

# El Canadá Hydroelectric Project



Monitoring Report  
23-Nov-03 to 30-Jun-07  
Reference No. UNFCCC 0606  
Version No. 1  
Date: October 31<sup>st</sup>, 2007

**El Canadá Hydroelectric Project**  
**Monitoring Report of the Emissions Reductions**  
**From 23<sup>rd</sup> November 2003 to 30 June 2007**  
**Reference No. UNFCCC 0606**

**Project Description:**

El Canadá Hydroelectric Project consists of a 43 MW peaking run-of-river hydroelectric plant located on the Samalá River on the west coast of Guatemala, near the town of Santa María de Jesus. The western Guatemala region has 350 MW of demand and 31 MW of installed capacity. Construction began in February 2002 and was completed in December 2003. The Project started commercial operation per the Wholesale Market Norms on November 23<sup>rd</sup>, 2003. Since its commissioning, it has been producing an average of 175 GWh/year of electricity, which is sold to Guatemala's largest commercial distributor, COMEGSA, under a 10-year Power Purchase Agreement (PPA).

The Project contributes to the sustainable development of Guatemala in various ways. First, it has increased the supply of power to the local grid, improving stability and helping reduce losses in the distribution system. Second, it is reducing greenhouse gas emissions as well as emissions of local pollutants from power generation by using a cleaner energy source than what typically would have been used in the country. Third, it is one of the first renewable energy projects to be developed after the approval of Guatemala's new General Electricity Law. Its development has provided important knowledge and experience for other project developers that are striving to participate in the competitive national and regional market. Fourth, through the agreements the Project Company has entered into with the neighbouring municipalities, the Project is conserving sub-surface water, it has re-forested parts of the land where it was constructed, and it is making annual payments to improve the conditions of the local communities. Finally, it has created 250 jobs, injecting at least US\$ 30 million into the Guatemalan economy over the course of the construction period.

**Technology employed by the project:**

**Main Project Characteristics**

Installed Capacity: 43MW  
Generation: 175 GWh/year  
Head: 365 m  
Maximum Hydraulic Capacity: 13.4 m<sup>3</sup>/sec.  
Number of Units: 2 x 21.5 MW  
Powerline: 69 kV

The Project collects power flows from the tailrace of the existing Santa María power plant that is owned by INDE and also collects spillages from the Santa María dam and local inflow from the area between the Santa María dam and the Project diversion dam. All power flows flow through a desander, located immediately downstream of the diversion dam, and are subsequently diverted

through a tunnel, three meters in diameter and approximately 1200 m long, to a regulating pond. The regulating pond is designed to collect water inflows for daily peaking operation, totalling 5 hours. The live storage volume is 184,000 m<sup>3</sup>, using an 8-meter pond fluctuation. The normal operating level of the reservoir is 1416.90 meters above sea level (masl) and the minimum operating level is 1409 masl. An intake structure on the regulating reservoir is equipped with trash racks and a hydraulically operated gate. The gate is equipped to close during emergency conditions in the event of penstock rupture. The penstock is approximately 2400 m long and conveys the power flows from the regulating reservoir to the powerhouse. The penstock is comprised of a low- and a high-pressure section 1590 and 800 m long, respectively. The penstock is bifurcated into two 1.45-m diameter penstock pipes, approximately 46 m from the powerhouse.

The penstock pipe is buried over its total length. The low-pressure penstock diameter is 2.10 m, and the high-pressure section diameter 1.85 m. El Canadá powerhouse contains two 21.5-MW units. Each generating unit has a Pelton turbine and synchronous generator. The powerhouse crane has a capacity at least equal to the heaviest lift during equipment installation of 65 tons. The control room is be air conditioned and separate from the equipment area of the powerhouse. The output from the El Canadá facility is stepped up from 13.8 kV to 69 kV, before it is transmitted to Santa María substation about 3.6 km away for delivery to the INDE utility grid. The transmission line poles are steel and the guard and the power cables are 636 MCM ACSR. Each pole of the transmission line is grounded to provide a resistance of not more than 10 ohms.

All equipment utilized in the El Canadá Project is proven technology that has been successfully applied worldwide. Each of the two 21.5-MW generating units has a Pelton turbine and a synchronous generator. The rubber dam used in the diversion dam is a new technology introduced to Guatemala. Rubber dam technology was chosen in order to properly regulate the level at the diversion dam considering the operational restrictions due to being down stream from the Santa Maria powerhouse. This technology also has an added advantage during high volume situations during the wet season, the rubber dam can be deflated in order to avoid diverting mud, rocks, tree trunks, and other garbage into the desander.

#### **Physical Location:**

The Project is located on the Samalá River, 12 kilometers south of the Quetzaltenango Municipality and 198 kilometers due west from Guatemala City. Quetzaltenango is Guatemala's second largest city and is responsible for a large portion of the 350 MW maximum demand of the western region. The Samalá River is nearly 130 kilometers in length, and has relatively high flows, due to intense rainstorms over the western slopes of the volcanic mountain ranges that act as the river's basin. The slopes around the Project are very steep, with small plateaus. The Project is located immediately downstream from the existing Santa María hydro powerhouse owned by the national utility, Instituto Nacional de Electrificación (INDE), and utilizes some of the existing infrastructure.

El Canadá  
Hydroelectric  
Project



**Category of the project activity:**

Grid-connected electricity generation from renewable energy sources.

**Choice of the crediting period:**

Renewable crediting period.

**Crediting Life Time:**

21 years.

**Length of the first crediting period:**

7 years.

**Baseline Emission Rate:**

0.71 tCO<sub>2</sub>/MWh. The baseline emission rate is calculated *ex-ante*.

