



Monitoring report form
(Version 05.1)

Complete this form in accordance with the Attachment "Instructions for filling out the monitoring report form" at the end of this form.

MONITORING REPORT

Title of the project activity	Rio Amoyá Run-of-River Hydro Project	
UNFCCC reference number of the project activity	3461	
Version number of the monitoring report	Version 3	
Completion date of the monitoring report	22/12/2015	
Monitoring period number and duration of this monitoring period	1, Monitoring period: 01/07/2012 - 31/05/2015 (first and last days included)	
Project participant(s)	ISAGEN S.A. E.S.P.	
Host Party	Colombia	
Sectoral scope(s)	Sectoral scopes 1 : Energy industries (renewable - / nonrenewable sources)	
Selected methodology(ies)	ACM0002-version 12.1.0. Consolidated methodology for grid connected electricity generation from renewable sources	
Selected standardized baseline(s)	NA	
Estimated amount of GHG emission reductions or net GHG removals by sinks for this monitoring period in the registered PDD	515,208 tCO _{2e}	
Total amount of GHG emission reductions or net GHG removals by sinks achieved in this monitoring period	GHG emission reductions or net GHG removals by sinks reported up to 31 December 2012	GHG emission reductions or net GHG removals by sinks reported from 1 January 2013 onwards
	0 tCO _{2e}	272,277 tCO _{2e}

SECTION A. Description of project activity

A.1. Purpose and 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 plant is considered not only as a plant of electric power generation, but also as an "Environmental Services Project", since 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 started its civil works on June 16th 2008. It was expected to start operation on July 1th 2011 and was expected to result in the reduction of about 1.2 million tCO₂e by 2018. However, due to the Colombian armed conflict – which delayed the construction of the project, the plant started commercial operation on May 30th 2013. The plant started commissioning period on April 4th 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 the *Páramo* ecosystem of *Las Hermosas*.

The upper reaches of the Amoyá River basin are conformed by a *Páramo*. 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, 650 km² are under protection status in the *Páramo de las Hermosas* National Park, 27% of which are in the Amoyá river basin (See Figure 1).

Project 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''

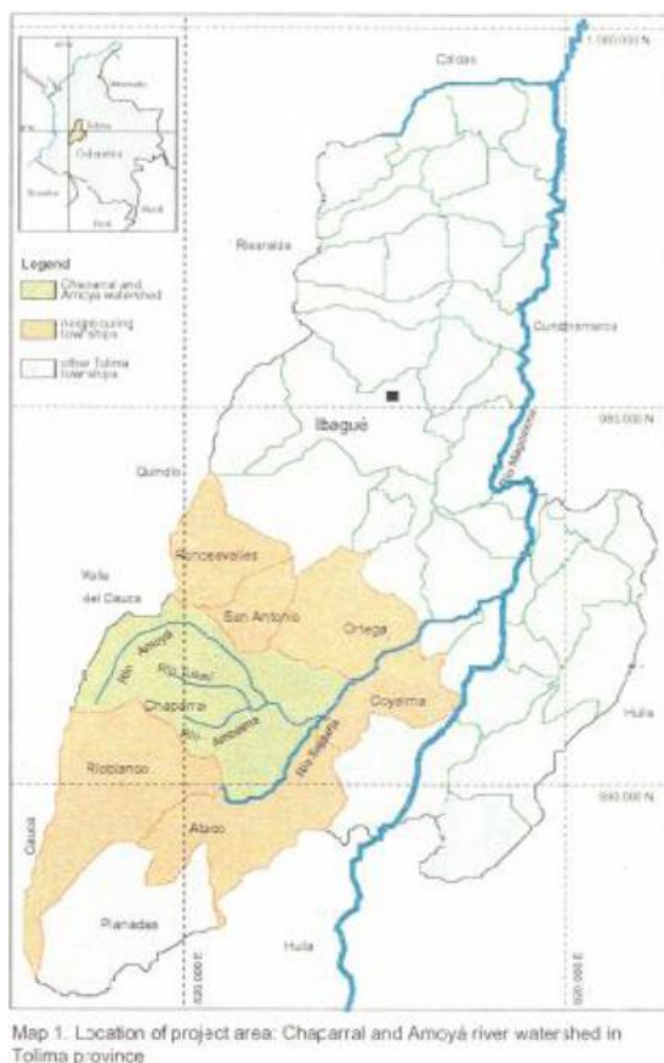


Figure 1. Location of the project

The plant is located around the geographical coordinates 75° 40'W and 3° 50'N along the Amoyá River, at elevations between 1,486 and 939 meters above mean sea level.

