

# **3<sup>rd</sup> MONITORING REPORT**

## **TROJES HYDROPOWER PROJECT**

### **Registration Number 0649**

**Version 7**  
**Version 1**

**January 20, 2011**  
**April 29, 2009**

**Monitoring period:**

**October 1<sup>st</sup>, 2007 – March 31<sup>st</sup>, 2009**

**Project Site Address**

Cortina Baja Presa Trojes,  
Municipality of Pihuamo,  
State of Jalisco  
Mexico

**Prepared by**

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## Table of contents

1.	Introduction .....	3
2.	Brief description of the Project Activity .....	3
3.	Technical description of the project .....	4
4.	Project Participants .....	6
5.	Implementation status of the project activity .....	7
6.	Data monitored .....	7
7.	Emission Reduction Calculation .....	9

Mexico City, January 20, 2011

## **1. Introduction**

The objective of this Monitoring Report is to show the calculation of the emission reductions (ERs) achieved by the project activity under the Clean Development Mechanism (CDM) and verified by a Designated Operational Entity.

The monitoring period is from 01/10/2007 to 31/03/2009 (both days included). The report also shows the Monitoring Plan for data collection and auditing followed by the project developer in order to determine real and credible emission reductions. The monitoring plan is based on the CDM registered project design document Trojes Hydropower Project Version 3 – 19/04/2006, which uses existing baseline and monitoring methodologies (AMS-I.D. ver. 8), which have been approved and made publicly available by the CDM Executive Board. The methodology is designated "Grid connected renewable electricity generation".

## **2. Brief description of the Project Activity**

The Trojes Hydropower Project<sup>1</sup> was developed by Impulsora Nacional de Electricidad S. de R.L. de C.V. (INELEC) and Hidroelectricidad del Pacífico S. de R.L. de C.V. (HPA), both registered as Project Participants. INELEC is a subsidiary of Energía Nueva Energía Limpia S. de R.L. de C.V. (Enel Mexico), entity responsible for the preparation of this monitoring report.

The objective of the proposed project activity is to generate renewable electricity using hydroelectric resources and to sell the generated output to Mexican consumer partners (primarily industrial users and municipalities) on the basis of power purchase agreements (PPA's), using the Comisión Federal de Electricidad (CFE) transmission system to wheel the energy. The project activity generates GHG emission reductions by displacing the electricity generation and CO<sub>2</sub> emissions from fossil fuel-fired power plants.

The Trojes project generates clean electricity in a rural area located into the Municipality of Pihuamo in the State of Jalisco and the nearest city to the

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<sup>1</sup> Trojes Hydroelectric Project is the name of the Project activity used in the registered PDD. The UNFCCC has identified the project as *Project 0649: Trojes Hydropower Project*, so this is the name that will be used in this Monitoring Report in order to avoid any misunderstanding with the UNFCCC, as this was the name used in the previous Monitoring Reports.

proposed project is Coalcomán, in the state of Michoacán. Trojes Project is located at the Trojes Dam in the Barreras River, 50 km south-east of the city of Colima within the state of Michoacán. The power house is located at 18° 57'55" North Latitude and 103° 23'48.0" West Longitude.

The actual installed capacity of the project is in line with the generation permit granted by the Comisión Reguladora de Energía. According to this permit, the capacity of the project is defined as 8 MW, which is the maximum amount allowed to be delivered to the national grid. This permit has been verified by the DOE onsite.

The amount of ERs calculated during the monitoring period is not affected in any way by the 0.3 MW above the capacity stated in the registered PDD, because the CERs are calculated according to the approved baseline and monitoring methodology AMS-I.D. ver. 8, using the maximum amount of electricity supplied by the project to the national grid, according to the generation permit and measured by Comisión Federal de Electricidad (CFE). The operation of the project during the monitoring period has been done in full compliance with the permits and licenses granted to the project.