### Objective:

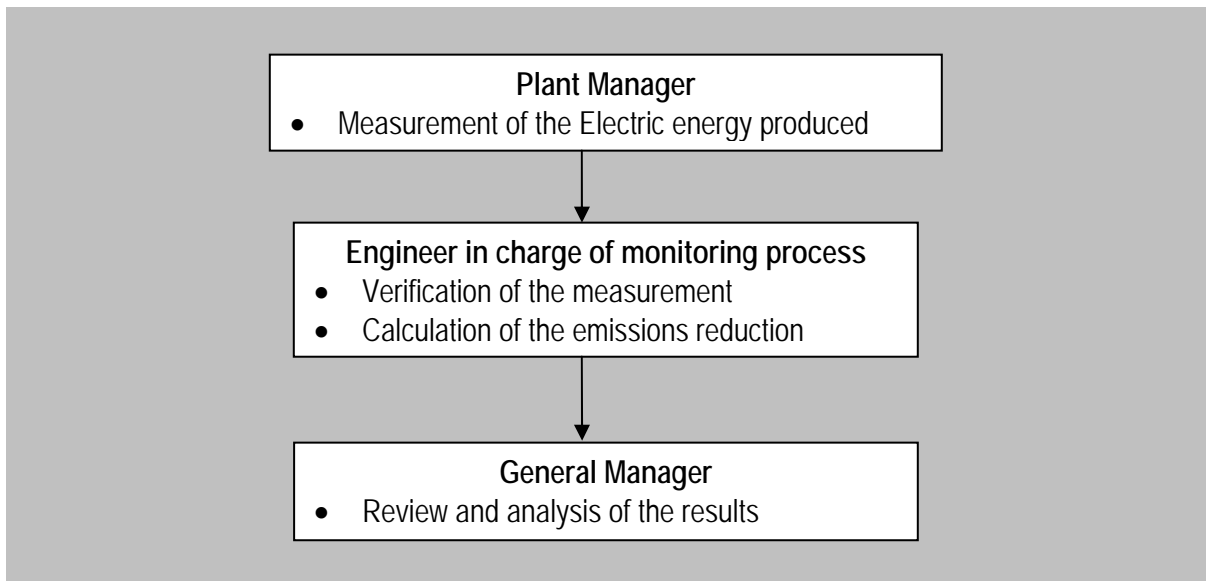
The objective of the present inform is to assure the complete, consistent, clear, and accurate monitoring and calculation of the emissions reductions, within the El Canadá Hydroelectric boundaries, during the first verification period from November 23<sup>rd</sup>, 2003 to June 30, 2007.

### Personnel responsible:

- The Plant Manager of El Canadá Hydroelectric Project is responsible of the electric energy measurement.
- The Marketing Analyst engineer of Generadora de Occidente, Ltda. is in charge of the monitoring process.
- The General Manager is responsible of the Monitoring Plan.

### Operational and Management Structure

The monitoring of the emissions reductions was done according to the operational structure shown in the below chart. The first step is measuring process, followed by verification of the measurement, calculation of the emissions reductions, and finally, review and analysis of results. Generadora de Occidente, Ltda. General Manager will be the responsible for the monitoring process.



## Measuring and calculation procedure

### Measuring

The Plant Manager collects electronically and monthly the generation data from the commercial energy meter installed in the El Canada Substation, which measures the energy produced by El Canada Hydroelectric Project and Montecristo Hydroelectric Project. In the Montecristo Substation in the 69 KV bus is installed the energy meter of Montecristo Hydroelectric Project, therefore El Canadá Hydroelectric Project could be calculated by difference. The generation data is reported in a spreadsheet for measuring control and register. The commercial meter data collection of the monitored month takes place during the first week of the following month. From the period November 23<sup>rd</sup>, 2003 to June 30, 2007, the commercial energy meter installed in the El Canadá Substation registered the following information:

El Canadá and Montecristo Hydroelectric Projects	
Year: 2003	
Month	Generation (MWh)
January	-
February	-
March	-
April	-
May	-
June	-
July	-
August	-
September	-
October	-
November	2,726
December	9,937
<b>Total</b>	<b>12,663</b>

El Canadá and Montecristo Hydroelectric Projects	
Year: 2004	
Month	Generation (MWh)
January	9,376
February	8,319
March	8,423
April	8,955
May	12,238
June	15,764
July	12,442
August	10,136
September	16,327
October	19,473
November	11,424
December	10,041
<b>Total</b>	<b>142,918</b>

El Canadá and Montecristo Hydroelectric Projects	
Year: 2005	
Month	Generation (MWh)
January	9,023
February	7,663
March	8,303
April	8,203
May	12,433
June	19,208
July	20,663
August	17,706
September	20,055
October	22,863
November	15,835
December	12,476
<b>Total</b>	<b>174,432</b>

El Canadá and Montecristo Hydroelectric Projects	
Year: 2006	
Month	Generation (MWh)
January	11,409
February	9,118
March	9,734
April	8,436
May	14,065
June	22,649
July	13,582
August	12,771
September	18,430
October	19,876
November	14,337
December	11,881
<b>Total</b>	<b>166,287</b>

<b>El Canadá and Montecristo Hydroelectric Projects</b>	
<b>Year: 2007</b>	
<b>Month</b>	<b>Generation (MWh)</b>
January	10,925
February	9,230
March	10,735
April	11,994
May	13,709
June	21,516
July	-
August	-
September	-
October	-
November	-
December	-
<b>Total</b>	<b>78,108</b>

The Plant Manager collects electronically and monthly the generation data from the commercial energy meter installed in the Montecristo Substation, which measures the energy produced by Montecristo Hydroelectric Project. The generation data is reported in a spreadsheet for measuring control and register. The commercial meter data collection of the monitored month takes place during the first week of the following month. From the period November 23<sup>rd</sup>, 2003 to June 30, 2007, the commercial energy meter installed in the Montecristo Substation registered the following information:

<b>Montecristo Hydroelectric Project</b>	
<b>Year: 2003</b>	
<b>Month</b>	<b>Generation (MWh)</b>
January	-
February	-
March	-
April	-
May	-
June	-
July	-
August	-
September	-
October	-
November	-
December	-
<b>Total</b>	<b>-</b>

<b>Montecristo Hydroelectric Project</b>	
<b>Year: 2004</b>	
<b>Month</b>	<b>Generation (MWh)</b>
January	-
February	-
March	-
April	-
May	-
June	-
July	-
August	-
September	-
October	-
November	-
December	-
<b>Total</b>	<b>-</b>