A.3. Parties and project participant(s)

Party involved (host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate whether the Party involved wishes to be considered as project participant (yes/no)
The Republic of Colombia (host)	ISAGEN S.A. E.S.P.	NO

A.4. Reference of applied methodology and standardized baseline

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 approved version of the following Tools: (i) the tool to calculate the emission factor for an electricity system (version 02), and (ii) the tool for the demonstration and assessment of additionality (version 05.2).

Website: <https://cdm.unfccc.int/methodologies/DB/EY2CL7RTEHRC9V6YQHLAR6MJ6VEU83>

A.5. Crediting period of project activity

The crediting period is 7 years, renewable. From 01/07/2012 to 30/06/2019 (first and last days included)

A.6. Contact information of responsible persons/entities

Last name: Salas Pajón

First name: Sergio Enrique.

Name of entity: PricewaterhouseCoopers Asesores Gerenciales Ltda - (Colombia)

Address: Carrera 7 # 156 - 80 Piso 19, Bogotá DC, Cundinamarca.

Colombia

SECTION B. Implementation of project activity**B.1. Description of implemented registered project activity**

The underground powerhouse takes advantage of maximum flow 18.4 m³/s. The powerhouse has two pelton turbine with a capacity of 40 MW each and two generator with a rated capacity 45.7 MVA each. At present based on the hydrological conditions the net generation of the project was 791.7 GWh during the period to be verified.

The run-of-river power plant was built as stated in the PDD. Basically, 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 pelton turbine with a capacity of 40 MW each and two generator with a rated capacity 45.7 MVA each.
- 2- Penstock: Access to tunnel Powerhouse.
- 3- Outflow: Downstream outlet

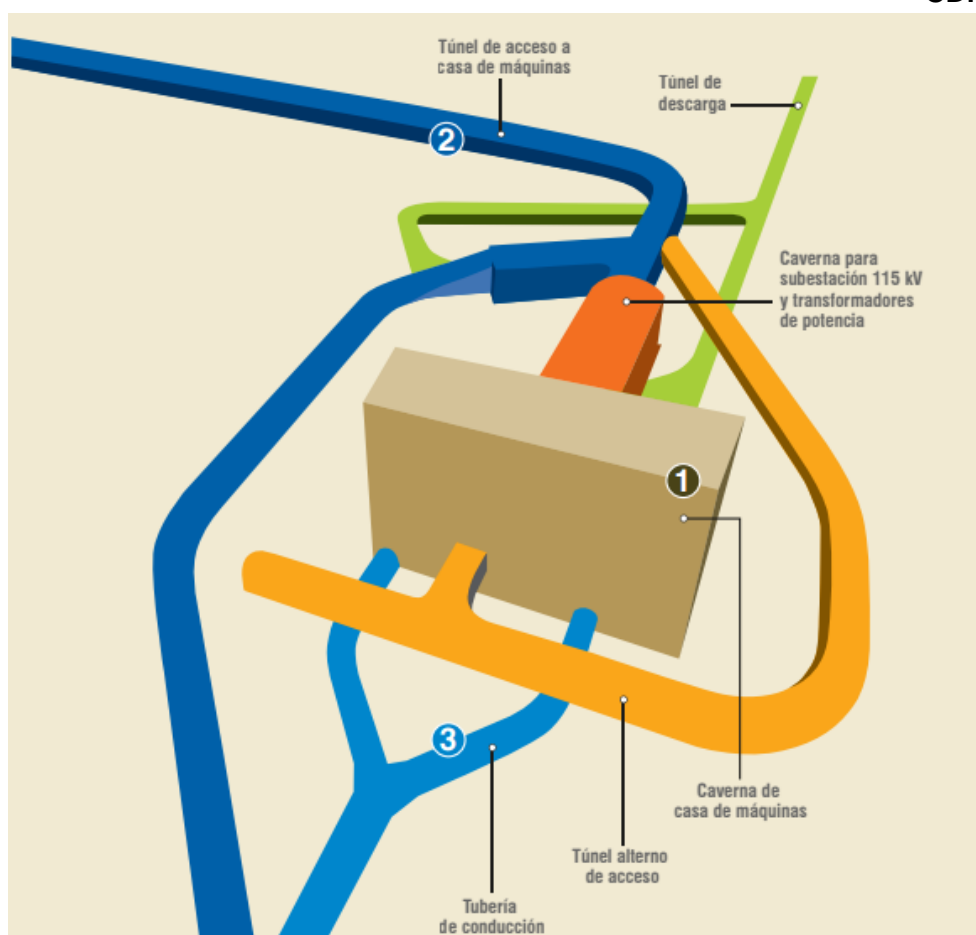


Figure 2. Amoyá hydroelectric power plant diagram.

