Monitoring report form for CDM project activity
(Version 06.0)

Complete this form in accordance with the instructions attached at the end of this form.

MONITORING REPORT		
Title of the project activity	Rio Amoyá Run-of-River Hydro Project	
UNFCCC reference number of the project activity	3461	
Version number of the PDD applicable to this monitoring report	6	
Version number of this monitoring report	Version 1	
Completion date of this monitoring report	18/12/2017	
Monitoring period number	Second Monitoring Period	
Duration of this monitoring period	01/06/2015 - 31/05/2017 (first and last days included)	
Monitoring report number for this monitoring report	1	
Project participants	ISAGEN S.A. E.S.P.	
Host Party	Colombia	
Sectoral scopes	Sectoral Scope 1: Energy industries (renewable - / non-renewable sources).	
Applied methodologies and standardized baselines	The ACM0002-version 12.1.0 “Consolidated baseline methodology for grid-connected electricity generation from renewable sources”	
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	0	272,277 tCO_2e
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	353,770 tCO_2e [1]	

[1] Two years of operation; according to the annual CER generation included at PDD section B.6.4.

SECTION A. Description of project activity

A.1. General description of project activity

The Rio Amoyá Run-of-River Hydro Project ("Project"), consists of a greenfield run-of-river power plant with a nominal capacity of 80 MW and an anticipated generation of approximately 513.6 GWh/year, based on the projected generation resulting from engineering studies contracted by ISAGEN S.A. E.S.P. ("ISAGEN") in 1998 and 2005. The power plant is connected to the national grid through an 18,6 km transmission line.

The Project is considered not only as a power plant, but also as an "Environmental Services Project". It contributes to decrease the global emissions of carbon through the substitution of polluting fuels as a source of electric power generation; and with its multiple benefits and capacity to yield and consolidate economic resources, it will contribute to the conservation and protection of the Amoyá River´s basin and to the conservation of the *Las Hermosas Páramo* ecosystem. About the environmental effects, the plant, thanks to its characteristics of being a run-of-river-intake hydroelectric with no dam, and the simplicity involving the civil works, had a minimum environmental impact, since it involved no settlement relocation or displacement whatsoever, it had a low effect on the ecosystems in the area of influence and its land requirements were minimal.

The Project was expected to start its operation in 2011 and to reduce about 1.2 million tCO_2e by 2018. However, the construction spent more time because of different circumstances and the plant started commercial operation on May 30th 2013.

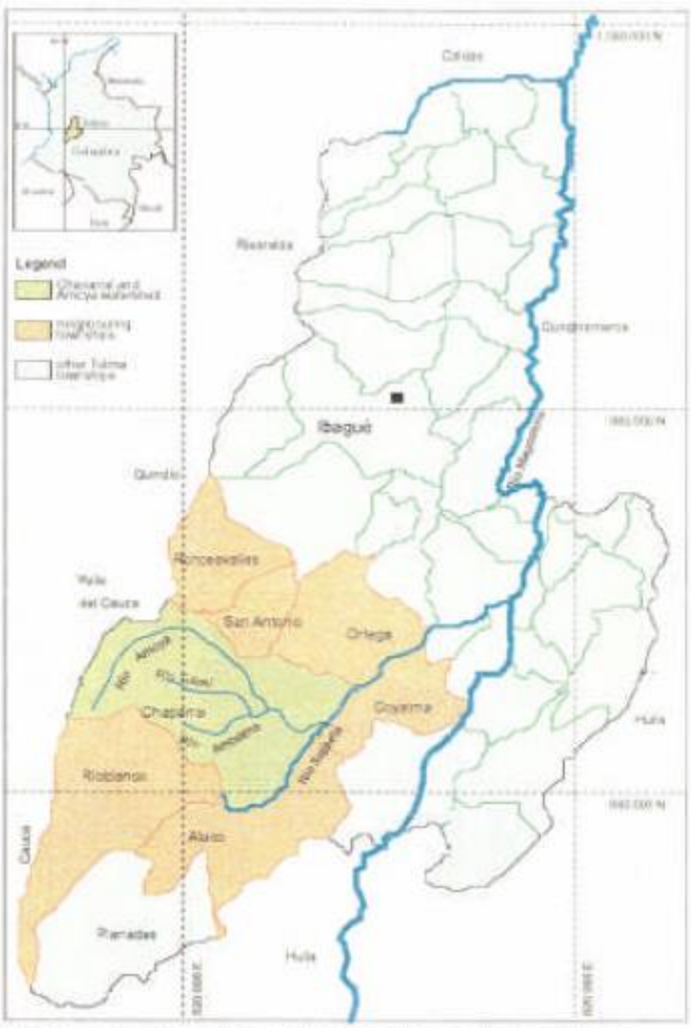
A.2. Location of project activity

The Project is located in the middle section of the Amoyá River Basin in the municipality of Chaparral, Tolima province, Colombia. Chaparral is 262 Km from Colombia´s capital, Bogota. The Amoyá River receives waters from Las Hermosas Páramo ecosystem.

