

MONITORING REPORT FORM (CDM-MR) *
Version 01 - in effect as of: 28/09/2010

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* as contained within the document entitled "Guidelines for completing the monitoring report form (CDM-MR)" (EB 54 meeting report, annex 34).

MONITORING REPORT
Version number 1 – 25/04/2012

CANDELARIA HYDROELECTRIC PROJECT
Reference Number 0604
4th Monitoring Period - 01/06/2010 to 31/05/2011

SECTION A. General description of the project activity

A.1. Brief description of the project activity: >>

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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.

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 has an installed capacity of 4.3 MW 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 4.3 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 also delivers part of its output locally 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.

The GHG emissions reductions and the monitoring report is based on the electricity delivered by Candelaria Hydroelectric Project to the Guatemalan National Interconnected Electricity Grid during the period from 01/06/2010 to 31/05/2011. The amount of energy delivered is monitored by the energy producer, through its PLC program and the energy meters installed at the substation, as well as by AMM –Administrador del Mercado Mayorista- (Wholesale Market Administrator) through the SCADA system, which controls and measures all electricity delivered to the grid and assures, for the producer, buyer and the marketer, that the generated electricity has been delivered properly to the grid.

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 0.824 tCO₂/MWh.

The total of emission reductions achieved in this monitoring period from 01/06/2010 to 31/05/2011 is: **19,273 (tonCO₂).**

A.2. Project Participants

The name of the project participants are:

- Hidroelectrica Candelaria S. A. (Host – Guatemala)
- Ecoinvest Carbon S. A. (Other – Switzerland)

A.3. Location of the project activity:

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: Guatemala, Alta Verapaz Department



A.4. Technical description of the project

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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 trailrased channel from where it enters 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 Francis type turbine located at Candelaria power house. The water used is returned to the original river basin downstream.

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

Candelaria Hydroelectric Project delivers an average of 23 GWh of energy per year.

A.5. Title, reference and version of the baseline and monitoring methodology applied to the project activity:

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Project Title:	Candelaria Hydroelectric Project
Reference Number:	0604
Version of the baseline:	PDD Version Number 07, Section D from 07/09/2006
Monitoring methodology applied:	AMS-I.D. Grid Connected renewable electricity generation (version 8).

A.6. Registration date of the project activity:

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Candelaria Hydroelectric Project was registered on 09/11/2006.

A.7. Crediting period of the project activity and related information (start date and choice of crediting period):

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Candelaria Hydroelectric Project total crediting period is 21 years (renewable 3 crediting period of 7 years) starting on 01/01/2007.

A.8. Name of responsible person(s)/entity(ies):

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Following the persons involved in completing the monitoring report:

General Manager:	Rodrigo J. Tormo / Hidroelectrica Candelaria S. A.
Operations Manager:	Mario Gutiérrez / Hidroelectrica Candelaria S. A.
General Manager Assistant:	Karina Gamboa / Hidroelectrica Candelaria S. A.

SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

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1. Candelaria Hydroelectric Project commissioning date took place from 16/06/2006 to 30/06/2006, and successfully started operations on 01/07/2006.
2. Yearly the operations management executes the annual programmed maintenance between April or May of each year. On 2011, the programmed maintenance started on April 29 at 9:00 and finished on May 6 at 9:00. No overhaul, down of equipment or exchange of equipment was made on this maintenance nor during this monitoring report period.
3. 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. Revision of the monitoring plan

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No revisions to the monitoring plan had been done on this monitoring period.

B.3. Request for deviation applied to this monitoring period

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No deviation occurred on this monitoring period.

B.4. Notification or request of approval of changes

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No applicable.

SECTION C. Description of the monitoring system

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Equipment used for the commercial measuring

The equipment used for measuring the energy produced by the Candelaria Hydroelectric Plant consists at two electronic General Electric meters, one is used as a Main Meter which obtains all the readings of the generated energy; the second one is used as a support/back-up meter which also obtains the same readings to be used in case the main meter should suffer any damage, this accordingly to the stipulations described in the Commercial Coordination Norm, number 14, (NCC-14) issued by the Administrador del Mercado Mayorista (Wholesale Market Administrator)¹, clauses 14.6.1, 14.10 bis and 14.10 tris.

Candelaria's Main Meter Features

- Model: KV2c
- Brand: General Electric
- Serial number: 28 620 847

¹ The Wholesale Market Administrator (Administrador del Mercado Mayorista) is the national entity in charge of regulate the commercialization energy in the national grid.