Montecristo Hydroelectric Project	
Year: 2005	
Month	Generation (MWh)
January	-
February	-
March	-
April	-
May	-
June	-
July	-
August	-
September	-
October	-
November	-
December	-
<b>Total</b>	<b>-</b>

Montecristo Hydroelectric Project	
Year: 2006	
Month	Generation (MWh)
January	-
February	-
March	-
April	-
May	1,145
June	2,253
July	-
August	-
September	-
October	-
November	-
December	-
<b>Total</b>	<b>3,397</b>

Montecristo Hydroelectric Project	
Year: 2007	
Month	Generation (MWh)
January	-
February	-
March	1,136
April	2,611
May	2,955
June	4,621
July	-
August	-
September	-
October	-
November	-
December	-
<b>Total</b>	<b>11,323</b>

The Plant Manager collects electronically and monthly the generation data from the commercial energy meter installed in the El Canadá Substation, which measures the energy produced by El Canadá Hydroelectric Project and Montecristo Hydroelectric Project. In the Montecristo Substation in the 69 KV bus is installed the energy meter of Montecristo Hydroelectric Project, therefore El Canadá Hydroelectric Project could be calculated by difference. Calculated the difference the generation data is reported in a spreadsheet for measuring control and register. The commercial meter data collection of the monitored month takes place during the first week of the following month. From the period November 23<sup>rd</sup>, 2003 to June 30, 2007, the energy produced by El Canadá Hydroelectric Project registered the following information:



El Canadá Hydroelectric Project	
Year: 2003	
Month	Generation (MWh)
January	-
February	-
March	-
April	-
May	-
June	-
July	-
August	-
September	-
October	-
November	2,726
December	9,937
<b>Total</b>	<b>12,663</b>

El Canadá Hydroelectric Project	
Year: 2004	
Month	Generation (MWh)
January	9,376
February	8,319
March	8,423
April	8,955
May	12,238
June	15,764
July	12,442
August	10,136
September	16,327
October	19,473
November	11,424
December	10,041
<b>Total</b>	<b>142,918</b>

El Canadá Hydroelectric Project	
Year: 2005	
Month	Generation (MWh)
January	9,023
February	7,663
March	8,303
April	8,203
May	12,433
June	19,208
July	20,663
August	17,706
September	20,055
October	22,863
November	15,835
December	12,476
<b>Total</b>	<b>174,432</b>

El Canadá Hydroelectric Project	
Year: 2006	
Month	Generation (MWh)
January	11,409
February	9,118
March	9,734
April	8,436
May	12,920
June	20,396
July	13,582
August	12,771
September	18,430
October	19,876
November	14,337
December	11,881
<b>Total</b>	<b>162,889</b>

El Canadá Hydroelectric Project	
Year: 2007	
Month	Generation (MWh)
January	10,925
February	9,230
March	9,599
April	9,383
May	10,754
June	16,895
July	-
August	-
September	-
October	-
November	-
December	-
<b>Total</b>	<b>66,786</b>

### Calculation energy produced and verification

The person in charge of the monitoring process verifies the accuracy of the recorded energy data. For this purpose, is necessary to compare the data recorded against the information of the commercial measurement published by the *Administrador del Mercado Mayorista* (AMM) in Certificates emitted by them.

The measuring verification is carried out as below shown:

<b>EI Canadá Hydroelectric Project Measurement Control</b>			
<b>Year: 2003</b>			
<b>Month</b>	<b>EI Canada Generation (MWh)</b>	<b>AMM Comercial Measurement (MWh)</b>	<b>EI Canada validated generation</b>
January	-	-	Validated
February	-	-	Validated
March	-	-	Validated
April	-	-	Validated
May	-	-	Validated
June	-	-	Validated
July	-	-	Validated
August	-	-	Validated
September	-	-	Validated
October	-	-	Validated
November	2,726	2,726	Validated
December	9,937	9,937	Validated
<b>Annual Total</b>	<b>12,663</b>	<b>12,663</b>	

<b>EI Canadá Hydroelectric Project Measurement Control</b>			
<b>Year: 2004</b>			
<b>Month</b>	<b>EI Canada Generation (MWh)</b>	<b>AMM Comercial Measurement (MWh)</b>	<b>EI Canada validated generation</b>
January	9,376	9,376	Validated
February	8,319	8,319	Validated
March	8,423	8,423	Validated
April	8,955	8,955	Validated
May	12,238	12,238	Validated
June	15,764	15,764	Validated
July	12,442	12,442	Validated
August	10,136	10,136	Validated
September	16,327	16,327	Validated
October	19,473	19,473	Validated
November	11,424	11,424	Validated
December	10,041	10,041	Validated
<b>Annual Total</b>	<b>142,918</b>	<b>142,918</b>	

<b>EI Canadá Hydroelectric Project Measurement Control</b>			
<b>Year: 2005</b>			
<b>Month</b>	<b>EI Canada Generation (MWh)</b>	<b>AMM Comercial Measurement (MWh)</b>	<b>EI Canada validated generation</b>
January	9,023	9,023	Validated
February	7,663	7,663	Validated
March	8,303	8,303	Validated
April	8,203	8,203	Validated
May	12,433	12,433	Validated
June	19,208	19,208	Validated
July	20,663	20,663	Validated
August	17,706	17,706	Validated
September	20,055	20,055	Validated
October	22,863	22,863	Validated
November	15,835	15,835	Validated
December	12,476	12,476	Validated
<b>Annual Total</b>	<b>174,432</b>	<b>174,432</b>	