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

Table 1. Technical data of the hydro turbines and the generators

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.08.003438A.02 and SP.08.003438A.01
	13.8 nominal	kV	
Load bridge	800	kN	IMOCOM/120T/16T
Transformers (2)	13.8/115	kV	SIEMENS/
Sub-station GIS	115	kV	SIEMENS/9610
Sub-station Tuluní	115	kV	SIEMENS/9610

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) as Trustee of the Netherlands CDM Facility (NCDMF), who was registered as project participant, decided to withdraw its participation. This change was notified to the UNFCCC on 13/08/2014.

B.2. Post-registration changes

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

NA.

B.2.2. Corrections

The Post - Registration Change procedure includes:

- Correction in the transmission line's distance of 18 km to 18.6 km.
- Correction in the number reported by the synchronous generator of 43.33 MVA to 45.7 MVA.
- Correction regarding the Project Participants: according to the withdrawal registered in the UNFCCC by the International Bank for Reconstruction and Development (IBRD) as Trustee of the Netherlands CDM Facility (NCDMF), who was registered as project participant, decided to withdraw its participation. This change was notified to the UNFCCC on 13.08.2014.
- Correction of the official web site for downloading the recorded generation data for each power plant. The official web site is www.xm.com.co
- Correction in the name National Dispatch Center (CND) by XM (Compañía de Expertos en Mercados SA ESP).
- Correction of the ex-ante emission reduction summary calculation due to the delay in the start date of the crediting period (Section B.6.4 in the revised PDD).

B.2.3. Changes to start date of crediting period

On December 18th, 2015 a change in the start date of Project Activity Rio Amoyá Run-of-River Hydro Project (number of Project Activity 3461) was requested to the UNFCCC Secretariat, according to the CDM Project Standard Document, Version 09. The start date of the project activity was postponed one (1) year. The current start date July 1, 2011 was changed for July 1, 2012 as the new start date of the project activity. It was approved by the UNFCCC and included on its website on January 18th, 2016.

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

NA.

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

A permanent change was included in Section B.7.1 where the explanation regarding the cross – check was erased in the part of any comments, Parameter: EGPJ, y (PDD updated version Page No. 23). As well in the monitoring report (updated version Page No. 41). The paragraph that was erased was:

"To cross check the metering, the electricity generated will be also measured at the plant substation at 13.8 kV, correcting the measure taking into account the transmission losses, estimated based on the technical specifications of the transmission line. The monitoring frequency and the precision of the meter located at the plant substation are the same as the ones located in Tuluní substation. Data will be archived for the crediting period plus 2 years".

Instead the following procedure applies at parameter QA/QC procedures and Monitoring Plan is:

To cross-check the electricity delivered by the Amoyá Hydroelectric Power Plant to the grid, the hourly energy measured per day in the commercial frontier in Tuluní Substation, must be compared with the last XM report published.

Despite this adjustment, the metering system in place fully complies with the CDM methodology and the Colombian regulations for electricity trading.

For the review of the minor changes please go to section B.2.2

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

NA.

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

NA.

SECTION C. Description of monitoring system

The Monitoring Plan (MP) defines a baseline against which 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.

The telemetry system of hydroelectric Amoyá is described in Figure 3.