Candelaria's Support Meter Features

- Model: KV2c
- Brand: General Electric
- Serial number: 28 620 848

Data quality obtained from the energy meters

Candelaria Hydroelectric Project fulfills the commitment regulated by law of the Commercial Coordination Norm number 14 (NCC-14), clause 14.12 which refers to "Periodic Verifications", about the obligation from the producer agent to verify and calibrate its commercial meters at least once a year, to satisfy the quality requirements from the Wholesale Market Administrator (Administrador del Mercado Mayorista, AMM).

In compliance with the referred norm, Candelaria Hydroelectric Plant annually calibrates both of its commercial meters. The company authorized and certified by Wholesale Market Administrator (Administrador del Mercado Mayorista) to calibrate commercial meters in Guatemala is AMELEC. This entity annually performs the verifications and calibration to both meters of Candelaria Hydroelectric Project.

The calibration certificates made by AMELEC in 2010 and 2011 to the Candelaria energy meters are enclosed to this monitoring report. These certificates confirm that the main and the support meters fulfilled the quality requirements of the ANSI C12.20 measuring energy regulation.

Data collection procedures

The data utilized to quantify the energy produced by Candelaria Hydroelectric Project is captured and recorded by three different procedures and using different data sources. Each procedure and the data collected are also verified by different persons to assure the accuracy of the measured data. Following are described the procedures used to collect, monitor and register the data of the produced energy by Candelaria Hydroelectric Project:

1. Hourly 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 the energy produced hourly. This system works using a computer with an installed SCADA software (Supervisory Control and Data Acquisition) connected to a PLC device (Programmable Logic Controller) which automatically captures the physical information and converts it to data which is displayed in the screen provided to use this program. At the shift of every hour, the quantity of energy produced is shown in the computers screen and expressed in kilowatts by hour. This hourly information is available to the operator continuously 24 hours a day.

The operator is responsible of transcribing the data of the energy quantity produced every hour to the "Control Operations Sheets" provided and available in the Control Room of the project. After transcribing that information, the operator also registers the energy quantity produced every hour in an

Excel spreadsheet where he summarizes the hourly information of the day. This information is checked and approved by the Operations Supervisor.

Moreover, at 12:00 a.m. on clock, the Operator makes a daily optical meter reading of the main and support meters taking note of the actual reading at that hour. Then the reading taken at 12:00 a.m. on clock of the previous day is subtracted from the actual reading; the result of that operation provides information about the energy produced in a day expressed in kilowatts. The result of the energy produced in a day is compared with the sum of the 24 hourly readings that were taken from the SCADA system. Both daily results coincide at the end of each day.

While comparing the records obtained through the manually and the automatically systems at the shift of every hour, the quality and accuracy of the data is continually guaranteed. Furthermore, at the end of the day, the operations supervisor reviews the hourly generations to validate the information as correct.

In case any registered data in the Excel spreadsheet obtained from the SCADA system doesn't match with the information read directly from the meters, it is immediately corrected in the Excel spreadsheet by the operator with the supervisor's approval. Due to this information is reviewed hourly, any detected mistake is corrected immediately at the end of the day using the meters readings and under the supervision of the Operations Supervisor. Due to the hourly meter readings are automatically shown in the SCADA computer screen, no human intervention is involved and any error in the database is possible.

In addition, a daily report is made by an automatic Data Monitoring System (Sistema de Monitoreo de Información –SIMON-) feed hourly by the operators with all the data of energy produced available in the plant. This program allows the access to updated data and graphics of the energy produced by Candelaria Hydroelectric Plant daily, weekly, monthly and yearly.

2. Monthly Readings Procedure

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

Procedure:

The operations supervisor monthly uses the automated reading system to summarize the total energy produced by Candelaria Hydroelectric plant for billing purposes. Every first day of the month, the operator in charge of the control room, uses an optical reader connected to a portable computer which has installed the meters reading software provided by the manufacturer General Electric, the Meter Mate Software. Through this software, hourly readings are taken automatically. The optical reader is positioned on the meter control panel lens and using the Meter Mate Software, a hhf format file is automatically created downloading all the updated hourly readings of the produced energy, one hhf file of the principal meter and another one for the support meter. Both hht format files are sent by email to the Operations Manager and the General Manager Assistant. Using the Meter Mate Software, the Candelaria Hydroelectric plant database of the hourly readings is updated using the hht format files. Finally a monthly report is exported to an Excel file allowing the total calculation of generated energy. Then, the report is reviewed and approved by the Operations Manager, the General Manager and the Financial Manager to later be sent to the Transactions Department of the Wholesale Market Administrator (AMM) and to the Commercial Management of the energy buyer company, Comercializadora Electronova. Both

entities make a review of the report by comparing the measurements taken by Candelaria Hydroelectric plant and the measurements taken through the external meters owned by the Wholesale Market Administrator. Both external managements validate and approve the report; and after that, a commercial invoice is made by Candelaria Hydroelectric plant to bill the energy provided to the national grid.

