



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	Candelaria Hydroelectric Project	
UNFCCC reference number of the project activity	0604	
Version number of the monitoring report	1	
Completion date of the monitoring report	31/03/2016	
Monitoring period number and duration of this monitoring period	1 st monitoring period of the 2 nd Crediting Period 01/01/2014 to 31/12/2015 (24 months)	
Project participant(s)	Hidroeléctrica Candelaria, S.A.(Host)	
Host Party	Guatemala	
Sectoral scope(s)	Scope 1: Energy industries (renewable-/non-renewable sources)	
Selected methodology(ies)	AMS-I.D. Grid Connected renewable electricity generation (version 17)	
Selected standardized baseline(s)	N/A	
Estimated amount of GHG emission reductions or net GHG removals by sinks for this monitoring period in the registered PDD	23,600 tCO ₂ e	
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	27,331tCO ₂ e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

(a) Purpose of the project activity and the measures taken for GHG emission reductions

The objective of the project activity is to generate renewable electricity using hydroelectric resources and to sell the generated output to the national grid. The project has the capacity to reduce CO₂ emissions by avoiding electricity generation by the fossil fuel-fired power plants connected to the grid.

(b) Brief description of the installed technology and equipment

The project has an installed capacity of 4.3 MW¹ and utilizes water from the Trece Aguas River. Currently, this watercourse is also utilized for electricity generation in an existing 16 MW hydropower plant (Secacao) located upstream of Candelaria plant. Secacao plant was developed in 1998 and is owned and operated by Candelaria's sponsors.

Total differential altitude (head) between the head pond and the turbine/generator of Candelaria is approximately 130 meters. The project consists of a 4.456 MW Francis type turbine, a 430 meter long tunnel, a 770 meter long penstock. The water used, once having gone through both plants, is returned to the original river basin downstream.

The plant delivers electricity to the Guatemalan National Electric Grid and is connected to it through a 69 kilovolt transmission line. The plant has the capacity to deliver part of its output locally, when required, through an existing 13.8 kilovolt distribution line owned by a Utility serving this rural area, thus giving access to electricity to several local communities.

(c) Relevant dates for the project activity (e.g. construction, commissioning, continued operation periods, etc.)

The construction of Candelaria Hydroelectric Project began in January 2005 and the commissioning took place from 12/06/2006 to 30/06/2006, to successfully start power generation on 01/07/2006. Since 2006, Candelaria Hydroelectric plant has been continuously operating and delivering energy to the National Grid.

The Project was registered under the Clean Development Mechanism on 09/11/2006, starting its first crediting period on 01/01/2007. The second crediting period started on 01/01/2014, with the renewable date on 12/04/2014.

(d) Total GHG emission reductions achieved in this monitoring period

The calculation of the emissions reductions are based on validated and registered parameters in the PDD and justified during the validation. The baseline combined margin emission factor for Candelaria Hydroelectric plant is 0.4833 tCO₂/MWh.

The total emission reductions achieved in the first monitoring period of the second crediting period from 01/01/2014 to 31/12/2015 is 27,331 tCO₂e.

¹ The installed capacity of the hydroelectric plant is determined and delimited by the capacity of the generator. As indicated by the manufacturer of the generator of Candelaria, the generator has an apparent power of 5,397 kVA and a power factor of 0.8. The maximum output capacity of the generator is the real power (in kW) and results from multiplying the apparent power (in kVA) by the power factor, as follows: 5,397 kVA × 0.8 = 4,318 kW = 4.3 MW.

A.2. Location of project activity

The Candelaria Hydroelectric plant is located in the north-central area of Guatemala, Senahú, Alta Verapaz Guatemala, on the mountain range called “Sierra de Santa Cruz,” on the northern side of the Polochic River Valley. The exact geographical coordinates of the power house are: 15.38695 N and -89.75510 W.

Figure 1 shows a map identifying the general location of the project:



Figure 1 Alta Verapaz Department, Guatemala

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)
Guatemala (host)	Hidroeléctrica Candelaria, S.A. (private)	No

A.4. Reference of applied methodology and standardized baseline

“AMS-I.D. Grid connected renewable electricity generation” (version 17).