The Trojes Hydropower Project is therefore characterized by an authorized capacity of 8 MW, and a nominal capacity of 8.3 MW, which is 0.3 MW above of the capacity mentioned in the permit. The authority is aware of the situation and on this regards they applied actions on the payment of the overdue energy delivered. However, as this energy generated is exported to the grid and the only action undertaken by the authority is the not accepting the total electricity in the period which will be bought in the next year period. Therefore, the ERs are calculated based on the energy recognized by the authority and actually delivered to the grid.

The project began construction in January 2002 and the commissioning took place on April 1, 2003.

### **3. Technical description of the project**

The Trojes project has an existing dam at the site. The power plant has a nominal capacity of 8 MW, using the existing pattern of irrigation flow to generate electricity. The existing dam is a rock filled dam with an impervious clay core center and has been built with the intent to construct future hydroelectric plant on-site.

The main design characteristics of the Trojes project are summarized in Table 1.

**Table 1: Trojes Hydropower Project  
Main Project characteristics**

Power (MW)	8.0
Design head (m)	61.8
Design rate of flow (m <sup>3</sup> /a)	15.0
Project efficiency	88.0
Transmission line (km)	2.5

The expected total annual average generation output is 38.7 GWh.

The technical equipment and main components of the project activity are presented below:

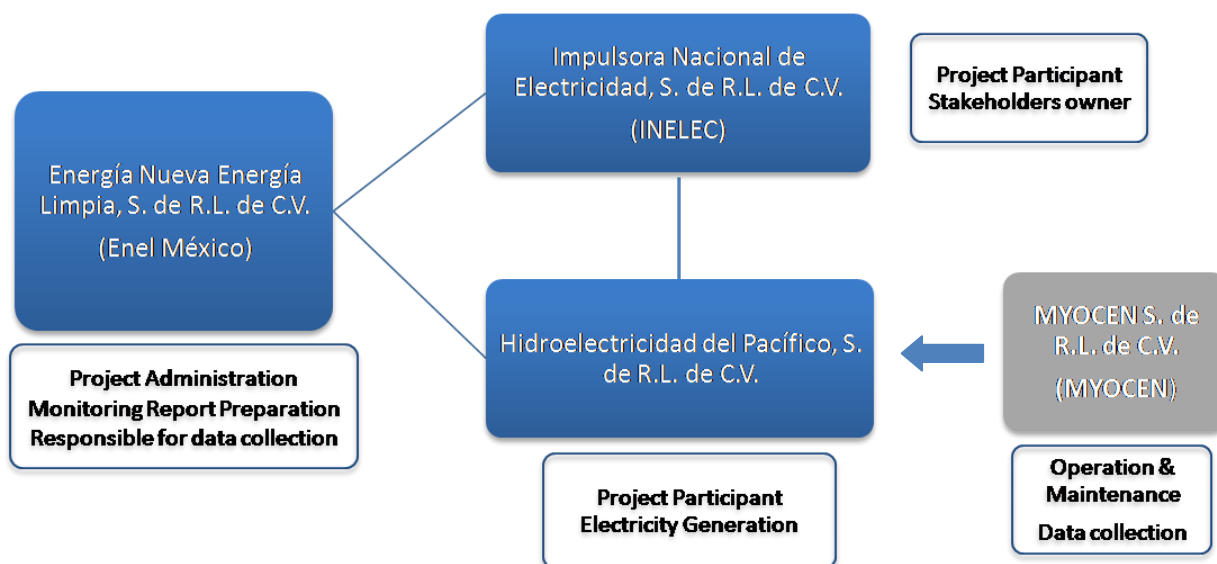
**Table 2: Technical Equipment**

Equipment	Characteristics	
<b>Generator</b>	ALSTOM No. Type: Year: Cos $\phi$ P= V = I= f:= v=	G0N019 SH 217/68/18 2002 0.95 nominal 8,760 kVA 8,600 V 505 A 60 Hz 3 phases 400 rpm
<b>Turbine</b>	ALSTOM Type: Year: Serial No.: P= Q = n=	Francis 7040 KW 2002 2017 10.5767 kW 17.37 m <sup>3</sup> /s 400 rpm
<b>Metering 1 (Main)</b>	Comissioning date: Instrument Type: Serial Number: Manufacturer Model Nr.: Specific Location:	March 2003 Electricity meter, one way S/N PR-0506A068-02 ION 8400 Trojes Power Plant, CFE's Substation, Presa Trojes
<b>Metering 2 (Backup)</b>	Comissioning date: Instrument Type: Serial Number: Manufacturer Model Nr.: Specific Location:	March 2003 Electricity meter, one way N/S AR-0012A368-02 ION 8400 Trojes Power Plant, CFE's Substation, Presa Trojes