The upper reaches of the Amoyá River basin are conformed by a Páramo ecosystem. This high altitude ecosystem is considered of major importance given its great ecological value and the multiple environmental services it provides. Both reasons make the relation with the Project of particular relevance. Páramos in the Amoyá area form the largest patch in the Central Cordillera. Out of the Páramo total area; there are 650 km2 under protection status in the Páramo de las Hermosas National Park; 27% of this area is in the Amoyá River basin.

Projects Coordinates

	Y	X	Latitude	Longitude
Bogotá	**N 1'000,000.000**	**E 1'000,000.000**		
Power house	N 912,781.836	E 831,653.566	3° 48' 22"	-75° 35' 35"
Intake	N 917,584.603	E 824,852.432	3° 50' 58"	-75° 39' 15"



Map 1. Location of project area: Chaparral and Amoyá river watershed in Tolima province

Civil works and generation equipment are located around the geographical coordinates 75º 40´W and 3º 50´N along the Amoyá River, at elevations between 1,486 and 939 meters above mean sea level, downstream from where the Davis River joints the Amoyá River.

A.3. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of Colombia (host Party)	ISAGEN S.A. E.S.P. - Private entity	No

A.4. Reference to applied methodologies and standardized baselines

The ACM0002-version 12.1.0 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" is chosen as the most relevant to the project activity. This methodology, as applied in this project activity, also refers to the latest approved version of the following Tools: (i) the tool to calculate the emission factor for an electricity system (version 02 - https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.pdf), and (ii) the tool for the demonstration and assessment of additionality (version 05.2 - https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v5.2.pdf).

A.5. Crediting period type and duration

The crediting period is a Renewable period for 7 years; from 01/07/2012 to 30/06/2019, (first and last days included).

This second monitoring period is for two operational years: from 01/06/2015 to 31/05/2017 (first and last days included)

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

The Rio Amoyá Run-of-River Hydro Project began operations at cero (0:00) hours of May 30 2013, and it was implemented according to the PDD approved by UNFCCC.

The underground powerhouse takes advantage of maximum flow 18.4 m^3/s. The powerhouse has two Pelton turbines with a capacity of 40 MW each and two generators with a rated capacity 45.7 MVA each. The net generation of the project was 851.63 GWh during the period to be verified.

The run-of-river power plant was built as stated in the PDD. It uses the water flow of the Amoyá and Davis rivers (See Figure 2).

The main components of the plant are:

1- Powerhouse: It has two generators with a capacity of 40 MW each.
2- Penstock: Access to tunnel Powerhouse.
3- Inflow: Conduction Pipeline