<b>EI Canadá Hydroelectric Project Measurement Control</b>			
<b>Year: 2006</b>			
<b>Month</b>	<b>EI Canada Generation (MWh)</b>	<b>AMM Comercial Measurement (MWh)</b>	<b>EI Canada validated generation</b>
January	11,409	11,409	Validated
February	9,118	9,118	Validated
March	9,734	9,734	Validated
April	8,436	8,436	Validated
May	12,920	12,920	Validated
June	20,396	20,396	Validated
July	13,582	13,582	Validated
August	12,771	12,771	Validated
September	18,430	18,430	Validated
October	19,876	19,876	Validated
November	14,337	14,337	Validated
December	11,881	11,881	Validated
<b>Annual Total</b>	<b>162,889</b>	<b>162,889</b>	

<b>EI Canadá Hydroelectric Project Measurement Control</b>			
<b>Year: 2007</b>			
<b>Month</b>	<b>EI Canada Generation (MWh)</b>	<b>AMM Comercial Measurement (MWh)</b>	<b>EI Canada validated generation</b>
January	10,925	10,925	Validated
February	9,230	9,230	Validated
March	9,599	9,599	Validated
April	9,383	9,383	Validated
May	10,754	10,754	Validated
June	16,895	16,895	Validated
July	-	-	Validated
August	-	-	Validated
September	-	-	Validated
October	-	-	Validated
November	-	-	Validated
December	-	-	Validated
<b>Annual Total</b>	<b>66,786</b>	<b>66,786</b>	

### Calculation of emissions reductions

The person responsible of perform the Monitoring Process calculated the emissions reductions for the First Verification Period (From November 23<sup>rd</sup>, 2003 to June 30, 2007) using the *ex ante* emission factor according to the Table A.3.5 on the PDD.

The chart prepared for the calculation is:

<b>EI Canadá Hydroelectric Project. First Crediting Period.</b>			
<b>Year</b>	<b>Annual validated generation (MWh)</b>	<b>Emission factor (ton CO2/MWh)</b>	<b>Emissions reductions (ton CO2)</b>
2003	12,663	0.71	8,991
2004	142,918	0.71	101,472
2005	174,432	0.71	123,847
2006	162,889	0.71	115,651
2007	66,786	0.71	47,418
2008	-	0.71	-
2009	-	0.71	-
2010	-	0.71	-
<b>Total</b>	<b>559,688</b>		<b>397,378</b>

From November 23<sup>rd</sup>, 2003 to June 30, 2007 the EI Canadá Hydroelectric Project has reduced 397,378 tones of CO<sub>2</sub> by using renewable resources for the generation of electrical energy.

### Calibration of the meters of energy

The manufacturer SIEMENS realized the test of both meters of energy of Generadora de Occidente, Ltda. in July 30, 2003. Each meter was tested by twagoner and found to comply with the following criteria:

- ✓ Pulse Outputs
- ✓ Individual Phase Drop
- ✓ Aux Power
- ✓ Flash EPROM Verified
- ✓ Cold Start
- ✓ RS-232 Direct Port
- ✓ RS-485 Master/Slave
- ✓ Power Fail/Trip Recovery
- ✓ No Format Jumper
- ✓ Optical Communications
- ✓ Battery Verified
- ✓ No Protocol Test Required
- ✓ 2400 Baud Modem Comm.
- ✓ Hipot
- ✓ Contrast Pot Sealed
- ✓ Current Loop
- ✓ Firmware Verified
- ✓ Printer Port
- ✓ RJ-11 Cable

The certificates delivered by the manufacturer SIEMENS of both meters of energy of Generadora de Occidente, Ltda. are the following ones:

# SIEMENS

Power Transmission & Distribution - Meter Division

## Test Compliance Certificate

ID: 72248      Assembly # 8220A050      Manufacturing Order Number # 1000641  
Serial Number: 85-762-982      Final Test Date: 07-30-2003      Time: 12:10:45

Calibration By: TIMW      Calibration Date: 030729      Calibration Time: 123530      Form/Voltage: 9S 120

### Overall Meter Calibration Results :

Test	WattHour	VarHour
SF	100.00	100.00
SP	100.14	99.84
SL	99.98	100.02
AF	99.99	100.00
BF	100.00	100.01
CF	99.95	99.97

Balance: Checked

This unit has been tested by twagoner and found to comply with the following criteria:

Pulse Outputs	Power Fail/Trip Recovery	Hipot
Individual Phase Drop	No Format Jumper	Contrast Pot Sealed
Aux Power	Optical Communications	Current Loop
Flash EPROM Verified	Battery Verified	Firmware Verified
Cold Start	No Protocol Test Required	Printer Port
RS-232 Direct Port	2400 Baud Modem Comm.	RJ-11 Cable
RS-485 Master/Slave		

# SIEMENS

Power Transmission & Distribution - Meter Division

## Test Compliance Certificate

ID: 72249    Assembly # 8220A050    Manufacturing Order Number # 1000641  
Serial Number: 85-762-983    Final Test Date: 07-30-2003    Time: 12:18:08

Calibration By: TIMW    Calibration Date: 030729    Calibration Time: 130038    Form/Voltage: 9S 120

### Overall Meter Calibration Results :

Test	WattHour	VarHour
SF	100.01	100.03
SP	100.08	99.95
SL	100.00	100.04
AF	99.96	99.99
BF	100.02	100.02
CF	100.01	100.02


Balance: Checked

This unit has been tested by twagoner and found to comply with the following criteria:

Pulse Outputs	Power Fail/Trip Recovery	Hipot
Individual Phase Drop	No Format Jumper	Contrast Pot Sealed
Aux Power	Optical Communications	Current Loop
Flash EPROM Verified	Battery Verified	Firmware Verified
Cold Start	No Protocol Test Required	Printer Port
RS-232 Direct Port	2400 Baud Modem Comm.	RJ-11 Cable
RS-485 Master/Slave		

According to the NCC-14 clause 14.12 "Periodic Verifications" the participant will verify his meters to fulfill the requirement of the Administrador del Mercado Mayorista, AMM (Wholesale Market Administrator) or of the manufacturer. Because of this, Generadora de Occidente, Ltda. last January 26, 2007, proceeded to the calibration of his meters of energy, the principal meter and the support meter; giving as result that both meters fulfill with the requirements of the norm ANSI C12.20 and they were certified by the company AMELEC.

