm.com.co/neonweb/PrinNeon.asp[29]
Value(s) applied	Please refer to file "060812_Emission Factor Calculation 2010 V3-Exante_Revision 1".
Choice of data or Measurement methods and procedures	This information is provided by each generation facility connected to the national interconnected system and is compiled by the national dispatch centre (CND) of Colombia and the Unidad de Planeación Minero Energética (UPME) which is part of the Ministry of Mines and Energy of Colombia.
Purpose of data	Estimation of national grid emission factor.
Additional comment	More calculation details are provided in appendix 4.

Data / Parameter	$EF_{grid,OMadj,y}$
Unit	tCO_2/MWh
Description	Simple adjusted operating margin CO_2 emission factor in year *y*.
Source of data	Project developer.
Value(s) applied	0.55843
Choice of data or Measurement methods and procedures	The Operating Margin was calculated according to the guidelines provided in the "Tool to calculate the emission factor for an electricity system" version 04.0, using official and public information. The calculation is based on the 3-year generation-weighted average using the most recent data available. The calculation is available on the spreadsheet ("060812_Emission Factor Calculation 2010 V3-Exante_Revision 1").
Purpose of data	Estimation of national grid emission factor.
Additional comment	More calculation details are provided in appendix 4.

Data / Parameter	$EF_{grid,BM,y}$
Unit	tCO_2/MWh
Description	Build margin CO_2 emission factor in year *y*.
Source of data	Project developer.

[29] To access information, it´s necessary to request a password to administrator of NEON.

Value(s) applied	0.20387
Choice of data or Measurement methods and procedures	The Build Margin was calculated according to the guidelines provided in the "Tool to calculate the emission factor for an electricity system" version 04.0, using official and public information. The calculation is based on the ex-ante information based on the option 1 (using the most recent data available at the time of PDD submission to the DOE for validation). The calculation is available on the spreadsheet ("060812_Emission Factor Calculation 2010 V3-Exante_Revision 1").
Purpose of data	Estimation of national grid emission factor.
Additional comment	The application details are provided in appendix 4.

Data / Parameter	$EF_{CO2,i\,y}$
Unit	kg CO_2/ TJ
Description	CO_2 emission factor for each fuel type *i* used.
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (Default values - lower limits of the 95% confidence intervals).
Value(s) applied	Please refer to file "060812_Emission Factor Calculation 2010 V3-Exante_Revision 1".
Choice of data or Measurement methods and procedures	Defined according to the "Tool to calculate the emission factor for an electricity system" version 04.0.
Purpose of data	Estimation of national grid emission factor.
Additional comment	The application details are provided in appendix 4.

Data / Parameter	***$EF_{grid,y}$* (referred in the tool to calculate the emission factor for an electricity system - version 04.0 as *$EF_{grid,CM,y}$*)**
Unit	tCO_2e/MWh
Description	Combined margin CO_2 emission factor in year *y*.
Source of data	Project developer.
Value(s) applied	0.38115 (Grid emissions factor)
Choice of data or Measurement methods and procedures	The emission factor is calculated as the weighted average of the Operating Margin (OM) and the Build Margin (BM) emissions factors according to the procedures described in the "Tool to calculate the emission factor for an electricity system" version 04.0., using official and public information. The calculation is available on the spreadsheet ("060812_Emission Factor Calculation 2010 V3-Exante_Revision 1").
Purpose of data	Estimation of emission reductions.
Additional comment	According to the tool to calculate the emission factor for an electricity system, the value was calculated ex-ante for the OM and under option 1 for the BM, thus will not need to be revised within crediting period. A single, fixed value is used for the entire crediting period. More calculation details are provided in appendix 4.