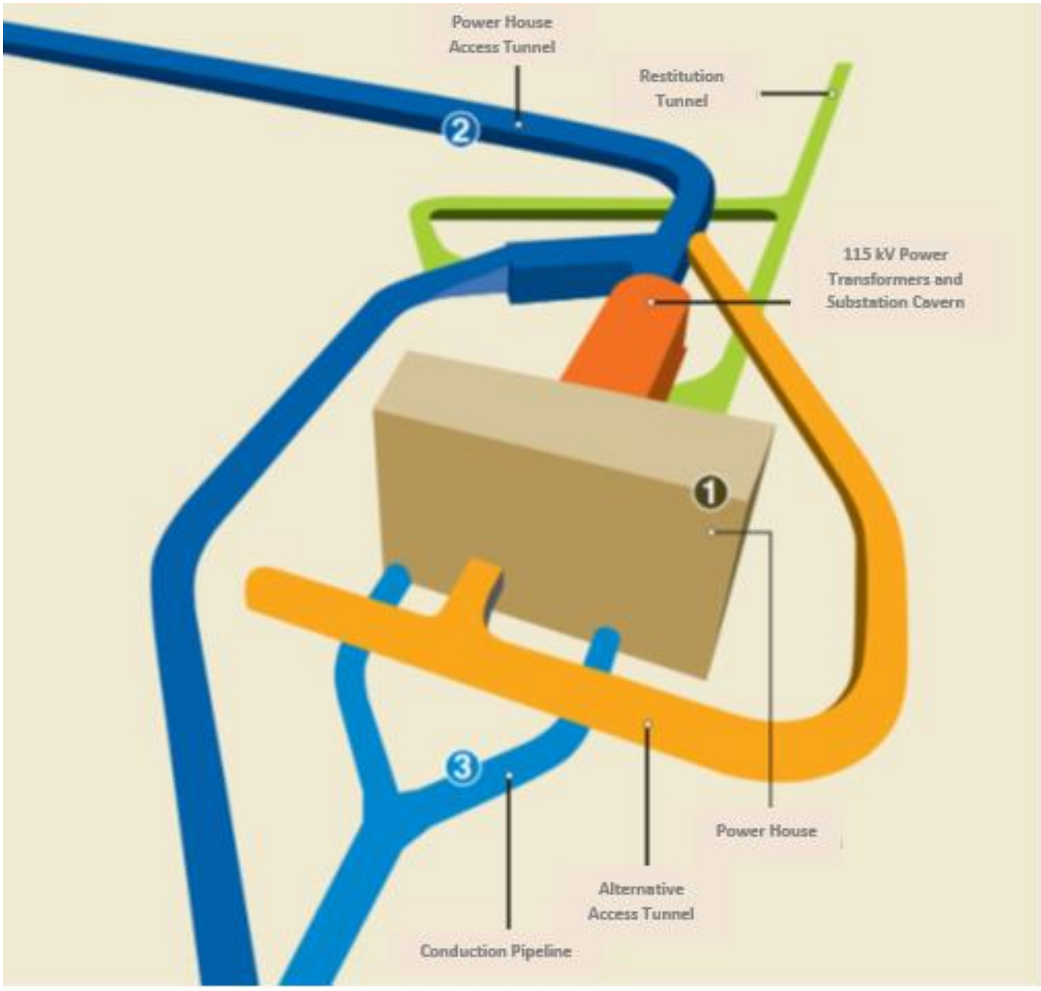


Figure 2. Amoyá hydroelectric power plant diagram

The key technical data of the hydro turbines and the generators of the project is listed in Table 1.

Table 1. Technical data of the hydro turbines, generators and energy measurement equipment

Element	Value/description	Unit	Brand/Serial
Pelton Turbines (2)			
Vertical axis (2)	40	MW	VOITH
Valves (2)	1.10 m D	Meters	
Synchronic generator (2)	45.7	M V A	VOITH / 1DH5949-3WF07-Z Built numbers: SP.08.003438.02 and SP.08.003438.01
	13.8 nominal	kV	
Load Bridge	800	kN	MOCOM/120T/16T
Transformers (2)	13.8/115	kV	SIEMENS
Sub-station GIS	115	kV	SIEMENS/ION 9610
Sub-station Tuluní	115	kV	POWER LOGIC: ION8650

The operation condition of the generating equipment during this monitoring period was normal. In addition, no events or situations, which may impact the applicability of the methodology, occurred during this monitoring period.

Overall the implementation of the project is consistent with the registered PDD. This project was implemented in just one phase.

On the other hand, the International Bank for Reconstruction and Development (IBRD), who was registered as project participant, decided to withdraw its participation. This change was notified to the UNFCCC on 29/08/2014.

B.2. Post-registration changes

B.2.1. Temporary deviations from the registered monitoring plan, applied methodologies or standardized baselines

>>N/A

B.2.2. Corrections

>>N/A

B.2.3. Changes to the start date of the crediting period

>>

B.2.4. Inclusion of monitoring plan

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B.2.5. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other applied standards or tools

On May 20 of 2014, The Gas and Energy Regulation Commission (CREG – www.creg.gov.co), issued the resolution CREG 038 of 2014, which modified the Measurement Code included on resolution CREG 025 of 1995. For that reason now days all the normativity related with the Measurement Code is included on the resolution CREG 038 of 2014 (http://apolo.creg.gov.co/Publicac.nsf/1c09d18d2d5ffb5b05256eee00709c02/0131f0642192a5a20 5257cd800728c5e/$FILE/Creg038-2014.pdf). According to the above-mentioned ISAGEN decided to update the measurement equipment installed at the commercial frontier at Tuluní Sub Station in order to standardize the measurement equipment installed in all the ISAGEN´s power plants. The new measurements equipment full fit all the technical requirements included on the Measurement Code.