The certificates delivered by the calibration of both meters of energy of Generadora de Occidente, Ltda. of the company AMELEC are the following ones:

	<b>AMELEC</b>	21 Calle 12-57 zona 1 Telfax: (502) 22 Tel: (502) 22 E-mail: amelec@tern Guatemala, Centro
<b>ASESORIA Y MEDICION ELECTRICA</b>		

**CERTIFICACION DE CALIBRACION**

**TIPO DE MEDIDOR: Maxsys 2510 - Siemens**

**No. SERIE MEDIDOR: 85 762 982**

**ID MEDIDOR: MEDIDOR PRINCIPAL**

**Ubicación del Medidor: HIDROELÉCTRICA CANADÁ**

**COMPAÑÍA: GENERADORA DE OCCIDENTE, Limitada.**


**FECHA DE CALIBRACIÓN: 26 de Enero 2,007**

Certificamos que los valores adjuntos obtenidos en las pruebas de exactitud realizadas al medidor arriba indicado muestran valores dentro de los límites requeridos por la norma ANSI C12.20 en la tabla No.4 y 5, por lo tanto éste medidor CUMPLE con los requisitos de exactitud de dicha norma.

Los datos fueron obtenidos utilizando un Sistema de Calibración Computarizado modelo 441 marca UTEC. El Modelo 441 incorpora un patrón de referencia modelo RM-10-06 calibrado el 19 de Octubre de Noviembre del 2,006 por Radian Research contra un patrón primario RD-20-432 certificado por Radian Research y trazable al Instituto Nacional de Patrones y Tecnología (N.I.S.T.) de los Estados Unidos de América. La calibración de Radian Research tiene una incertidumbre de 0.005% para todos los rangos. La temperatura ambiente durante la prueba era de 24 grados centígrados. Para obtener el factor de potencia atrasado, la corriente se retrasó del voltaje.

La clase de exactitud global del Sistema de Calibración Computarizado modelo 441 marca UTEC es +/- 0.01% con factor de potencia igual a la unidad y +/- 0.04% con factor de potencia igual a 0.5.

El Sistema de Calibración Computarizado modelo 441 marca UTEC utilizado tiene el número de serie B0142. El mismo tiene el patrón de referencia interno modelo RM-10-06 marca Radian Research con número de serie 506004.

Prueba realizada por:   
Mario Raúl Túchez Chupina



# Single Meter Record

1/29/2007 11:42:50 AM

## Meter Owner: GENERADORA DE OCCIDENTE, LIMITADA

S/N 85 762 982	Type SolidState	TA 2.50
Alt	Form 9	Volts 120
Mfg SIEMENS	Base S	Kh 1.8
Model Maxsys2510	Class 20	Reg.
Service	Accuracy +/- 0.20%	KWh 0.00
Circuit		KW 0.00
Desc HIDRO CANADA METER PRINCIPAL		Dial Type
Lot	Assigned Test Set	
Status InService	AMM120V 20A ANSI	
Retire	120V, 20A, 1.8Kh, Rr?, Base-S, Srv-4WWye	
Create Date 1/26/2007	Edit Date 1/26/2007	Version Date 12/14/2006 3:36:18 PM

## Test Results:

TestSet AMM120V 20A ANSI  
 Descriptio 120V, 20A, 1.8Kh, Rr?, Base-S, Srv-4WWye  
 Version Date 12/14/2006 3:36:18 PM

Meter	Read In	Read Out
	AF Begin	AL End
	1/26/2007 1:55:10 PM	1/26/2007 2:06:16 PM

### SubTest 1

Wh Del(Entregado)

AF

AL

### Test

	AF	AL
FL20.0A, 120V, PF=1.0	99.98556	99.98556
PF-20.0A, 120V, PF=0.5	100.0000	100.0000
FL18.0A, 120V, PF=1.0	100.0867	100.0867
FL15.0A, 120V, PF=1.0	100.0500	100.0500
FL10.0A, 120V, PF=1.0	100.0837	100.0837
PF-10.0A, 120V, PF=0.5	100.0444	100.0444
FL5.0A, 120V, PF=1.0	99.98944	99.98944
PF-5.0A, 120V, PF=0.5	100.0956	100.0956
FL2.5A, 120V, PF=1.0	99.98444	99.98444
PF-2.5A, 120V, PF=0.5	100.1379	100.1379
FL1.5A, 120V, PF=1.0	100.0589	100.0589
PF-1.0A, 120V, PF=0.5	100.1736	100.1736
FL0.5A, 120V, PF=1.0	100.0188	100.0188
FL0.25A, 120V, PF=1.0	100.0105	100.0105
FL0.15A, 120V, PF=1.0	100.0072	100.0072
FL2.5A, 108V, PF=1.0	99.99833	99.99833
FL2.5A, 132V, PF=1.0	100.0027	100.0027

## Extra Data:

Data Name	Data Value
Standard ID:	- RM-10-06
Standard S/N:	- 506004
Standard:	- Radian Research
Calibrator ID:	- UTEC 441
Calibrator S/N:	- B0142
Test realized by:	- Raul Tuche

## CERTIFICACION DE CALIBRACION

TIPO DE MEDIDOR: **Maxsys 2510 - Siemens**

No. SERIE MEDIDOR: **85 762 983**

ID MEDIDOR: **MEDIDOR DE RESPALDO**

Ubicación del Medidor: **HIDROELÉCTRICA CANADÁ**

COMPAÑÍA: **GENERADORA DE OCCIDENTE, LIMITADA.**

FECHA DE CALIBRACIÓN: **28 de Enero 2007**

Certificamos que los valores adjuntos obtenidos en las pruebas de exactitud realizadas al medidor arriba indicado muestran valores dentro de los límites requeridos por la norma ANSI C12.20 en la tabla No.4 y 5, por lo tanto éste medidor CUMPLE con los requisitos de exactitud de dicha norma.