For more information regarding the methodology, please refer to the following link:

<http://cdm.unfccc.int/methodologies/DB/RSCTZ8SKT4F7N1CFDXCSA7BDQ7FU1X>

A.5. Crediting period of project activity

Type: Renewable crediting period (7 years x 3)

Starting date: 01/01/2014

Length: 7 years

Crediting period: 01/01/2014 to 31/12/2020

A.6. Contact information of responsible persons/entities

Hidroeléctrica Candelaria, S.A. (project participant)

info@gruposecacao.com

16 Calle 0-26, Zona 14, Ciudad de Guatemala, Guatemala

+502 2313 8383

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

The Candelaria Hydroelectric Project has an installed capacity of 4.3 MW and 130 meters of net head utilizing water from the Trece Aguas River. The water flows through a tailrace channel from where it enters into a 430 meter long tunnel. The water then runs through a head pond and into a 770 meters long penstock, and finally propels in a 4.456 MW Francis type turbine located at Candelaria's power house. The water used is returned to the original river basin downstream.

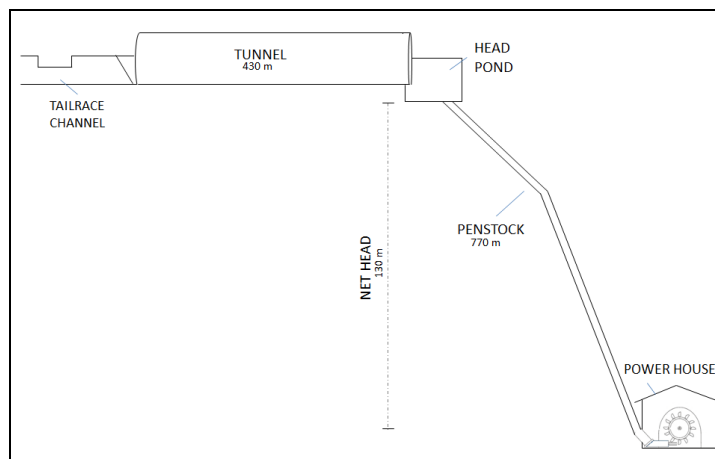


Figure 2 Candelaria's outline

The plant delivers electricity to the Guatemalan National Electric Grid and it is connected to a 69 kilovolt transmission line. The plant has also the capacity to deliver, when required, part of its output locally through an existing 13.8 kilovolt distribution line, giving access to electricity to several local communities.

Every year, the operations management executes the annual programmed maintenance between April and May. On 2014, the annual programmed maintenance started on April 28 and finished on May 12. On 2015, the annual programmed maintenance started on April 14 and finished on April 29. No exchange of equipment was made on this maintenance nor during this monitoring report period.

No equipment has changed since Candelaria Hydroelectric Project began operations on 2006 and the plant continues operating with the same equipment since its beginning.

B.2. Post-registration changes

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

Not applicable.

B.2.2. Corrections

Not applicable.

B.2.3. Changes to start date of crediting period

Not applicable.

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

Not applicable.

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

Not applicable.

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

Not applicable.

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

Not applicable.

SECTION C. Description of monitoring system

The equipment used to measure the energy produced by the Candelaria Hydroelectric Plant consists in a main and a backup meter (electronic General Electric meters). This is in line with the stipulations described in the Commercial Coordination Norm, No. 14, (NCC-14) issued by the Wholesale Market Administrator (Administrador del Mercado Mayorista - AMM)², clauses 14.6.1, 14.10 bis and 14.10 tris.

Candelaria's Main Meter Features	Candelaria's Support Meter Features
<ul style="list-style-type: none"> • Model: KV2c • Brand: General Electric • Serial number: 28 620 847 	<ul style="list-style-type: none"> • Model: KV2c • Brand: General Electric • Serial number: 28 620 848

The metering units are shown in the following diagram:

² The Wholesale Market Administrator (Administrador del Mercado Mayorista) is the entity in charge of dispatching and programming the operation and coordination of the National Power Grid.

- **Data quality obtained from the energy meters**

Additionally, as an internal quality control procedure, in order to guarantee the precision and quality required, a verification of the calibration of both commercial meters used in Candelaria Hydroelectric Project is executed annually, by the company AMELEC.