B.2.6. Changes to project design

>>N/A

SECTION C. Description of monitoring system

The Monitoring Plan (MP) defines a baseline against which it is possible to measure the Rio Amoyá Run-of-River Hydro Project performance in terms of its greenhouse gas (GHG) emissions and emission reductions that can be monitored and verified in conformity with the modalities and procedures of the Clean Development Mechanism.

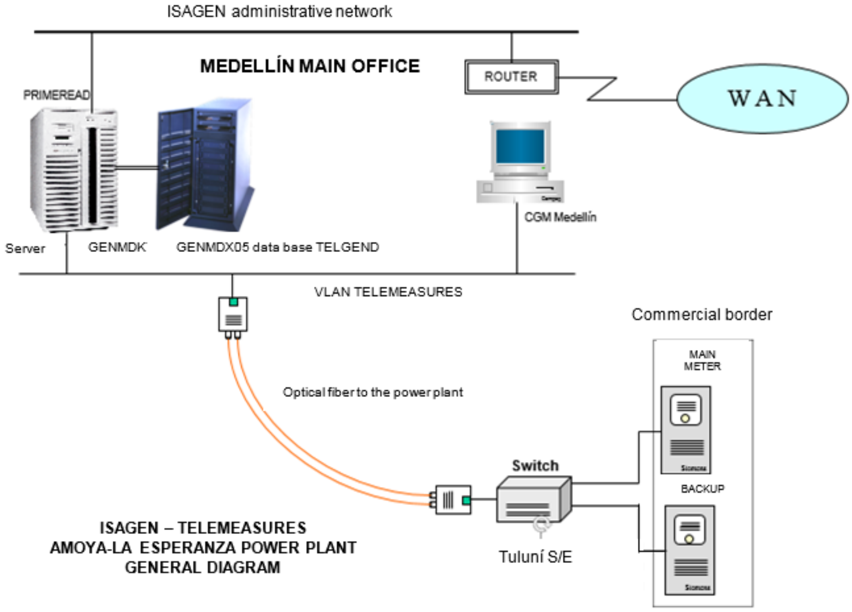

Figure 3. Operational and Management Structure

ISAGEN has incorporated explicitly into its internal procedures a detailed description of the activities regarding to the adequate management of the CDM monitoring system, including the roles and responsibilities associated with those activities (Eg. Internal procedure number 0029).

ISAGEN has formed a multidisciplinary team, coordinated by the Production Department (Gerencia de Producción) which is responsible to monitor the parameters, to record them and to analyse the data. Since the project will be using an Ex-Ante option for the grid emission factor, the only parameter to monitor for upcoming verifications is the actual electricity dispatched to the grid. This is relatively simple process, as the Colombian interconnected system relies on a highly regulated metering setup, which is required for the electricity accountability and payments.

As per the metering, the Amoyá hydroelectric power plant is equipped with multi-function electronic metering devices, which register all information that needs to be monitored, such as exported

energy, imported energy, power factor, electric tension, electric flow, etc. It is mandatory to install a backup equipment in addition to the main meter. The metering devices are located at the commercial frontier at the Tuluní substation, located 18.6 km away from the power plant. Before the starting of commercial energy exchanges in the wholesale market system, the equipment needs to be duly certified by authorized entities[2].

Information recorded by the metering equipment is sent every 24 hours to the Commercial Exchange System, operated by the National Dispatch Center (XM). All energy transactions are registered every hour. ISAGEN sends every day, before 8:00 am, the recorded values of the day before. According to that information, the National Dispatch Center (XM) processes the bills and payments for all transactions performed in the wholesale market. All this information is available to the market agents and to the system control authorities.

The Production Management Unit keeps a periodical maintenance and calibration program according to the codes approved by law, and following recommendations by the equipment providers.

ISAGEN saves the data in the internal software ZSIGEN. The data system is composed by software and hardware that allow recording the data collected at the meters automatically. Using a system called PRIMEREAD, all data for outgoing and incoming energy are measured so that net electricity records are kept in files.

For verification purposes, the data will be easily available at ISAGEN. In addition, historic records of actual energy supplied to the grid are publicly available at the XM website

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

(Copy this table for each data or parameter.)

Data/Parameter	**EF *grid,CM,y***
Unit	tCO_2/MWh
Description	Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the “Tool to calculate the emission factor for an electricity system”
Source of data	Ex-ante calculations
Value(s) applied	0.3439
Choice of data or measurement methods and procedures	As per the “Tool to calculate the emission factor for an electricity system”.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	As per the “Tool to calculate the emission factor for an electricity system”. This value is calculated ex-ante and will be used throughout the crediting period.