Los datos fueron obtenidos utilizando un Sistema de Calibración Computarizado modelo 441 marca UTEC. El Modelo 441 incorpora un patrón de referencia modelo RM-10-06 calibrado el 19 de Octubre de Noviembre del 2006 por Radian Research contra un patrón primario RD-20-432 certificado por Radian Research y trazable al Instituto Nacional de Patrones y Tecnología (N.I.S.T.) de los Estados Unidos de América. La calibración de Radian Research tiene una incertidumbre de 0.005% para todos los rangos. La temperatura ambiente durante la prueba era de 24 grados centígrados. Para obtener el factor de potencia atrasado, la corriente se retrasó del voltaje.

La clase de exactitud global del Sistema de Calibración Computarizado modelo 441 marca UTEC es +/- 0.01% con factor de potencia igual a la unidad y +/- 0.04% con factor de potencia igual a 0.5.

El Sistema de Calibración Computarizado modelo 441 marca UTEC utilizado tiene el número de serie B0142. El mismo tiene el patrón de referencia interno modelo RM-10-06 marca Radian Research con número de serie 506004.

Prueba realizada por:



Mario Raúl Túchez Chupina

# Single Meter Record

1/29/2007 11:44:13 AM

## Meter Owner: GENERADORA DE OCCIDENTE, LIMITADA

S/N 85 762 983	Type SolidState	TA 2.50
Alt	Form 9	Volts 120
Mfg SIEMENS	Base S	Kh 1.8
Model Maxsys2510	Class 20	Reg.
Service Accuracy +/- 0.20%	KWh 0.00	KW 0.00
Circuit	Dial Type	
Desc HIDRO CANADA - MEDIDOR RESPALDO	Assigned Test Set	
Lot	AMM120V 20A ANSI	
Status InService	120V, 20A, 1.8Kh, Rr?, Base-S, Srv-4WWy6	
Retire	Version Date 12/14/2006 3:38:18 PM	
Create Date 1/26/2007	Edit Date 1/26/2007	

## Test Results:

TestSet AMM120V 20A ANSI  
 Descriptio 120V, 20A, 1.8Kh, Rr?, Base-S, Srv-4WWy6  
 Version Date 12/14/2006 3:38:18 PM

Meter	Read In	Read Out
	AF Begin	AL End
	1/26/2007 11:59:20 AM	1/26/2007 12:13:09 PM

### SubTest 1

Wh Del(Entregado)

AF AL

### Test

	AF	AL
FL20.0A, 120V, PF=1.0	100.1307	100.1307
PF-20.0A, 120V, PF=0.5	99.94318	99.94318
FL18.0A, 120V, PF=1.0	100.1271	100.1271
FL15.0A, 120V, PF=1.0	100.0678	100.0678
FL10.0A, 120V, PF=1.0	100.0670	100.0670
PF-10.0A, 120V, PF=0.5	100.0020	100.0020
FL5.0A, 120V, PF=1.0	100.1101	100.1101
PF-5.0A, 120V, PF=0.5	100.0138	100.0138
FL2.5A, 120V, PF=1.0	100.0233	100.0233
PF-2.5A, 120V, PF=0.5	100.0650	100.0650
FL1.5A, 120V, PF=1.0	100.0277	100.0277
PF-1.0A, 120V, PF=0.5	100.1140	100.1140
FL0.5A, 120V, PF=1.0	100.0383	100.0383
FL0.25A, 120V, PF=1.0	100.0277	100.0277
FL0.15A, 120V, PF=1.0	100.0266	100.0266
FL0.6A, 108V, PF=1.0	100.0030	100.0030
FL2.5A, 132V, PF=1.0	100.0566	100.0566

## Extra Data:

Data Name	Data Value
Standard ID:	- RM-10-06
Standard S/N:	- 508004
Standard:	- Radian Research
Calibrator ID:	- UTEC 441
Calibrator S/N:	- E0142
Test realized by:	- Raul Tuche

According to the NCC-14 clause 14.12 "Periodic Verifications" the participant will verify his meters to fulfill the requirement of the Administrador del Mercado Mayorista, AMM (Wholesale Market Administrator) or of the manufacturer. Because of this, Generadora de Occidente, Ltda. last May 25, 2007, proceeded to the calibration the principal meter; giving as result that both meters fulfill with the requirements of the norm ANSI C12.20 and they were certified by the company VELCA.

The certificates delivered by the calibration of both meters of energy of Generadora de Occidente, Ltda. of the company VELCA are the following ones:



**Administrador del Mercado Mayorista**

**ME-131-2007**

Guatemala, 03 de Agosto de 2007

Enel Guatemala, S.A.

Ing.  
Juan Carlos Mendez  
Mandatario General con Representación  
Generadora de Occidente, Ltda.  
Pte

03 AGO. 2007

RECIBIDO

Estimado Ing. Mendez:

Con base a su solicitud relacionada con la habilitación comercial de la Central Hidroeléctrica Hidrocanadá, por este medio le informo que dicha planta quedó habilitada comercialmente en el Mercado Mayorista a partir del 20 de Noviembre de 2003, a la vez le adjunto copia del certificado de verificación del punto de medición comercial extendido por la empresa VELCA, S.A.

Sin otro particular, atentamente,

**Ing. Omar E. Maldonado Arévalo**  
**Coordinador Departamento Medición -AMM-**



No. CERTIFICADO: 107-2007

**CERTIFICADO DE VERIFICACION DE PUNTO DE MEDICION  
AMM, Sistema de Medición Comercial****DATOS GENERALES:**

TIPO DE INSPECCION:	Verificación de medición
LEGISLACION APLICABLE:	NCC14
CODIGO DE PUNTO DE MEDICION:	QUE01047
PUNTO DE MEDICION:	HIDROELECTRICA CANADA
UBICACIÓN:	KM. 197 CARRETERA A ZUMIL, QUETZALTÉNANGO
RESPONSABLE:	GEN/CANADA
FECHA DE VERIFICACIÓN:	26-Abril-07
PORCENTAJE DE ERROR DE LA MEDICION	0.0227%
PORCENTAJE DE REGISTRO DE LA MEDICION	100.022%
MEDICION DE CONEXIÓN A TIERRA	0.115 Ohms