## 4. Project Participants

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**Table 3: Organizational Chart**



## 5. Implementation status of the project activity

The Project was registered as a CDM Project activity on 04/11/2006. The crediting period is 7 years starting from the commercial operation date, 01/04/2003, and can be renewed for two more 7 year periods. Up to date, 85,400 CERs have been issued.

The project is operated by an external company called MYOCEN S. de R.L. de C.V. according to international standards. MYOCEN is responsible of executing any corrective action recommended by INELEC, who determines the amount of electricity to be generated according to the annual program and Comisión Nacional del Agua (CNA) guidelines and allowed Volumes. INELEC is also responsible of recommending corrective actions that would be implemented by MYOCEN in the case of encountering Generation Deviations.

Since the commissioning, the Project has operated continuously without any major stops, others than the ones considered for ordinary maintenance. The plant load factor for the months corresponding to 2007 was 65.16%, 2008 was 58.41% and for 2009 64.53%.

## 6. Data monitored

The monitoring methodology used by the project activity consists of metering the electricity generated by the renewable technology.

MYOCEN team supports Enel Mexico to collect the needed information to complete the monitoring report. The Auxiliary Technician is in charge of collecting the data related to the plant operation; the Superintendent collects and develops the generation reports and other specific administrative documents to backup the information presented in the monitoring report. The rest of the data is collected by the Business Developer of Enel Mexico.

**Table 4: Data to be monitored**

ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/paper)	Comment
1	Electricity Generated by the Project Delivered to Grid (net of parasitic consumption)	CFE and Project Operator	MWh	m	yearly	all	Electronic and paper	Data will be archived for 2 years following the end of the Crediting Period

Net generation Quality Control and Quality Assurance are undertaken through double measurement:

- i. at Trojes power plant instruments and checked by the operating company MYOCEN, and
- ii. by Comision Federal de Electricidad (CFE) measurement devices and procedures.

MYOCEN's meter is only used for internal purposes. CFE is the responsible entity of charging for the wheeling cost of the project, therefore it is CFE who officially establishes the electricity generated by the project and that is actually billed to the consumer partners.

The Interconnection Agreement signed with CFE defines the calibration periods for the official meters that record the energy delivered to the grid, which has to be checked annually for accuracy and is CFE's sole responsibility. The metering equipment shall have sufficient accuracy so that any error resulting from such equipment shall not exceed 0.2% of full-scale rating.

The metering equipment are calibrated and checked annually for accuracy. The net energy output registered by the meters alone will suffice for the purpose of billing and emission reduction verification as long as the error in the meters is within the agreed limits.

**Table 5: Dates of calibrations of monitoring equipment**

Equipment	Date of calibration
N/S AR-0012A368-02	03/03/06
	05/11/07
	05/12/08
S/N PR-0506A068-02	03/03/06
	05/11/07
	05/12/08

On November 5, 2007, CFE annual calibration process took place at Trojes plant. The principal meter, N/S AR-0012A368-02 presented a percentage error higher than the admitted according to manufacturer's standards, so it was replaced with the backup meter S/N PR-0506A068-02, which is now used as the principal meter for CFE invoices. The meter was calibrated and tested to corroborate it complies with CFE requirements for main meters.

As a result of the situation presented with the main meter during 2007, a 0.5% has been deducted from the CERs generated during this year, as a conservative approach. For 2008 calibration, a 0.2% has been deducted from the CERs generated from November to December, because the calibration took place one month later than programmed.