The energy data of the Candelaria Hydroelectric Project are monitored, captured and recorded by three different procedures. Each procedure and the data collected are also verified by different persons to ensure the accuracy of the measured data. The procedures used to collect, monitor and register the data of the produced energy are described below:

1. Hourly and Daily Readings Procedure

Source of data: SCADA system / Main and Support commercial meters
 Responsible to collect data: Operator
 Responsible of quality data: Operations Supervisor

Procedure:

The SCADA system reports hourly the instantaneous power and other generation conditions. This system works using a computer with SCADA (Supervisory Control and Data Acquisition) software, connected to a PLC (Programmable Logic Controller) device that automatically captures the information and converts it to data. This hourly generation data is available to the operator continuously 24 hours a day on the computer screen. The Operator is responsible for transcribing the hourly data to the "Operation Control Sheets", which are kept in the Control Room of the plant.

Besides this, at 00:00hrs, the Operator directly takes visual meter readings (from the main commercial meter). The difference from the previous day's reading and the current reading corresponds to the energy produced over that day (data read in kilowatts).

In addition, an internal daily report is made by an automatic Data Monitoring System (Sistema de Monitoreo de Información –SIMON-), which is fed by the Operator with the SCADA and the commercial meter data. This program allows the access to updated data and graphics of the daily, weekly, monthly and yearly power and energy produced by Candelaria Hydroelectric Plant.

These procedures are performed for monitoring purposes.

2. Monthly Readings Procedure

Source of data: Main and Support commercial meters
 Responsible to collect data: Operations Supervisor
 Responsible of quality data: Operations Manager

Procedure:

Once a month, the Operations Supervisor uses the automated reading system to summarize, for billing purposes, the total energy produced by Candelaria Hydroelectric Plant.

On the first day of the month, the Operations Supervisor uses an optical reader connected to a portable computer in which the Meter Mate Software (meter-reading software provided by General Electric) has been installed. This software allows for hourly automatic reading: the optical reader is positioned on the meter control panel lens and an hhf format file with all the updated hourly energy production reading is automatically created. Both hhf format files are sent by email to the Operations Manager, who exports it to an Excel file, reviews it and generates a monthly report, allowing the total calculation of generated energy. Both reports are sent to the Financial Manager, General Manager Assistant, Comercializadora *Electronova's* Market Manager and to the *AMM's* Measuring Coordinator, for their revision or reference.

Both entities (*AMM* and *Electronova*) compare the measurements taken by Candelaria Hydroelectric plant with those taken through the external meters owned by the Wholesale Market Administrator. Once *AMM* and *Comercializadora Electronova* confirm their approval of the report, commercial invoice is issued by Candelaria Hydroelectric plant for the energy provided to the national grid.

3. Yearly Data Collection Procedure

Source of data: Monthly commercial invoice reports
 Responsible to collect data: CDM Coordinator
 Responsible of quality data: General Manager

In order to prepare the monitoring report to calculate the total energy produced by the Candelaria Hydroelectric Plant and estimate the certified reduced emissions, the General Management and Financial Division collect in a single report all the monthly reports used for billing purposes in an Excel spreadsheet, calculating the annual emission reductions. This report is reviewed and approved by the General Manager

SECTION D. Data and parameters

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

(Copy this table for each piece of data and parameter)

Data/parameter:	$EF_{CO_2,grid,y} / E_{grid,CM,y}$
Unit	tCO ₂ /MWh
Description	CO ₂ emission factor of the grid electricity in year y / Combined Margin CO ₂ emission factor of the grid electricity in year y
Source of data	Data provided by the Wholesale Market Administrator (official source).
Value(s) applied)	0.4833
Choice of data or measurement methods and procedures	In accordance with paragraph 12 of the methodology, Option (a) was selected: a combined margin, consisting of the combination of operating margin and build margin is calculated based on the procedures prescribed in version 04.0 of the "Tool to calculate the emission factor for an electricity system".
Purpose of data	Data used to calculate baseline emissions.
Additional comments	Data updated at the time of submission of the request for renewal of the crediting period to the DOE. No monitoring and recalculation of the emission factor during the second crediting period is required.