B.6.3. Ex-ante calculation of emission reductions

Baseline emissions

As prescribed in AMS-I.D version 17, the baseline's emissions are obtained as the product of the net electricity produced and delivered by the renewable generating units multiplied by an emission coefficient of the grid measured in tCO2e/MWh. According to the design reports prepared by CGB, the energy to be generated by the project power plants is:

Power generation - Suba and Usaquen hydroelectric CDM umbrella project								
Effective power rating (MW)	**2013***	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020****
Suba	2.230	2.230	2.230	2.230	2.230	2.230	2.230	2.230
Usaquen	1.546	1.546	1.546	1.546	1.546	1.546	1.546	1.546
Total	3.776	3.776	3.776	3.776	3.776	3.776	3.776	3.776
Plant load factor (%)								
Suba	72.575%	87.090%	87.090%	87.090%	87.090%	87.090%	87.090%	14.515%
Usaquen	63.600%	76.320%	76.320%	76.320%	76.320%	76.320%	76.320%	12.720%
Annual power generation (MWh/y)								
Suba	14,177	17,012	17,012	17,012	17,012	17,012	17,012	2,835
Usaquen	8,614	10,337	10,337	10,337	10,337	10,337	10,337	1,723
Total	**22,791**	**27,349**	**27,349**	**27,349**	**27,349**	**27,349**	**27,349**	**4,558**

(*) 10 months of operation (**) 2 months of operation

Table: Projected annual power generation

As is shown in Annex 3 below, the operating margin emission factor calculated under the simple adjusted method ($EF_{OMsimp-adj,y}$) results to be 0.55843 tCO_2/MWh and the build margin emission factor ($EF_{BM,y}$) 0.20387 tCO_2/MWh. Thus, the resulting grid emission factor is:

$$EF_{grid,y} = 0.5\ x\ \ EF_{OM,simp-adj,y} + 0.5\ x\ \ EF_{BM,y} = (0.5\ x\ 0.55843) + (0.5\ x\ 0.20387) = 0.38115\ tCO2e/MWh.$$

Project emissions

As described in section B.6.1, the anthropogenic emissions of GHG due to the project activity are zero, since the project does not include a reservoir and will not involve the use of other energy sources.

Leakage emissions

In accordance to the methodology, leakage calculation is only required if the renewable energy technology equipment is transferred from another activity or to another activity. This is not the case of the proposed project, so leakage is not to be considered.

Emission reductions

The emission reductions resulting from the project implementation are:

Emission reductions calculation - Suba and Usaquen hydroelectric CDM umbrella project								
year	**2013***	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020****
Electricity to the grid (MWh/y)	22,791	27,349	27,349	27,349	27,349	27,349	27,349	4,558
EF (tCO_2e/MWh)	0.38115	0.38115	0.38115	0.38115	0.38115	0.38115	0.38115	0.38115
Baseline emissions (tCO_2e/y)	8,687	10,424	10,424	10,424	10,424	10,424	10,424	1,737

Project Emissions (tCO_2e/MWh)	0	0	0	0	0	0	0	0
Leakage (tCO_2e/MWh)	0	0	0	0	0	0	0	0
Net Emission Reductions (tCO_2e/y)	8,687	10,424	10,424	10,424	10,424	10,424	10,424	1,737

(*) 10 months of operation (**) 2 months of operation

Table: Emission reduction calculation

B.6.4. Summary of ex-ante estimates of emission reductions

Emission reductions calculations taken into account the small scale methodology AMS-I.D are:

Year	Baseline emissions (tCO_2 e)	Project emissions (tCO_2 e)	Leakage (tCO_2 e)	Emission Reductions (tCO_2 e)
2013*	8,687	0	0	8,687
2014	10,424	0	0	10,424
2015	10,424	0	0	10,424
2016	10,424	0	0	10,424
2017	10,424	0	0	10,424
2018	10,424	0	0	10,424
2019	10,424	0	0	10,424
2020**	1,737	0	0	1,737
Total	72,968	0	0	72,968
Total number of crediting years	7			
Annual average over the crediting period	10,424			

(*) 10 months of operation (**) 2 months of operation

Table: Summary of project emission reductions

B.7. Monitoring plan
B.7.1. Data and parameters to be monitored

Data / Parameter	$EG_{facility,y}$ ($EG_{BL,y}$)
Unit	MWh/year
Description	Net electricity generated and supplied to the grid by the project activity in the year *y*.
Source of data	Measurement by project participant (power meters).
Value(s) applied	Net energy generation (average for the first crediting period) used for ex-ante estimation:

Power plant	MWh/yr
Suba	17,012
Usaquen	10,337
Total	27,349

Note: Please refer the spreadsheet "power generation" on file "230413_EAAB

	emission reductions calculation V2_Revision 4".
Measurement methods and procedures	For each power plant, the net electricity export/supplied to a grid will be measured continuously and periodically recorded (records of any energy generated would be registered since the start of project). According to the provisions of AMS.I-D version 17, the net electricity export/supplied to a grid is the difference between the measured quantities of the grid electricity export and the import, thus in the project power plants the energy exported and imported will be measured (the net electricity supplied to the grid will be determined as the measured quantities of the grid electricity delivered to the grid minus the auxiliary electricity consumption, technical losses and electricity imports from the grid to each project power plant, determined in the commercial border or connection point used for billing purposes). Power meters will be installed in the project installations (for both, energy exported/supplied and energy imported from the grid). The measurements will be compiled at least hourly and stored in a specific spreadsheet (for each power plant).
Monitoring frequency	Measured continuously and periodically recorded
QA/QC procedures	Power meters will be calibrated periodically according to the national standards and reference points or IEC standards and recalibrated at appropriate intervals according to manufacturer's specifications (at least once every two years). Data collected has low uncertainty levels and to guarantee its accuracy it will be cross checked with records of invoices/receipts for sold/purchased electricity obtained from the grid trader/generator (where applicable, the low value would be used for emission reductions calculation. This is conservative). To ensure the information of each power plant, the grid trader/generator will deliver sales receipt separately (for Suba and Usaquén). The accuracy of the meters (+/-% readings 1s) are voltage 0.1%, frequency 0.01%, current (I1,I2,I3) 0,1% and current (I4, I5) 0.4%.
Purpose of data	Estimation of baseline emissions.
Additional comment	Data will be archived at least for two years after the crediting period.

B.7.2. Sampling plan

There is no parameter that to be determined by means of a sampling plan.

B.7.3. Other elements of monitoring plan

A monitoring plan will be implemented to ensure that the approved monitoring methodology AMS-I.D version 17 is correctly implemented in order to enable the accurate and transparent determination of emission reductions. The plan will incorporate the QA/QC procedures described in B.7.1 above, which are in line with the quality control system of EAAB. The overall management structure responsible for project monitoring is as follows:

Management monitoring structure: The project's structure for the management plan is as flows:

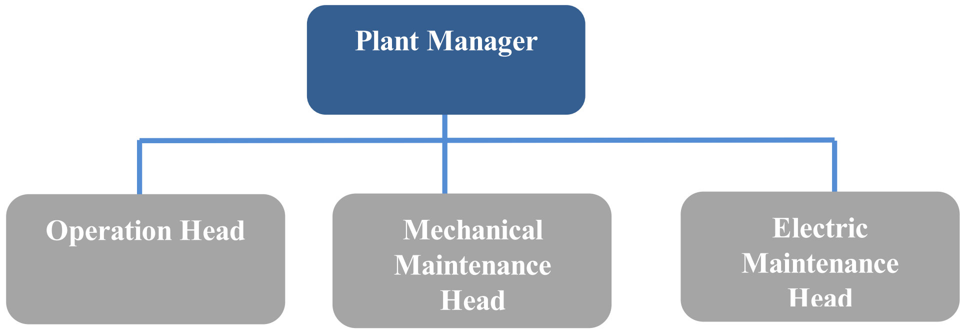

Figure: Monitoring management proposed structure

- **Plant Manager:** will be responsible for the following activities:
  - Supervise and guarantee the quality of the data registered in the spreadsheets.
  - Supervise and guarantee the quality of the annual and monthly final reports.
  - File the data and final reports.
  - Will have knowledge of the activities and calibration and maintenance of the equipment and will file the certificates of the procedure.

- **Operation Head:** will be responsible for the following activities:
  - Supervise and guarantee the quality of the data during their compilation process.
  - Compare the registered data to other available documents (bills, official information, formal communications of the electricity sector and other entities, among others).
  - File the data and final reports.
  - Process the data and generate the final reports.

- **Mechanical Maintenance Head:** will be responsible for performing the periodic revisions of equipment and when required, help with the calibrations and repairs of the equipment.

- **Electric Maintenance Head**: will be responsible for informing the requirements of inspection for calibration and maintenance of the equipment and filing the certificates of the procedure.