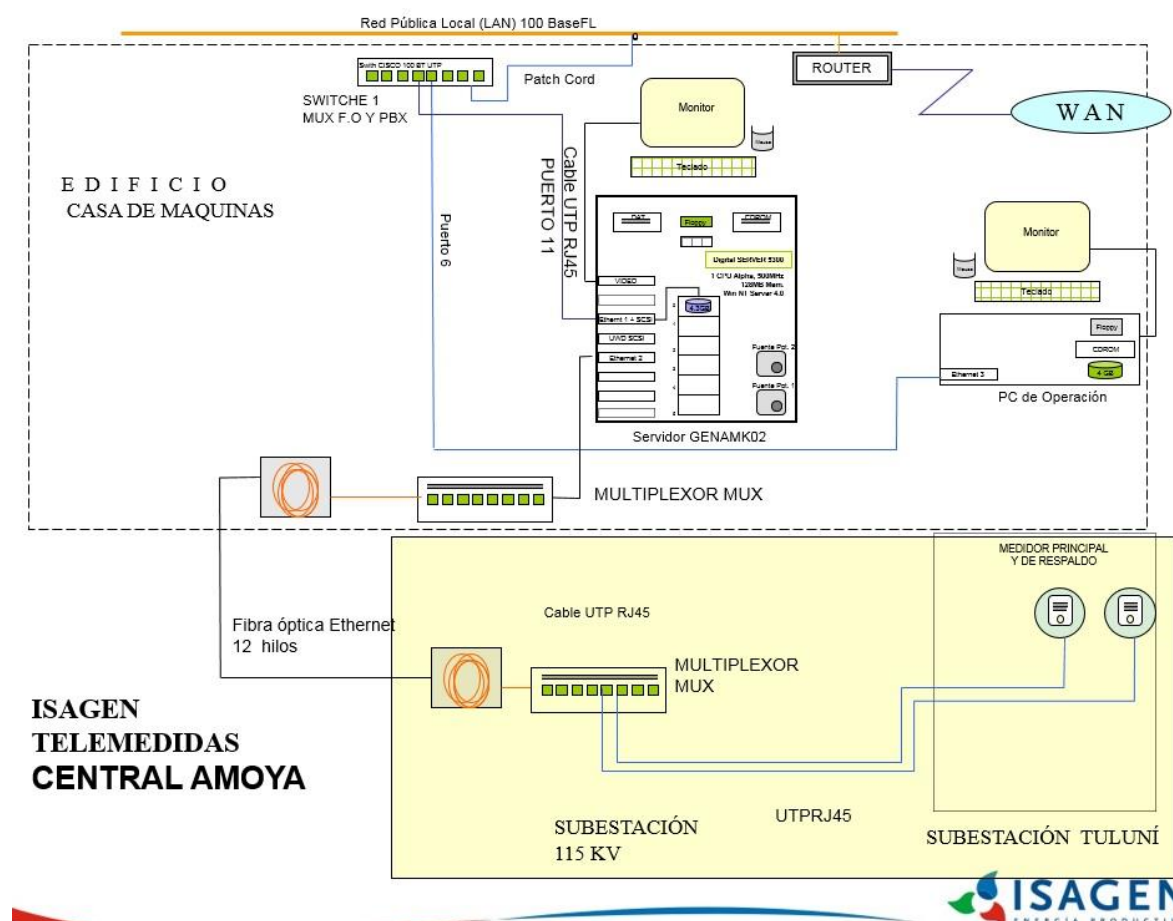


Figure 3. Telemetry system of Amoyá hydroelectric power plant

Operational and Management Structure

ISAGEN has incorporated explicitly into its internal procedures a detailed description of the activities related with 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 Manager (Gerencia de Producción) which is responsible for monitoring the parameters and is responsible for recording and analyzing 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 payments. The data is saved in the internal software (ZSIGEN).

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 km away from the plant). Before the starting of commercial energy exchanges in the wholesale market system, the equipment needs to be duly certified by authorized entities¹.

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

¹ Following Decree 2269/93.

providers. Information recorded by the metering equipment is sent every 24 hours to the Commercial Exchange System, operated by the National Dispatch Center. All energy transactions are registered every hour. ISAGEN sends every day, before 8am, the recorded values of the day before. According to that information, the National Dispatch Center 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 metering system at ISAGEN for the project is composed by software and hardware that allows for automatic recording of data collected at the meters. 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 or at renewal of crediting period

Data/parameter:	EF_{grid, CM, y}
Unit	tCO ₂ /MWh
Description	Combined margin CO ₂ emission factor for grid connected power generation in year <i>y</i> 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	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_{PJ, y}
Unit	MWh
Description	Net electricity displaced by the project activity during year <i>y</i>
Measured/calculated/default	Measured. Hourly values. XM monitors continuously the value of this variable. It also keeps records for its customers.
Source of data	Data supplied by ISAGEN for ex-post calculation, and later by the Colombian National Dispatch Center (CND) for verification purposes. Data supplied by ISAGEN used for ex-post calculations.
Value(s) of monitored parameter	Refer to the electronic spreadsheet (Document: Mitigación Emisiones hidroeléctrica amoyá.xls)