3. Yearly Readings Procedure

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

In order to prepare the annual 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 collects in a single report, all the monthly reports used for billing purposes in an Excel spreadsheet and calculating by formulas the annual emissions. This report is reviewed and approved by the General Manager.

SECTION D. Data and parameters

D.1. Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors	
Data / Parameter:	EF
Data unit:	tCO ₂ /MWh.
Description:	Annual electricity production of Candelaria hydroelectric plant
Source of data used:	Registered PDD
Value(s) :	0.824.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	For baseline emission calculation
Additional comment:	

D.2. Data and parameters monitored	
Data / Parameter:	CG
Data unit:	MWh
Description:	Electricity generation of the Candelaria hydropower plant
Measured /Calculated /Default:	Measured
Source of data:	Commercial Meters
Value(s) of monitored parameter:	Hourly readings from 01/06/2010 to 31/05/2011. Details are shown in Excel spreadsheet titled “Energy data and CERs calculations – 4 th Monitoring Period” attached to this Monitoring Report

Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	For reduction emissions calculations (CER's)
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	<p>Commercial Electricity Main Meter Model: KV2c Brand: General Electric Serial number: 28 620 847 Dates of calibration: 06/06/2010 and 02/05/2011 Validity: 1 year</p> <p>Commercial Electricity Support Meter Model: KV2c Brand: General Electric Serial number: 28 620 848 Dates of calibration: 06/06/2010 and 02/05/2011 Validity: 1 year</p>
Measuring/ Reading/ Recording frequency:	Measuring: Hourly continued Recording: Hourly, Daily, Monthly and Yearly
Calculation method (if applicable):	-
QA/QC procedures applied:	According to the Commercial Coordination Norm number 14 (NCC-14), clause 14.12, "Periodic Verifications", issued by the Wholesale Market Administrator (Administrador del Mercado Mayorista, AMM) meters will be calibrated yearly. Data measured by the meters will be cross checked with the Buyer's electricity reports, monthly invoices and through the records saved in the SCADA system, software utilized by the Wholesale Market Administrator (Administrador del Mercado Mayorista, AMM) to control and measure all the electricity delivered to the national grid.

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

Baseline Emission Factor

The build margin (BM) emission factor of 0.88 tCO₂/MWh and the operating margin (OM) emission factor of 0.767 tCO₂/MWh resulted in a combined margin emissions factor of **0.824 tCO₂/MWh**. This emissions factor will be multiplied with the verified electricity generation delivered to the grid to determine the emissions reductions (CERs).

$$ER = EF \times EG$$

ER = Emission Reductions

EF = Emission Factor (combined)

EG = Electricity Generation

The emission reductions calculated for the Fourth Verification Period using the *ex ante* emission factor according to Item E2 of the PDD, factor referenced above, is show in the following chart:

Candelaria Hydroelectric Plant
Calculation of Emissions Reductions
Period: June 2010 to May 2011, 4th Verification Period

Year	Month	MW/hour
2009	June	1,844.787
	July	2,524.033
	August	2,868.554
	September	2,844.114
	October	2,901.040
	November	2,305.080
	December	1,892.944
	January	1,564.892
2010	February	1,219.141
	March	1,233.764
	April	1,129.765
	May	1,061.837
Total annual energy		23,389.950

$$E_{\text{baseline}} = 0.824 \times 23,389 = 19,273 \text{ tonnes CO}_2$$

E.2. Project emissions calculation

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According to the PDD of the project, the project emission is zero. $PE = 0$.

E.3. Leakage calculation

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According to the PDD of the project, the leakage is not considered. $LE = 0$.

E.4. Emission reductions calculation / table

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The total of emissions reductions achieved in this monitoring period from 01/06/2010 to 31/05/2011 is:
19,273 (tonCO₂).

E.5. Comparison of actual emission reductions with estimates in the CDM-PDD

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The following chart shows a comparison between the actual values of the emission reductions achieved during the monitoring period and the estimations registered in the CDM-PDD of the Candelaria Hydroelectric Project:

Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reductions (tCO ₂ e)	18,922 (12 months)	19,723 (12 months)

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

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The increase registered in emissions reductions for this monitoring period from 01/06/2010 to 31/05/2011, is a result of significant increases in the flow of many rivers in the country, including the Trece Aguas River, caused by abundant rains and storms in comparison with the previous year, mainly in the months of August and September of 2010 and January, February, March and April of 2011, as shown in the data and chart attached to this monitoring report titled “Rain Yearly Trend 2009, 2010 and 2011”.