On-line monitoring system: All key meters required to determine parameters to calculate GHG emission reductions will be monitored from a central control point which will record meters readings at a pre-determined interval as specified in the project documents. These data will be used to continually update total emission reductions as long as the generating plant is in operation. Key meters will measure the parameters listed in B.7.1 above. Data collected has low uncertainty levels and to guarantee its accuracy it will be cross checked with the electricity sales receipts obtained from the grid trader/generator (where applicable, the low value would be used for emission reductions calculation. This is conservative).

Emission reductions calculation: Data required for calculating baseline will be fed into a processor (spreadsheet application) which will calculate the emission reductions according to the formulae described above (B.6.1), using the defined default values. Access to the spreadsheet will be controlled for security. The process will include various checks, such as the comparison of the total energy generated by the power units and delivered to the grid, against the energy supplied to the grid as is indicated in the electricity sales receipts or similar documents obtained from the grid´s operator.

Non-essential data: The on-line monitoring system will also record "non-essential" data. Such data is termed non-essential because it is not directly listed in the monitoring methodology, but it will constitute a means of corroborating the on-line system. Non-essential data will include measurements of net and gross output from generator, certificated conversion efficiency, fed water and any other data considered relevant to the project activity.

Accuracy and calibration of the equipment: All meters will be operated and maintained according to the manufacturers' specifications. All key meters will be subjected to a quality control regime that will include maintenance and periodic calibration, as indicated in Resolution CREG 025- Measurement Code[30]. A record will be maintained showing the location and unique identification number of each meter, the calibration status of that meter (date of the last calibration and date of the next calibration) and who will develop the calibration service. Calibration certificates will be retained for all meters until two years after the end of the crediting period.

Archiving data: The on-line system will archive data automatically in a secure and retrievable storage format on a periodic basis (eg. weekly basis). Calibration log registries will be archived in an accessible electronic format. This data will be stored for at least two years after the crediting period ends.

Document control: A document control system will be implemented to ensure that current versions of the necessary documents are available at the point of use. A CDM monitoring guideline will be adopted to guarantee the best practice and results in the monitoring implementation.

Preparation of the monitoring report: Data filed/measured will be used to prepare a monitoring report to be submitted to the DOE for verification and to the CDM Executive Board for issuance of CERs. A standard format for the monitoring report will be prepared before the presentation of the first monitoring report.

Treatment of lost or damaged data: Where data in the on-line system are corrupted or missing whilst the generator is operating (as shown, for example, by monitoring equipment failure) the missing data can be estimated by taking the lower value for the parameter in question in the hour before the error arose or the hour immediately after the system came on-line again. If there is evidence to suggest that both of these values are un-representative, the average from the previous 24 hours will be used. The error will be recorded in the daily log sheet and the occurrence of the error will be investigated and rectified as soon as possible. If the on-line system is compromised for more than 24 hours, data will be manually recorded. Any deficiencies in energy generated monitoring data will be rectified by back calculation from power sold.

Auditing function and management revision: The plant manager will be responsible for auditing the monitoring management system at least once per year. The auditor will not be involved in the daily operation of the power plant, and if is necessary, may be sourced from a third party. The auditor will evaluate the implementation of the monitoring plan and the preparation of the monitoring report. Audit findings, and steps taken to address findings will be recorded and reviewed in a management review meeting (convened at least annually) at which time the effectiveness of these procedures will be reviewed and necessary changes implemented. The variable to be monitored was listed and described in Section B.7.1.

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[30] This regulation indicates that the owner of the measurement equipment is forced to develop a regular maintenance and calibration program.

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

The contract No.1-01-26300-1063-2009[31], signed between the contractor Consorcio Generación Bogotá and the project participant, establishes as a starting date the signature of the Work Initiation Act (document signed on 01/03/2010[32]). The project participant decides to use this date as a starting date for the project activity, since this was the moment in which it has acquired contractual obligations to execute expenditures related to the implementation/construction of the power plant (this act indicates that a real action has begun).