Monitoring equipment	<p>Following Colombian regulations, the electricity generation from each power plant connected to the grid will be monitored using metering equipment located at the commercial frontier of the project. For Amoya, this equipment is located at the Tuluní substation (Chaparral town). An 18.6 km - 115 kV transmission line connects the plant and the substation. This substation links the plant with the national interconnected system. In Colombia, The Measurement Code “<i>Codigo de Medida</i>” establishes mandatory high technical standards, procedures for reading, registering and recording activities of electricity transactions performed in the Colombian energy market. This code is part of the CREGs resolution 025 of 1995, which is followed for electricity output measurements.</p> <p>The measuring equipment located at Tuluní has the following characteristics:</p> <p>First calibration date</p> <table border="1"> <tr> <td>Type</td> <td>SIEMENS: ION 9610 Access Compatible</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>SJ-1103A546-02.</td> </tr> <tr> <td>Calibration frequency</td> <td>2 years.</td> </tr> <tr> <td>Calibration Date</td> <td>14/02/2013</td> </tr> <tr> <td>Validity Period</td> <td>2015</td> </tr> </table> <p>Back-up equipment:</p> <table border="1"> <tr> <td>Type</td> <td>SIEMENS: ION 9610 Access Compatible</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>SJ-1103A547-02.</td> </tr> <tr> <td>Calibration frequency</td> <td>2 years.</td> </tr> <tr> <td>Calibration Date</td> <td>14/02/2013.</td> </tr> <tr> <td>Validity Period</td> <td>2015</td> </tr> </table> <p>Last calibration date:</p> <table border="1"> <tr> <td>Type</td> <td>SIEMENS: ION 9610 Access Compatible</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>SJ-1103A546-02.</td> </tr> <tr> <td>Calibration frequency</td> <td>2 years.</td> </tr> <tr> <td>Calibration Date</td> <td>08/10/2014</td> </tr> <tr> <td>Validity Period</td> <td>2016</td> </tr> </table> <p>Back-up equipment:</p> <table border="1"> <tr> <td>Type</td> <td>SIEMENS: ION 9610 Access Compatible</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>SJ-1103A547-02.</td> </tr> <tr> <td>Calibration frequency</td> <td>2 years.</td> </tr> <tr> <td>Calibration Date</td> <td>08/10/2014.</td> </tr> <tr> <td>Validity Period</td> <td>2016</td> </tr> </table>		Type	SIEMENS: ION 9610 Access Compatible	Accuracy class	CL active accuracy: 0.2S CL reactive accuracy: 2	Serial number	SJ-1103A546-02.	Calibration frequency	2 years.	Calibration Date	14/02/2013	Validity Period	2015	Type	SIEMENS: ION 9610 Access Compatible	Accuracy class	CL active accuracy: 0.2S CL reactive accuracy: 2	Serial number	SJ-1103A547-02.	Calibration frequency	2 years.	Calibration Date	14/02/2013.	Validity Period	2015	Type	SIEMENS: ION 9610 Access Compatible	Accuracy class	CL active accuracy: 0.2S CL reactive accuracy: 2	Serial number	SJ-1103A546-02.	Calibration frequency	2 years.	Calibration Date	08/10/2014	Validity Period	2016	Type	SIEMENS: ION 9610 Access Compatible	Accuracy class	CL active accuracy: 0.2S CL reactive accuracy: 2	Serial number	SJ-1103A547-02.	Calibration frequency	2 years.	Calibration Date	08/10/2014.	Validity Period	2016
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Measuring/reading/recording frequency:	Hourly measurement and monthly recording.
Calculation method (if applicable):	NA
QA/QC procedures:	<p>All metering devices used to monitor and measure data follow rules that have been summarized in resolution number 025 of 1995, (<i>Resolución 025 de 1995</i>) from CREG. This resolution specifies the technical characteristics measurement, telecommunications and back-up equipment to meet installation, testing, certification, operation and maintenance procedures.</p> <p>To cross-check the electricity delivered by the Amoyá Hydroelectric Power Plant to the grid, the hourly energy measured per day in the commercial frontier in Tuluní Substation, must be compared with the last XM report published for the same day, during the first fifteen days of the following month.</p>
Purpose of data:	This data is needed to calculate baseline emissions
Additional comments:	NA

D.3. Implementation of sampling plan

NA

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

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

Calculation ex – ante. Description in annex 3 of the PDD.