**RESULTADOS**

DE LOS DATOS OBTENIDOS EN LA VERIFICACION REALIZADA EN EL PUNTO DESCRITO INFORMAMOS QUE EL PUNTO:

☒ CUMPLE☐ INCUMPLE

CON LOS PARAMETROS ESTABLECIDOS EN LA LEGISLACION APLICABLE A LAS VERIFICACIONES ELECTRICAS

25 de mayo 2007

INSPECTOR

TONY BRAN FINO

FIRMA:

SUPERVISOR

ING. OTTO RAUL CASTAÑEDA FLORES

FIRMA:

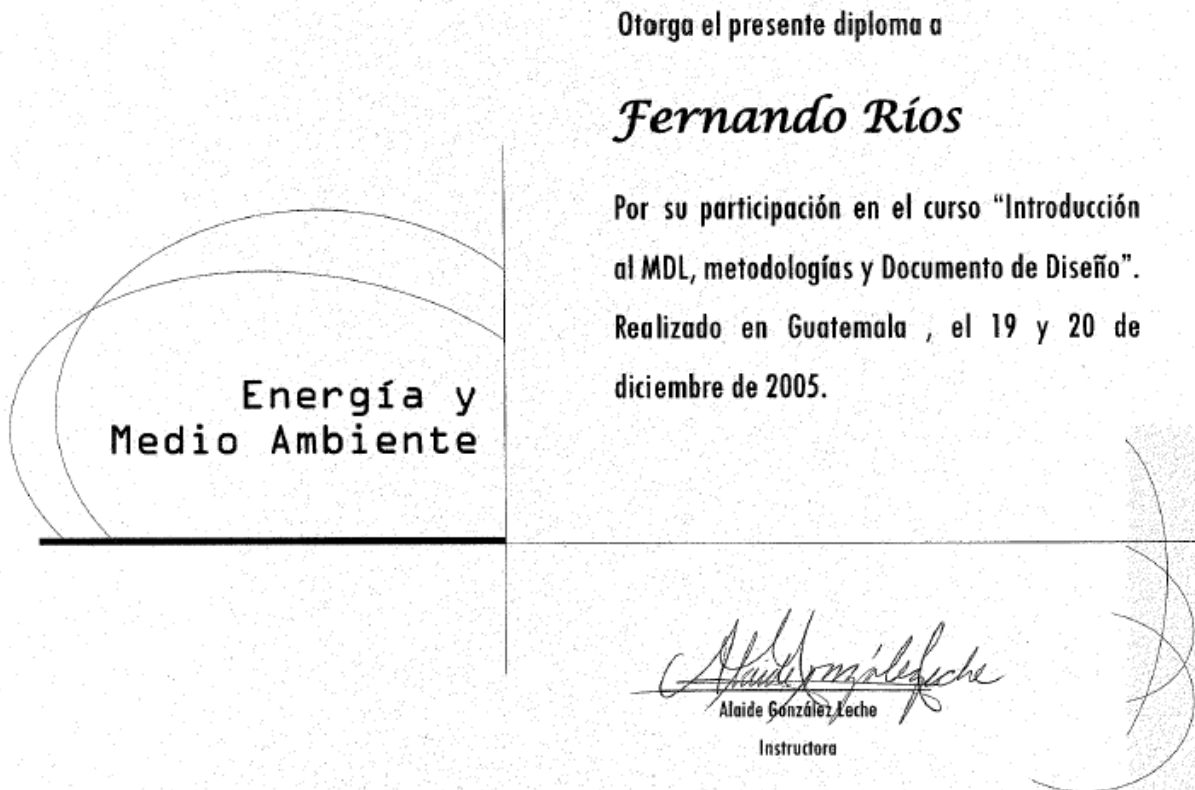
### Meter of support

The Hydroelectric Project El Canadá has a meter of principal energy that is used to obtain the readings of commercial measurement of the plant and a meter of support which is used to obtain the readings of commercial measurement in case that the principal meter trumps or is damaged, according to the stipulated in the regulation NCC-14 of the Administrador del Mercado Mayorista, AMM (Wholesale Market Administrator) in the clauses 14.6.1, 14.10.2 and 14.10.3.

### Training of the Personnel

The engineer in charge of monitoring process received training on introduction to the CDM, the different methodologies and project design document, given by the instructing Alaide Gonzalez of the company Energy and Environment on December 19 and 20, 2005. Likewise the engineer in charge of monitoring process received a training of CDM project monitoring, given by the instructing Alaide Gonzalez of the company Energy and Environment on January 9, 2006.

The certificates delivered by the company Energy and Environment of these trainings are the following ones:





Otorga el presente diploma a

***Fernando Ríos***

Por su participación en el curso "Monitoreo de proyectos MDL".

Realizado en Guatemala , el 9 de enero de 2006.



Alaide González Leche  
Instructora

#### Certification of Records of Measurement

In March 14, 2007 the Administrador del Mercado Mayorista, AMM (Wholesale Market Administrator) delivered the certification of records of measurement from November 19, 2003 to December 31<sup>st</sup>, 2006 of Generadora de Occidente, Ltda.

The certificates delivered by the Wholesale Market Administrator of this measurement are the following ones:



**Administrador del Mercado Mayorista**

**ME-052-2007**

Guatemala, 14 de Marzo de 2007

Ingeniero  
Juan Carlos Mendez  
Mandatario General con Representación  
Generadora de Occidente, Ltda.  
Pte.

Estimado Ing. Mendez:

Con relación a lo solicitado por su persona en nota con fecha 9 de Marzo de 2007, por este medio le adjunto los certificados de la energía generada por Generadora de Occidente, Ltda en los años 2003, 2004, 2005 y 2006.