D.2. Data and parameters monitored

Data/Parameter	**EG *p,j,y***
Unit	MWh
Description	Network electricity displaced by the project activity during year y

[2] Following Decree 2269/93.

<table>
<tr><td>Measured/calculated/ default</td><td>Measured. Hourly values. XM monitors the value of this variable. It also keeps records for its customers.</td></tr>
<tr><td>Source of data</td><td>Data supplied by ISAGEN for ex-ante calculation, and later by XM for verification purposes. Data supplied by ISAGEN used for ex-ante calculations.</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>Net electricity</td></tr>
<tr><td>Monitoring equipment</td><td>
According to Colombian regulations, the electricity generated by each power plant connected to the grid will be monitored using metering equipment located at the commercial frontier of every plant. For Amoyá, this equipment is located at the Tuluní substation (Chaparral town) and the commercial frontier is identify with the XM code Frt19972. An 18.6 km - 115 kV transmission line connects the plant and the Tuluní substation. This substation links the plant with the regional interconnected system. In Colombia, The Measurement Code “Código de Medida” establishes mandatory high technical standards, procedures for reading, registering and recording activities of electricity transactions performed in the Colombian energy market, according to the resolution CREG 038 of 2014 (Measurement Code).
Due the measurement code was modified on May 20 2014, ISAGEN updated the measurement equipment in order to fulfil the new regulation conditions and update the measurement equipment installed to standardize them in its power plants.
On May 6 2016, ISAGEN changed the measurement equipment at Tuluní substation.
The measuring equipment located at Tuluni has the following characteristics:
Principal Measurement Equipment
<table>
<tr><td>Type/Brand</td><td>POWER LOGIC: ION8650</td></tr>
<tr><td>Accuracy class</td><td>CL active accuracy:0.2S
Cl reactive accuracy: 2</td></tr>
<tr><td>Serial number</td><td>MW-1511A832-02</td></tr>
<tr><td>Calibration frequency</td><td>2 years.</td></tr>
<tr><td>Last Calibration date</td><td>25/01/2016</td></tr>
<tr><td>Validity Period</td><td>2016-2018</td></tr>
<tr><td>Calibration Certificate</td><td>19919742-1-1</td></tr>
</table>
Backup Measurement Equipment
<table>
<tr><td>Type/Brand</td><td>POWER LOGIC: ION8650</td></tr>
<tr><td>Accuracy class</td><td>CL active accuracy:0.2S
Cl reactive accuracy: 2</td></tr>
<tr><td>Serial number</td><td>MW-1511A833-02</td></tr>
<tr><td>Calibration frequency</td><td>2 years.</td></tr>
<tr><td>Last Calibration date</td><td>25/01/2016</td></tr>
<tr><td>Validity Period</td><td>2016-2018</td></tr>
<tr><td>Calibration Certificate</td><td>19919742-2-1</td></tr>
</table>
The previous measurement equipment which also met all the technical requirements of the Measurement Code defined by CREG had the technical information which is presented on the following tables:
</td></tr>
</table>

<table>
<tr><td>Monitoring equipment</td><td>Previous Principal Measurement Equipment
<table><tr><td>Type/Brand</td><td>SIEMENS / ION 9610</td></tr><tr><td>Accuracy class</td><td>0.2s</td></tr><tr><td>Serial number</td><td>SJ-1103A546-02</td></tr><tr><td>Calibration frequency</td><td>Every 2 years</td></tr><tr><td>Last Calibration date</td><td>08/10/2014</td></tr><tr><td>Validity Period</td><td>2 years</td></tr><tr><td>Calibration Certificate</td><td>SIEMENS / ION 9610</td></tr></table>
Previous Backup Measurement Equipment
<table><tr><td>Type/Brand</td><td>SIEMENS / ION 9610</td></tr><tr><td>Accuracy class</td><td>0.2s</td></tr><tr><td>Serial number</td><td>SJ-1103A547-02</td></tr><tr><td>Calibration frequency</td><td>Every 2 years</td></tr><tr><td>Last Calibration date</td><td>08/10/2014</td></tr><tr><td>Validity Period</td><td>2 years</td></tr><tr><td>Calibration Certificate</td><td>SIEMENS / ION 9610</td></tr></table>
Additional to the Measurement Code, ISAGEN has implemented an administrative document (reference 0545) that defines the internal policy regarding to the technical characteristics, calibration conditions, maintenance of measurement equipment, etc.</td></tr>
<tr><td>Measuring/reading/recording frequency</td><td>Hourly measurement and monthly recording.</td></tr>
<tr><td>Calculation method
(if applicable)</td><td>NA</td></tr>
<tr><td>QA/QC procedures</td><td>All metering devices used to monitor and measure data follow rules that have been summarized in resolution CREG 038 of 2014. This resolution specifies the technical measurement, telecommunications and back-up equipment characteristics to meet installation, testing, certification, operation and maintenance procedures.</td></tr>
<tr><td>Purpose of data/parameter</td><td>This information is required to calculate baseline emissions</td></tr>
<tr><td>Additional comments</td><td>NA</td></tr>
</table>