Emission reductions in the Monitoring Plan are calculated following steps described in the ACM0002, version 12.1.0. Basically, the following formula is used,

$$ER_y = BE_y - PE_y - L_y$$

Where,

BE_y = Baseline emissions due to the displacement of electricity during the year y in tonnes of CO₂e in year “y”

PE_y = Project emissions in year “y”

L_y = Leakage in year “y”

The Baseline emissions are calculated as follows:

$$BE_y = EG_{PJ,Y} * EF_{grid,CM,y}$$

EG_{PJ,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 CO₂ 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*” (tCO₂e/MWh) in year “y”

Table 2. Net Electricity Generation.

	Year	Month	Ex - ante Net Electricity Generation (kWh)	TOTAL ANNUAL (kWh-year)
7	2012	July	0	0
8		August	0	
9		September	0	
10		October	0	
11		November	0	
12		December	0	
1	2013	January	0	242,699,179
2		February	0	
3		March	0	
4		April	0	
5		May	1,428,736	
6		June	26,175,360	
7		July	34,016,817	
8		August	44,883,275	
9		September	39,622,841	
10		October	33,209,298	
11		November	28,690,039	
12		December	34,672,813	
1	2014	January	21,479,425	402,073,677
2		February	13,145,853	
3		March	31,362,022	
4		April	33,893,596	
5		May	40,346,144	
6		June	47,972,236	
7		July	43,267,483	
8		August	46,082,429	
9		September	33,071,746	
10		October	32,116,189	
11		November	30,237,676	
12		December	29,098,878	
1	2015	January	24,265,845	146,962,509
2		February	31,744,447	
3		March	19,295,721	
4		April	37,156,271	
5		May	34,500,225	

TOTAL AÑO	Period	Total period (kWh)	Ex-ante E.F. (tCO2/MWh)	Total Baseline emissions period (tCO2)
TOTAL 2012	July 1 - December 31	0	0.3439	0
TOTAL 2013	January 1 - December 31	242,699,179	0.3439	83,464
TOTAL 2014	January 1 - December 31	402,073,677	0.3439	138,273
TOTAL 2015	January 1 - May 31	146,962,509	0.3439	50,540
Total emission reductions (tCO2) =				272,277

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

- Determine the net yearly 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 actual electricity output produced by the project 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 **PE_y** is the project emissions in year **y** and **L_y** 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”), both are equal to zero (0).

E.3. Calculation of leakage

Zero (0): ACM0002 (ver. 12.1.0 -“Consolidated baseline methodology for grid-connected electricity generation from renewable sources”).

E.4. Summary of calculation of emission reductions or net GHG removals by sinks

Item	Baseline emissions or baseline net GHG removals by sinks (t CO ₂ e)	Project emissions or actual net GHG removals by sinks (t CO ₂ e)	Leakage (t CO ₂ e)	GHG emission reductions or net GHG removals by sinks (t CO ₂ e) achieved in the monitoring period		
				Up to 31/12/2012	From 01/01/2013	Total amount
Total	272,277	0	0	0	272,277	272,277

E.5. Comparison of actual emission reductions or net GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO ₂ e)	515,208	272,277

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

- The operation of the plant started two years later than planned, due to the number of delays beyond ISAGEN control presented during the Project construction, which didn't allowed the entry into commercial operation at the time estimated. These delays were mainly due to the complex situation of public order in the site of works, which resulted in difficulties for the contractor to comply with work expected yields and consequently with the schedules contractually agreed.

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

Project participant and/or responsible person/ entity	<input checked="" type="checkbox"/> Project participant <input type="checkbox"/> Person/entity responsible for completing the CDM-MR-FORM
Organization name	ISAGEN S.A. E.S.P.
Street/P.O. Box	
Building	ISAGEN
City	Medellín
State/region	Antioquia
Postcode	
Country	Colombia
Telephone	
Fax	
E-mail	
Website	www.isagen.com.co
Contact person	
Title	
Salutation	Mr.
Last name	Fehrmann Espinosa
Middle name	
First name	Adolfo
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

Project participant and/or responsible person/ entity	<input type="checkbox"/> Project participant <input checked="" type="checkbox"/> Person/entity responsible for completing the CDM-MR-FORM
Organization name	PricewaterhouseCoopers Asesores Gerenciales Ltda.
Street/P.O. Box	
Building	
City	Bogota DC
State/region	Cundinamarca
Postcode	
Country	Colombia
Telephone	(+57-1) 668-4999 Ext 139
Fax	(+57-1) 673 8575
E-mail	sergio.salas@co.pwc.com
Website	www.pwc.com/co/es/
Contact person	
Title	Climate Change Senior Manager
Salutation	Mr.
Last name	Salas Pajón
Middle name	
First name	Sergio Enrique
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	