C.1.2. Expected operational lifetime of project activity

25 years[33]

C.2. Crediting period of project activity

C.2.1. Type of crediting period

Renewable crediting period

C.2.2. Start date of crediting period

01/03/2013 (or the registration date, whichever is later)

C.2.3. Length of crediting period

7 years

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

The compliance with the environmental regulation must be considered for each hydroelectric power plant separately. According to the national regulation (Ministry of Environment, Housing and Territorial Development, Decree 2820, 05 August 2010[34]) the construction and operation of hydropower plants with a capacity below 100 MW will require environmental license before its installation (this process includes the environmental impacts analysis), however, the normative has an exception for those projects that had contracts in course or were being executed before entry into force of the regulation (August 5, 2010) and were not obliged to have environmental licensing.

Considering the above, the project being developed by EAAB does not require environmental license, since before the date of entry into force of the regulation, the projects had an execution contract and they were being developed by the contractor; therefore, it is not necessary to do a study of environmental impacts. Nevertheless,

[31] The document "Contract No.1-01-26300-1063-2009" was signed on 24/12/2009.
[32] Work initiation act signed by the EAAb and the the contractor Consorcio Generación Bogotá.
[33] Communications from "Consorcio Generación Bogotá" certifying the expected lifetime of the main equipment of each power plant (Suba and Usaquen), dated January 8, 2013.
[34] Decree 1220, 2005 – Ministry of Environment, Housing and Territorial Development.

it is necessary to obtain the water concession (permissions) for the water collection and utilization[35]. These permissions were emitted by the local environmental authorities according to their jurisdiction and correspond to concessions for the use of water from the municipal potable water supply system of Bogota.

Likewise, the contractor received other necessary permissions for the civil works, such as a construction license, a land movement authorization and a land use certification. For this project activity, the project developer has already obtained all the above mentioned permissions. An environmental management plan has been prepared in order to determine the environmental impact during construction of the proposed power plants. The plan contains measures to ensure the correct environmental performance during construction and eventually project operation. The environmental aspects identified are:

1. Noise

The major source of noise during the construction stage is related to the use machinery and vehicles. These sources are usually between 80 dB to 85 dB. The major source of noise during the operation stage would be the turbine and generator, which is expected to be between 70 dB to 88 dB. As a mitigation measure, machinery with low noise level has been selected during the construction period. The equipment with high noise level is not operate during the night. The implementation of these measures has reduced effectively the noise level during construction period. For the operation stage, equipment with low noise level will be used. Noise control measures like absorption and insulation will be taken during operation. The power house will be set in places provided with sound insulation. Evergreen trees would be planted around the border of the plant. Noise level for both day and night shall be in compliance with the requirements of national regulations (Resolution 8321 of 1983 from the Ministry of Health).

2. Air Pollution

Dust and suspended solids were the main pollutants created during construction period. Requirements stipulated in national regulations (Decree 948 of 1995, from Ministry of Environment) and other regulations were strictly followed by the contractors. The stone and soil generated from digging activities were reused on the site, and the permit to move and dispose the soil not used was requested. After any construction work, the site has been cleaned without delay, and the exposed land has been covered with vegetation. It is expected that there are not pollutants to be generated during operation period.

3. Wastewater

Industrial wastewater has not been generated during the construction period. The only wastewater to be generated during operation period would be domestic waters. The sewage will be treated according to the local regulations using existing infrastructure.

4. Solid waste

The solid waste created during construction period has been mainly soil from the digging activity and abandoned construction materials. These residues have been disposed correctly following the regulations. No industrial solid waste will be generated during operation. Domestic garbage will be disposed in the local landfill.

[35] Resolution 157/2004 UAESPNN, Resolution 158/2004 UAESPNN, Resolution 260/2007 UAESPNN.

5. Ecological impact

The project is located within the area property of the EAAB (urban and rural area) and no additional land would be necessary. There are no rare plants or animals around the site, therefore this project will cause a small impact to ecological environment. The company has a certification of land use that indicates that the implementation of the projects is not prohibited. The project complies with all the country's regulations in terms of environmental requirements and has been approved by the local authorities.

As a result of the analysis, environmental impacts due to the implementation of the project activity are not considered significant. The measures adopted in this process will result in the improvement of the environmental performance of the entire project activity. In addition, any possible environmental impacts of this project activity will be monitored by the local environment authority.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

A stakeholder consultation process was developed in order to invite local stakeholders to express their comments regarding the "Suba and Usaquen hydroelectric CDM umbrella project". According to the Resolution 2734 of 2010 emitted by the Ministry of Environment, Housing and Territorial Development, a CDM project must send to the municipal ombudsman office a document with a description of the project and a letter inviting local stakeholders to participate in a meeting in order to provide information of the project and obtain their comments.