## 7. Emission Reduction Calculation

The emission factor of the electric national grid and used for this project was fixed ex-ante as a result of the calculation of the Operating Margin (OM) using the simple OM method. This emission factor will be valid during the crediting period of the project. For the current crediting period, the emission factor is 0.531 tCO<sub>2</sub>/MWh.

The total emission reductions achieved by the project activity through the monitoring period is equal to **33,614** tCO<sub>2</sub>e. The following tables show the values obtained during the monitoring period, by applying the AMS-I.D. methodology ver. 8

According to the AMS-I.D., the emission reductions can be calculated with the following equation:

$$ER_y = BE_y - PE_y - LE_y \quad (1)$$

Where:

ER<sub>y</sub>: Emission reductions due to displacement of electricity during the year y (tCO<sub>2</sub>/y)  
BE<sub>y</sub>: Baseline emissions in year y (tCO<sub>2</sub>/y)  
PE<sub>y</sub>: Project emissions in year y (tCO<sub>2</sub>/y)  
LE<sub>y</sub>: Leakage emissions in year y (tCO<sub>2</sub>/y)

Considering that in the Trojes project the water reservoir was already existent and that the power plant installation did not result in the increase of the basin, project emissions are set to zero.

Furthermore, since the electricity generating equipment is not transferred from another activity, also leakages are absent.

Thus equation (1) becomes:

$$ER_y = BE_y = EG_y * EF_{CO2,grid,y}$$

Where:

EG<sub>y</sub>: Net quantity of electricity generated as a result of the project activity during the year y (MWh)  
EF<sub>CO2,grid,y</sub>: CO<sub>2</sub> emission factor (CEF) for the electricity displaced due to the project activity during the year y (tCO<sub>2</sub>/MWh)

Since the monitoring of emission reduction is achieved through the measurement of net electricity generation, no special operational and management structure is needed apart from normal electricity generation O&M structure. The Table 6 contains the electricity generation of the project during the monitoring period.

**Table 6: Electricity generation in MWh (CFE meter) from October 1<sup>st</sup>, 2007 to March 31<sup>st</sup>, 2009**

Period	2007	2008	2009	TOTAL
January	0	3,279.55	3,538.34	
February	0	3,764.97	3,517.49	
March	0	3,898.35	4,089.81	
April	0	3,913.72	0	
May	0	3,854.12	0	
June	0	2,091.86	0	
July	0	139.94	0	
August	0	3,314.49	0	
September	0	6,072.90	0	
October	6,032.09	5,547.81	0	
November	3,309.51	2,575.56	0	
December	2,183.21	2,371.66	0	
<b>Total</b>	<b>11,524.81</b>	<b>40,824.93</b>	<b>11,145.64</b>	<b>63,495.38</b>

The electricity consumed from the grid is taken from the CFE invoices sent every month to the plant in order to charge for the electricity bill. The detailed consumption of the auxiliary electricity is shown in Table 7.

**Table 7: Auxiliary Electricity Used in MWh from October 1<sup>st</sup> 2007 to March 31<sup>st</sup>, 2009**

Period	2007	2008	2009	TOTAL
January	0	8.16	7.91	
February	0	5.96	6.60	
March	0	6.72	6.51	
April	0	5.76	0	
May	0	3.15	0	
June	0	8.47	0	
July	0	17.95	0	
August	0	10.01	0	
September	0	1.50	0	
October	2.02	3.07	0	
November	8.25	10.42	0	
December	11.80	10.53	0	
<b>Total</b>	<b>22.07</b>	<b>91.71</b>	<b>21.03</b>	<b>134.81</b>

The Net electricity generation by the Trojes project is the result of the Electricity generated minus the electricity consumed from the National Grid, as shown in Table 8.

