

MONITORING REPORT
Version number 7 – 23/02/2011

CANDELARIA HYDROELECTRIC PROJECT
Reference Number 0604
Monitoring period: 01/06/2009 – 30/06/2010

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 power generation began on July 1, 2006. 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 June 1st, 2009 to June 30st, 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 June 1, 2009 to June 30, 2010 is: **21,471 (tonCO₂)**.

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

A.2. Project Participants

Name of the Party involved	Private entity	Is the Party involved a project participant?
Guatemala (Host)	Hidroeléctrica Candelaria S. A.	No

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: E204246, N1703014, latitude (msnm) 109.

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. The water flows through a trailrased channel from where it enters a 422 meter long tunnel. The water then runs through a head pond and into a 760 meters long penstock, and finally propels in a Francis type turbine located at Candelaria power house. It delivers an average of 25 GWh of energy per year. Candelaria transmits electricity at 69kV which is injected into the national grid.

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 November 9, 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 / Hidroeléctrica Candelaria, S. A.
Operations Manager: Mario Gutiérrez / Hidroeléctrica Candelaria, S. A.
General Manager Assistant: Ana Maldonado / Hidroeléctrica Candelaria, S. A.

SECTION B. Implementation of the project activity**B.1. Implementation status of the project activity**

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1. The starting date of operations for Candelaria Hydroelectric Project was on July 1, 2006.
2. Yearly the operations management execute the annual programmed maintenance between April or May of each year. On 2010, the programmed maintenance started on April 24 at 8:00 and finished on April 30 at 12:00. No overhaul, down of equipment or exchange of equipment was made on this maintenance nor during this monitoring report period.

3. From June 1st to June 16, 2009, Secacao hydroelectric plant, located upstream Candelaria Hydroelectric Project, executed a long maintenance over this period, blocking the river flow used by Candelaria to produce energy. The river flow was available again to turbine until June 16, restarting operations in both plants.

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

Candelaria's Support Meter Features

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

A copy of the technical specifications of the KV2c General Electric electronic meter model used in Candelaria Hydroelectric Plant is attached to this monitoring report.

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).

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

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 2009 and 2010 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 is 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 reading taking the hourly information directly from the main and support meters using an optical reader to get the file with the information which is downloaded to the control room computer. The hourly data obtained from the meters is compared with the data taken from the SCADA system which must match each other.

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 in comparison with the meters readings with the Operations Supervisor approval. Due to the meter readings are automatically

upload and download to the computer, no human intervention is involved and any error in the database is possible.

In addition, a daily report is made by the Operations supervisor containing updated information of the total kilowatts produced by Candelaria Hydroelectric, this report also includes a graphic that shows the annual generation behavior of the plant which is sent to the General and Financial Manager for review and validation.

2. Monthly Readings Procedure

Source of data:	Main and Support commercial meters
Responsible to collect data:	Operator / 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 the 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 reading software provided by the meters 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 hht format file is automatically created downloading all the hourly readings of the produced energy to date. One file is created while reading the principal meter and a second file is created while reading the support meter. Both hht format files are sent by email to the General Manager Assistant at the central offices. Using the Meter Mate Software, the database of the hourly readings for Candelaria Hydroelectric plant are updated by opening the hht format file with the principal and support meters readings. Finally a monthly report is printed and exported to an Excel file allowing the calculation of monthly generations. This report is reviewed and approved by the General Management and the Financial Management.

Due to Candelaria Hydroelectric Plant provides electricity to the National Grid, this monthly report is sent to the Transactions Department of the Wholesale Market Administrator (AMM) and to the Commercial Management of the buyer company, Comercializadora Electronova. Both entities review 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 managements validate and approve the report and an 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 creates annually a report with all the information monthly recorded from the

meters for billing and in a Excel spreadsheet format automatically calculates de 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:	Electricity generation of the Candelaria hydroelectric project
Source of data used:	Hidroeléctrica Candelaria, S. A.
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 hydroelectric project
Measured /Calculated /Default:	Measured
Source of data:	Commercial Meters
Value(s) of monitored parameter:	Hourly readings from 01/06/2009 to 31/12/2010. Details are shown in Excel spreadsheet Annex 2 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: 24-09-2009 and 06-06-2010 Validity: 1 year</p> <p>Commercial Electricity Support Meter Model: KV2c Brand: General Electric Serial number: 28 620 848 Dates of calibration: 24-09-2009 and 06-06-2010 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.
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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 Third 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 2009 to December 2010

Year	Month	MW/hour	Emission Factor (Ton CO ₂ /MWh)	Emissions Reductions (Ton CO ₂)
2009	June	1,219	0.824	1,005
	July	2,779	0.824	2,290
	August	3,109	0.824	2,562
	September	2,968	0.824	2,445
	October	3,090	0.824	2,546
	November	2,558	0.824	2,108
	December	1,962	0.824	1,616
2010	January	1,601	0.824	1,319
	February	1,243	0.824	1,024
	March	1,186	0.824	978
	April	863	0.824	711
	May	1,635	0.824	1,347
	June	1,845	0.824	1,520
Total of CER's				21,471

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 June 1, 2009 to June 30, 2010 is: **21,471 (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)	21,471 (12 months)

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

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The small difference shown between the estimated and real emissions reductions obeys to an increase in the water resource due to abundant rains that took place during the referred period.