To attend this process, the EAAB considered three consultation sessions to provide adequate consultation opportunities to communities and other stakeholders. The first session was developed with local and national authorities while the other sessions were developed with representatives from local communities in the influence area of each project. The process required by the Resolution 2734 was followed to invite the participation of the communities.

A project description and the invitation letter were published at the ombudsman office in Bogota. In order to assure the participation of as many stakeholders as possible, the EAAB organized the meetings with personnel of the city and the municipality. In addition, personal invitations were sent to community leaders, local people, local authorities, committee representatives, media, among others.

The first meeting was held in the auditorium of the Chamber of Commerce of Bogota on July 19, 2011, at 9:00 am and was attended by the project owner representatives, project consultant and the authorities indicated in the attendance list. The second meeting was held in the auditorium of the community of Suba on August 27, 2011, at 8:00 am and was attended by the project owner representatives, project consultant and representatives from the Suba community. The third meeting was held in the installations of EAAB in the neighborhood of Santa Barbara, on August 27, 2011, at 2:00 pm and was attended by the project owner representatives, project consultant and representatives from the Usaquen community. During the meetings several presentations were made by the project owner and consultants who outlined the planned project activity in a non-technical manner (including environmental, social and technological considerations, climate change and, the role of the CDM). The presentations were followed by questions and answers sessions.

The main objective of the meetings was to clarify and inform the communities about the main characteristics of the project (for each power plant). In addition, the meetings allowed invited stakeholders to understand the basic concepts related to the power plants considering the CDM and the local communities living conditions.

A total of 72 participants attended the meetings. All opinions were collected by means of questionnaires filled out by the participants. All documents regarding the meeting are available for validation.

E.2. Summary of comments received

The consultation gave an opportunity for the stakeholders to fully understand the project. The comments received from representatives of the local communities are summarized in the following points:

- Does the project beneficiate people of the surrounding community when it begins operations?
- Who is going to take responsibility for the damage to the roads and urban areas caused by the movement of dump trucks during project construction?
- If the United Nations rejects the project activity as a CDM, all the work already done is going to be lost?
- Does EAAB have all permissions required to use the water to produce energy?
- Will the radiation from the electric substation affect the surrounding communities?
- Is the project activity going to reduce the energy tariff?
- How much money will be invested in the communities in the project area?

In addition, the local stakeholders were asked to complete a survey handed out by the project developer. The results show that stakeholders believe that the proposed CDM project activity will have positive impacts on the local, ecological, environmental, employment, and social life. All stakeholders expressed their support for the proposed project. The complete information of each stakeholder will be provided to the DOE during the validation process.

E.3. Report on consideration of comments received

As a result, the comments received by local stakeholders were highly positive about the implementation of the project activity. During the meeting the project owner assured that:

- The construction and operation of the project would be in line with the environmental and health laws of the country and do not affect the surrounding areas.
- The project developer will hire local workers for the unskilled labour and will develop training programs to improve their skills.
- The current water rights allow other uses, such as mechanical use, only if it water conditions are not altered.
- The project developer has an agreement with the authorities to fix the roads and urban areas affected when the construction activities have finished.
- The substation will not generate radiation that can affect the communities.
- The project depends on the incentives generated by the CDM.
- According to the national regulations, the energy generated must be sold to the national grid, thus the tariff for the energy in the region does not depend on the project developer.

In addition, during the meeting EAAB informed of its voluntary commitment to invest a certain percentage of the CER revenues in activities to protect the Chingaza water basin.

SECTION F. Approval and authorization

The letter of approval was issued by the local Designated Authority on December 03, 2012 and has been available for validation.

Appendix 1: Contact information of project participants

Organization	Empresa de Acueducto y Alcantarillado de Bogotá E.S.P-EAAB
Street/P.O. Box	Avenida Calle 24 No. 37 - 15
Building	-
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Appendix 2: Affirmation regarding public funding

As has been stated on section A.5, the project activity does not involve the use of public funding from Annex I Parties.