**Table 8: Net Electricity Generation (MWh) from October 1<sup>st</sup>, 2007 to March 31<sup>st</sup>, 2009**

Period	2007	2008	2009	TOTAL
January	0	3,271.39	3,530.42	<b>6,801.81</b>
February	0	3,759.01	3,510.89	<b>7,269.90</b>
March	0	3,891.62	4,083.30	<b>7,974.92</b>
April	0	3,907.96	0	<b>3,907.96</b>
May	0	3,850.96	0	<b>3,850.96</b>
June	0	2,083.39	0	<b>2,083.39</b>
July	0	121.99	0	<b>121.99</b>
August	0	3,304.47	0	<b>3,304.47</b>
September	0	6,071.40	0	<b>6,071.40</b>
October	5,999.91	5,544.74	0	<b>11,544.65</b>
November	3,284.72	2,559.98	0	<b>5,844.70</b>
December	2,171.41	2,356.39	0	<b>4,527.80</b>
<b>Total</b>	<b>11,456.03</b>	<b>40,723.32</b>	<b>11,124.62</b>	<b>63,303.96</b>

MYOCEN delivers to INELEC operating reports in a daily basis according to the Monitoring requirements established in the Monitoring Plan of the registered PDD.

The emission reductions resulting from the project are calculated considering an Emission Factor of 0.531 TCO<sub>2</sub>e/MWh calculated *ex ante*, as established in the baseline methodology, and the Net Electricity Generation indicated in the Table 8.

As a result, we obtain Table 9 showing the ERs obtained during the monitoring period, considering the two deductions of 0.5% of the CERs generated from October to November 2007 and 0.2% of the CERs generated from November to December 2008.

**Table 9: Emission Reduction (0.531tonCO<sub>2</sub>e/MWh) from Electricity Generation (MWh)**

Period	2007	2008	2009	TOTAL
January	-	1,737.11	1,874.65	<b>3,611.76</b>
February	-	1,996.04	1,864.28	<b>3,860.32</b>
March	-	2,066.45	2,168.23	<b>4,234.68</b>
April	-	2,075.13	-	<b>2,075.13</b>
May	-	2,044.86	-	<b>2,044.86</b>
June	-	1,106.28	-	<b>1,106.28</b>
July	-	64.78	-	<b>64.78</b>
August	-	1,754.67	-	<b>1,754.67</b>
September	-	3,223.91	-	<b>3,223.91</b>
October	3,185.95	2,944.26	-	<b>6,130.21</b>
November	1,744.18	1,359.35	-	<b>3,103.54</b>
December	1,153.02	1,251.24	-	<b>2,404.26</b>
<b>Total</b>	<b>6,083.15</b>	<b>21,624.08</b>	<b>5,907.17</b>	<b>33,614.40</b>

A comparison between the ERs actually generated during the monitoring period (1.5 years) and the ERs estimated in the registered PDD is given in Table 10.


**Table 10: Emission Reduction Comparison PDD vs MR (tCO<sub>2</sub>e)**

Period (1.5yr)	2007	2008	2009	TOTAL
PDD	5,137.50	20,550.00	5,137.50	<b>30,825</b>
MR	6,083.15	21,624.08	5,907.17	<b>33,614.40</b>
<b>Difference</b>	<b>945.65</b>	<b>1,074.08</b>	<b>769.67</b>	<b>2,789.40</b>
<b>Difference (%)</b>	<b>18.41</b>	<b>5.23</b>	<b>14.98</b>	<b>9.05</b>

The amount of ERs generated by the project will vary annually according to the metered net generation output from Trojes. The estimations in the PDD are based on a grid emission rate of 0.531 tCO<sub>2</sub>e/MWh and an expected 38,700 MWh of electric-energy output per year, which will be 58,050 MWh for the current monitoring period (1.5 years). The actual annual generation for the period under consideration was 63,303 MWh. It is important to mention that the electricity generation of the project is conditioned mainly by 2 factors: 1) the water flow available as determined on the annual irrigation program of the CNA, as explained in section 4, and 2) the rainy season. For this monitoring period, the conditions of the project were favorable considering a heavy rainy season and therefore higher water availability, allowing an increase of the generation and, therefore an increase of 9% of the expected CERs in the PDD. This increase considers a 0.5% deduction of the ERs generated from October to November 2007, and a 0.2% deduction of the ERs generated from November to December 2008, as a conservative approach, as explained in section 5.

For further details see the monitoring spreadsheet "3rd\_Monitoring Report\_Trojes\_27abr09v5".

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