Data/parameter:	$EF_{CO_2,m/k,i,y} / EF_{CO_2,m,i,y}$
Unit	tCO ₂ /GJ
Description	Average CO ₂ emission factor of fuel type i used in power unit m or k in year y
Source of data	Data from the 2006 IPCC Guidelines on National GHG Inventories, Table 1.4, Chapter 1, Vol. 2 (Energy).
Value(s) applied)	See Appendix 4 of the PDD.
Choice of data or measurement methods and procedures	According to version 04.0 of the "Tool to calculate the emission factor for an electricity system", if there is no data from fuel supplier of the power plants in invoices or local average default values, IPCC default values at the lower limit of the uncertainty at a 95 per cent confidence interval should be used. In accordance with the Tool, where several fuel types are used in the power unit, the fuel type with the lowest CO ₂ emission factor is used.
Purpose of data	Data used to calculate baseline emissions.
Additional comments	For the simple adjusted OM emission factor calculation: data updated once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation or request for renewal of the crediting period (ex-ante option). For the BM emission factor calculation: for the first crediting period, data determined once 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 and third crediting period, data updated only once ex ante at the start of the second crediting period, 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.

Data/parameter:	$EG_{m,y} / EG_{k,y}$
Unit	MWh

Description	Net quantity of electricity generated and delivered to the grid by power unit m or k in year y
Source of data	Data provided by the Wholesale Market Administrator (official source).
Value(s) applied)	See Appendix 4 of the PDD.
Choice of data or measurement methods and procedures	According to version 04.0 of the "Tool to calculate the emission factor for an electricity system", data from utility or government records or official publications should be used.
Purpose of data	Data used to calculate baseline emissions.
Additional comments	For the simple adjusted OM emission factor calculation: data updated once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation or request for renewal of the crediting period (ex ante option). For the BM emission factor calculation: for the first crediting period, data determined once 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 and third crediting period, data updated only once ex ante at the start of the second crediting period, 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.

Data/parameter:	$\eta_{m/k,y} / \eta_{m,y}$
Unit	-
Description	Average net energy conversion efficiency of power unit m or k in year y
Source of data	Data from the Appendix 1 of the "Tool to calculate the emission factor for an electricity system" (version 04.0).
Value(s) applied)	See Appendix 4 of this PDD and the attached spreadsheet named "Grid EF and ER_Candelaria_Simple Adjusted OM_27Dec13".
Choice of data or measurement methods and procedures	According to version 04.0 of the "Tool to calculate the emission factor for an electricity system", if the efficiencies are not directly available for the power plants, default values from the Appendix 1 of the Tool should be used.
Purpose of data	Data used to calculate baseline emissions.
Additional comments	Data determined once for the crediting period.

D.2. Data and parameters monitored

(Copy this table for each piece of data and parameter)

Data/parameter:	$EG_{BL,y}$
Unit	MWh
Description	Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y
Measured/calculated/default	Measured
Source of data	Electricity meters onsite
Value(s) of monitored parameter	Hourly readings from 01/01/2014 to 31/12/2015. Details are shown in Excel spreadsheet titled "Energy data and CERs calculations – 1 st Monitoring Period – 2 nd CP"

Monitoring equipment	Data measured using the following commercial electricity meters: Main electricity meter Model: KV2c Brand: General Electric Serial number: 28 620 847 Accuracy: 0.2% (according to regulation) Support electricity meter Model: KV2c Brand: General Electric Serial number: 28 620 848 Accuracy: 0.2% (according to regulation)
Measuring/reading/recording frequency:	Data monitored continuously, measured hourly and daily, and recorded hourly, daily, monthly and yearly.
Calculation method (if applicable):	-
QA/QC procedures:	According to the Commercial Coordination Norm number 14 (NCC-14), clause 14.12, "Periodic Verifications", issued by the Wholesale Market Administrator (<i>Administrador del Mercado Mayorista</i> , AMM), meters and related equipment verifications/audits are carried out annually at the expense of the AMM, to verify the equipment accuracy. In parallel, in order to satisfy the conditions set forth in the aforementioned norm and to guarantee the precision and quality required, both commercial meters are verified and calibrated once a year (regularly during the annual programmed maintenance) by a recognized calibration company at the expense of Candelaria Hydroelectric Project. Data measured by the meters is cross checked with the buyer's electricity reports, monthly invoices or through the records saved in the SCADA system, software utilized to control and monitor all the electricity delivered to the national grid.
Purpose of data:	Data used to calculate baseline emissions.
Additional comments:	All the data monitored will be archived for two years after the end of the crediting period or the last CERs issuance, whichever occurs later.