Appendix 3: Applicability of selected methodology

The project activity is in compliance with the applicability conditions of the approved baseline methodology in the context since:

Technology/measure as per AMS.I-D- version 17	Measure of project activity
This methodology comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and	The project activity considers the installation of two new small power plants (which generate energy using a flow of water). The energy generated by the project activity will be

renewable biomass: a. Supplying electricity to a national or a regional grid; or b. Supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling.	supplied to the National Interconnected System of Colombia (that is or would have been supplied by at least one fossil fuel fired generating unit).
This methodology is applicable to project activities that: a. Install a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity (Greenfield plant); b. Involve a capacity addition; c. Involve a retrofit of (an) existing plant(s); or d. Involve a replacement of (an) existing plant(s).	The project activity considers the installation of two new power plants at a sites where there were no renewable energy power plants operating prior to the implementation of the project activity (corresponds to a greenfield plant).
Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology: a. The project activity is implemented in an existing reservoir with no change in the volume of reservoir; b. The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the project emissions section, is greater than 4 W/m2; c. The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the project emissions section, is greater than 4 W/m2.	The project activity considers the use of water from an existing water supply system (water supply system of Bogotá city), therefore does not require the construction of a reservoir.
If the new unit has both renewable and non-renewable components (e.g. a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the new unit co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW.	The project activity does not consider the installation of a power plant (unit) with both renewable and non-renewable components.
Combined heat and power (co-generation) systems are not eligible under this category.	The project activity is a run-of-river type hydro power plant, thus does not correspond to a combined heat and power (co-generation) system.
In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units. In	The project activity does not consider the addition of renewable energy generation units at an existing renewable power generation facility. And does not consider the retrofit or replacement of any unit.

the case of retrofit or replacement, to qualify as a small-scale project, the total output of the retrofitted or replacement unit shall not exceed the limit of 15 MW.	

Table: Methodology applicability conditions

Appendix 4: Further background information on ex ante calculation of emission reductions

The grid emission factor is determined according to the tool to calculate the emission factor for an electricity system, as a combined margin emission factor, consisting of the combination of the operating margin and the build margin emission factors. The detailed calculation, as well as all the information used for it, is shown in the spreadsheet prepared by the project developer. The following table summarizes the grid emission factor calculation for an ex ante estimation.

Operating Margin Emission Factor 2010			
Year	2008	2009	2010
Electricity generation – low cost/must run (MWh)	46,304,225.011	40,974,680.276	40,731,236.779
CO2 emissions – low cost/must run (tCO2)	0	0	0
Electricity generation – no low cost/must run (MWh)	8,128,306.238	14,964,392.812	16,068,817.265
CO2 emissions – no low cost/must run (tCO2)	5,137,805	9,396,972	10,628,547
Lambda factor	0.3243	0.0523	0.0201
Operating Margin Emission factor (tCO2/MWh)	0.42709	0.59512	0.64815
Full generation-weighted average Operating Margin Emission factor (tCO2/MWh)	**0.55843**		
Build Margin Emission Factor 2010			
Electricity generation in 2010 (MWh)	56,422,515,005		
20% of electricity generation in 2010 (MWh)	11,284,503,001		
Electricity generation of the power plant capacity additions that comprises 20% of the system generation in 2010 (MWh)	16,224,230.184		
CO2 emissions of the power plant capacity additions that comprises 20% of the system generation in 2010 (tCO2)	3,307,648		
Build Margin Emission factor (tCO2/MWh)	**0.20387**		
Combined Margin Emission Factor 2010 – weighted 50% (tCO2/MWh)	**0.38115**		

Table: Summary of emission factor calculation

Appendix 5: Further background information on monitoring plan

There is no further information regarding monitoring plan.

Appendix 6: Summary of post registration changes

There are no changes at the time of submission of this document.

History of the document

Version	Date	Nature of revision
04.1	11 April 2012	Editorial revision to change history box by adding EB meeting and annex numbers in the Date column.
04.0	EB 66 13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the project design document form for small-scale CDM project activities" (EB 66, Annex 9).
03	EB 28, Annex 34 15 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.
02	EB 20, Annex 14 08 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
01	EB 07, Annex 05 21 January 2003	Initial adoption.
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