Sin otro particular, Atentamente,

**Ing. Omar E. Maldonado Arévalo**  
**Coordinador Departamento Medición -AMM-**

**Adjunto: 4 Certificados**





*Astua Aldam*

Diagonal 6, 10-65 zona 10. Centro Gerencial Las Margaritas, Torre 1, Nivel 15  
Teléfono 332-7901 Fax: 331-7148. E-Mail: amm@amm.org.gt






**ADMINISTRADOR DEL MERCADO MAYORISTA  
DEPARTAMENTO DE MEDICION  
CERTIFICACIÓN DE REGISTROS DE MEDICION**

<b>GENERADOR</b>	Generadora de Occidente, Ltda.
<b>Ubicación</b>	Km.197 carretera a Zunil, Quetzaltenango
<b>MES \ AÑO</b>	<b>Energia Generada KW h</b>
Ene-03	-----
Feb-03	-----
Mar-03	-----
Abr-03	-----
May-03	-----
Jun-03	-----
Jul-03	-----
Ago-03	-----
Sep-03	-----
Oct-03	-----
Nov-03	3,086,760
Dic-03	9,936,720
Los presentes datos son energias mensuales en kwh	
<b>Depto Medición:</b>	 Ing. Omar E. Maldonado A.  Coordinador Depto. Medición
<b>Fecha emisión:</b>	13/03/2007

Nota: Los datos consignados en la presente, son los registros reportados por el Agente y que el AMM toma como oficiales.



**ADMINISTRADOR DEL MERCADO MAYORISTA  
DEPARTAMENTO DE MEDICION  
CERTIFICACIÓN DE REGISTROS DE MEDICION**

<b>GENERADOR</b>	Generadora de Occidente, Ltda.
<b>Ubicación</b>	Km. 197 carretera a Zunil, Quetzaltenango
<b>MES \ AÑO</b>	<b>Energia Generada KW h</b>
Ene-04	9,376,140
Feb-04	8,318,940
Mar-04	8,423,340
Abr-04	8,955,060
May-04	12,237,660
Jun-04	15,763,620
Jul-04	12,442,200
Ago-04	10,136,220
Sep-04	16,327,080
Oct-04	19,473,240
Nov-04	11,423,580
Dic-04	10,040,580
Los presentes datos son energias mensuales en kwh	
<b>Depto Medición:</b>	 Ing. Omar E. Maldonado Arevalo Coordinador Depto. Medición
<b>Fecha emisión:</b>	13/03/2007



Ing. OMAR E. MALDONADO AREVALO  
COORDINADOR DEPTO. MEDICION

Nota: Los datos consignados en la presente, son los registros reportados por el Agente y que el AMM toma como oficiales.






**ADMINISTRADOR DEL MERCADO MAYORISTA  
DEPARTAMENTO DE MEDICION  
CERTIFICACIÓN DE REGISTROS DE MEDICION**

<b>GENERADOR</b>	Generadora de Occidente, Ltda.
<b>Ubicación</b>	Km.197 carretera a Zunil, Quetzaltenango
<b>MES \ AÑO</b>	<b>Energia Generada KW h</b>
Ene-05	9,023,340
Feb-05	7,662,840
Mar-05	8,302,980
Abr-05	8,202,960
May-05	12,433,080
Jun-05	19,207,980
Jul-05	20,663,220
Ago-05	17,706,420
Sep-05	20,054,700
Oct-05	22,863,420
Nov-05	15,835,140
Dic-05	12,475,800
Los presentes datos son energias mensuales en kwh	
<b>Depto Medición:</b>	 Ing. Omar E. Maldonado Coordinador Depto. Medición
<b>Fecha emisión:</b>	13/03/2007



Ing. OMAR E. MALDONADO AREVALO  
COORDINADOR DEPTO. MEDICION

Nota: Los datos consignados en la presente, son los registros reportados por el Agente y que el AMM toma como oficiales.

 <b>ADMINISTRADOR DEL MERCADO MAYORISTA DEPARTAMENTO DE MEDICION CERTIFICACIÓN DE REGISTROS DE MEDICION</b>	
<b>GENERADOR</b>	Generadora de Occidente, Ltda.
<b>Ubicación</b>	Km.197 carretera a Zunil, Quetzaltenango
<b>MES \ AÑO</b>	<b>Energia Generada KW h</b>
Ene-06	11,409,000
Feb-06	9,117,660
Mar-06	9,733,680
Abr-06	8,435,580
May-06	12,920,491
Jun-06	20,396,427
Jul-06	13,582,380
Ago-06	12,770,700
Sep-06	18,430,320
Oct-06	19,875,840
Nov-06	14,336,520
Dic-06	11,880,660
Los presentes datos son energias mensuales en kwh	
<b>Depto Medición:</b>	  <b>Ing. OMAR E. MALDONADO AREVALO</b> COORDINADOR DEPTO. MEDICION
<b>Fecha emisión:</b>	13/03/2007

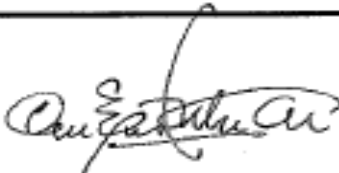

Nota: Los datos consignados en la presente, son los registros reportados por el Agente y que el AMM toma como oficiales.



**ADMINISTRADOR DEL MERCADO MAYORISTA  
DEPARTAMENTO DE MEDICION  
CERTIFICACIÓN DE REGISTROS DE MEDICION**

<b>GENERADOR</b>	Generadora de Occidente, Ltda.
<b>Ubicación</b>	Km. 197 carretera a Zunil, Quetzaltenango
<b>MES \ AÑO</b>	<b>Energia Generada KW h</b>
Ene-07	10,924,500
Feb-07	9,230,160
Mar-07	9,598,795
Abr-07	9,383,246
May-07	10,753,649
Jun-07	16,895,299
-----	-----
-----	-----
-----	-----
-----	-----
-----	-----
-----	-----

Los presentes datos son energias mensuales en kwh

<b>Depto Medición:</b>	 Ing. Omar E. Maldonado A. Coordinador Depto. Medición	 Ing. OMAR E. MALDONADO AREVALO COORDINADOR DEPTO. MEDICION
<b>Fecha emisión:</b>	26/10/2007	

Nota: Los datos consignados en la presente, son los registros reportados por el Agente y que el AMM toma como oficiales.