D.3. Implementation of sampling plan

>>N/A

SECTION E. Calculation of emission reductions or net anthropogenic removals

E.1. Calculation of baseline emissions or baseline net removals

The Baseline emissions are calculated as follows, according to the Consolidated Baseline Methodology ACM0002 version 12.1.0:

$BE_y = EG_{p,j,y} * EF_{grid,CM,y}$

BE_y = Baseline emissions in year “y” (tCO_2e)

$EG_{p,j,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr).

$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the *“Tool to calculate the emission factor for an electricity system v.02”* (tCO_2e/MWh) in year “y”

Year	Month	Net Electricity Supply to the Grid (kWh)
2015	June	40,292,414.3
	July	48,971,702.3
	August	47,941,605.9
	September	29,269,513.2
	October	34,905,282.8
	November	39,392,372.9
	December	21,303,918.0
2016	January	13,317,727.2
	February	14,046,948.0
	March	23,560,545.1
	April	31,256,466.6
	May	44,757,691.6
	June	44,816,202.2
	July	45,494,606.1
	August	47,556,585.0
	September	44,389,479.7
	October	44,918,177.8
	November	44,791,902.9
	December	34,325,623.9
2017	January	38,829,573.0
	February	6,380,017.1
	March	28,756,354.4
	April	42,262,903.1
	May	40,092,526.4
TOTAL kW/h		**851,630,139.3**

E.2. Calculation of project emissions or actual net removals

Methodology:

Determine the net annual project electricity output for the period under verification from the XM (the official database of the National Dispatch Center), which can be accessed from the website, http://informacioninteligente10.xm.com.co. The output is available in kWh.

- Use the ex-ante combined emission factor calculated in the PDD.
- Multiply the project actual electricity supply to the Grid by the combined emission factor for the Colombian interconnected electricity grid.
- *Total CERs generated by the project for the period are calculated as:*

$$ER_y = BE_y - PE_y - L_y$$

Where:

ER_y = Emission reductions in year y (t CO_2e/yr.)

BE_y = Baseline emissions in year y (t CO_2/yr.)

PE_y = Project emissions in year y (t CO_2e/yr.)

PEy is the project emissions in year ***y*** and

Ly refers to leakage in year y as defined in the methodology ACM0002 (ver. 12.1.0 -“Consolidated baseline methodology for grid-connected electricity generation from renewable sources”).

According to the PDD, **PE*y*** = 0 and **LE*y*** = 0

E.3. Calculation of leakage emissions

According to the PDD, no leakage emissions are considered. The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, and transport). These emissions sources are neglected.

E.4. Calculation of emission reductions or net anthropogenic removals

	Baseline GHG emissions or baseline net GHG removals (t CO_2e)	Project GHG emissions or actual net GHG removals (t CO_2e)	Leakage GHG emissions (t CO_2e)	GHG emission reductions or net anthropogenic GHG removals (t CO_2e)		
				Before 01/01/2013	From 01/01/2013	Total amount
Total	353,770	292,875	0	0	272,722	565,597

E.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the registered PDD

Amount achieved during this monitoring period (t CO_2e)	Amount estimated ex ante (t CO_2e)
292,875	353,770

E.6. Remarks on increase in achieved emission reductions

The differences between the expected and the real generation are due to the following reasons:

i. The power plant is a plant run of river, for that reason all generation depends on the river flows, and not always, the river´s flows are as high as it was expected.
ii. Additionally, the quality of water on the intake is not as good as it was expected during the project development phase and this condition has caused unexpected stops on the operation and higher levels of wear on the generation equipment’s that has forced to make majors maintenance ahead of schedule.