D.3. Implementation of sampling plan

Not applicable.

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

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

Emission reductions are calculated as follows:

$$ER_y = EG_{BL,y} \times EF_{grid,CM,y} \quad (1)$$

Where:

- ER_y = Emission reductions in year y (tCO₂)
- $EG_{BL,y}$ = Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y (MWh)
- $EF_{grid,CM,y}$ = CM CO₂ emission factor in year y (tCO₂/MWh)

As per the registered PDD, the ex-ante calculation of the combined emission factor is **0.4833 tCO₂/MWh**. This value is considered fixed throughout the first crediting period.

The net electricity delivered to the grid, generated by Candelaria during the 1st Monitoring Period of the 2nd Commitment Period is summarized in the next table. A complete report of the delivered electricity is shown in the attached “*Energy data and CERs calculations – 1st Monitoring Period – 2nd CP*” spreadsheet.

Candelaria Hydroelectric Plant
Monthly Net Electricity Delivered to the Grid

Period: January 2014 to December 2015, 1st Monitoring Period 2nd CP

Year	Month	MWhour
2014	January	1,995
	February	1,595
	March	1,720
	April	1,214
	May	1,716
	Jun	3,066
	Jul	3,174
	Ago	3,199
	Sep	3,117
	Oct	3,145
	Nov	3,042
	Dic	2,582
2015	January	2,065
	February	1,667
	March	1,684
	April	830
	May	1,974
	Jun	2,700
	Jul	2,939
	Ago	2,740
	Sep	2,774
	Oct	2,492
	Nov	2,644
	Dic	2,476
TOTAL		56,552

Table 1: Candelaria’s Monthly Generation

The emission reductions calculated for the 6th Monitoring Period are as follows:

Parameter	$\langle E \rangle_{baseline}$ (t CO ₂ /MWh)	CG (MWh/year)	$E_{baseline}$ (t CO ₂ /year)
Data	0.4833	56,552	27,331

Table 2: Baseline emission reductions of the project activity

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

As per the methodology, project emissions in year y (PE_y) for hydroelectric power projects without reservoir are null. Thus, $PE_y = 0$.

E.3. Calculation of leakage

As per the methodology, as energy generating equipment was not transferred from another activity, the leakage emissions are null. Thus, $LE_y = 0$.

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	27,331	0	0	0	27,331	27,331

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)	23,600 tCO ₂ e	27,331 tCO ₂ e

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

Increase in water availability. The significant increase in rainfall during 2014 caused a flow growth of many rivers of the region, including the Trece Aguas River. This, automatically results in the significant increase of emission reductions generated during this monitoring period.

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 checked="" type="checkbox"/> Person/entity responsible for completing the CDM-MR-FORM
Organization name	Hidroeléctrica Candelaria, S.A.
Street/P.O. Box	16 Calle
Building	0-26
City	Zona 14, Guatemala
State/region	Guatemala
Postcode	01014
Country	Guatemala
Telephone	+502 2313 8383
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E-mail	rtormo@grupossecacao.com
Website	www.grupossecacao.com
Contact person	Rodrigo Tormo
Title	
Salutation	
Last name	Tormo
Middle name	
First name	Rodrigo
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

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Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: <ul style="list-style-type: none"> • Include provisions related to delayed submission of a monitoring plan; • Provisions related to the Host Party; • Remove reference to programme of activities; • Overall editorial improvement.
04.0	25 June 2014	Revisions to: <ul style="list-style-type: none"> • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from <i>F-CDM-MR</i> to <i>CDM-MR-FORM</i>; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.
Decision Class: Regulatory Document Type: Form Business Function: Issuance Keywords: monitoring report		