

**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 03 of 5/03/2012

### TROJES HYDROELECTRIC PROJECT

CDM registration reference number: 0649

Monitoring period 04 from 01/04/2009 to 31/03/2010 (first and last days included)

## SECTION A. General description of the project activity

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

The present monitoring report is based on the registered CDM PDD Trojes Hydroelectric Project Version 4 (registration date: 4/11/2006) and the corresponding monitoring procedures applied by the project participant. The baseline and monitoring methodology AMS-I.D. (version 08) applied in the PDD is also used as a reference.

The hydroelectric plant started commercial operation on 01/04/2003. A notification of changes from the project activity as described in the registered PDD was submitted via DOE to the EB on September 15, 2011 (accepted on 31/10/2011) in order to correct a mistake in the registered PDD regarding the statement of the installed capacity of the turbine and the generator. In the revised PDD, it is correctly stated that the installed capacity of the generator is 8 760 kW and that the installed capacity of the turbine is 10 576 kW. This change is also reflected in this monitoring report.

The correct determination and description of the installed capacities for the generator and the turbine has no impact on the overall operation or ability of the project activity to deliver emission reductions as stated in the registered PDD, because there is no physical change of the project activity, that is, the guaranteed output in the registered PDD and revised PDD are the same, 38.7 GWh.

The conditions of the installed capacity and the overall operation of the project activity are in line with the generation permit granted by the *Comisión Reguladora de Energía (CRE)*. 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.

So far, the project activity has carried out three CDM verifications for the monitoring periods from 01/04/2003 to 30/11/2006; 01/12/2006 to 30/09/2007 and 01/10/07 to 31/03/2009. This is the fourth verification process that aims at verifying real emission reductions that result from the implementation of the project activity during the monitoring period from 01/04/2009 to 31/03/2010.

The project consists of a hydropower plant at the existing dam of Trojes on the Barreras River near the border of the State of Michoacan and Guerrero. The land and the dam are owned by the Federal Government and the administrator *Comisión Nacional del Agua (CNA)*. The dam was built with the two-fold objective of (i) irrigation for the 53 Colima district and (ii) clean electricity generation. However, due to lack of funds the electricity generation was not installed before and needed the incentives of the CDM to be implemented. The project uses the existing pattern of irrigation flow releases to generate electricity. The project activity has a capacity under design conditions of 8 MW and an installed capacity of 8.7 MW, using the existing pattern of irrigation flow to generate electricity.

The total emission reductions archived in this 4<sup>th</sup> monitoring period from 01/04/2009 to 31/03/2010 are 10,543 tCO<sub>2</sub>.

**A.2. Project Participants**

Name of Party involved	Project participants	Kindly indicate if the Party involved wishes to be considered as Project participant (yes/no)
Mexico (host)	Hidroelectricidad del Pacifico, S. de R.L. de C.V.	No
Mexico (host)	Impulsora Nacional de Electricidad, S. de R.L. de C.V.	No
United Kingdom of Great Britain and Northern Ireland	BNP Paribas S.A.	No
Switzerland	BNP Paribas S.A.	No

**A.3. Location of the project activity:**

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 Michoacan. The Trojes project generates clean electricity in a rural area located in the Municipality of Pihuamo, State of Jalisco and the nearest city to the proposed project is Coalcoman, in the state of Michoacan. The power house is located at 18° 57'55'' North Latitude and 103° 23'48.0'' West Longitude.

**A.4. Technical description of the project**

The Trojes project is located in the Barreras River. It consists of a 8.7MW power plant at the existing Trojes dam, within the State of Michoacan. The dam was with the two-fold objective of (i) irrigation for the 53 Colima district and (ii) clean electricity generation. However, due to lack of funds the electricity generation was not installed before and needed the incentives of the CDM to be implemented. The project uses the existing pattern of irrigation flow releases to generate electricity.

The existing dam is a rock filled dam with an impervious clay core center and it was 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: Main Project characteristics**

Transmission line	2.5 km
Turbine nominal power	10,576 MW
Generator nominal power	8,760 kW
Design head	61.8 m
Design flow rate	15 m <sup>3</sup> /s
Project efficiency	88%
Project activity power under design conditions	8.0 MW

The actual installed capacity of the project is in line with the generation permit granted by the *Comisión Reguladora de Electricidad (CRE)*. According to this permit, the installed capacity is defined as 8 MW, which is the maximum amount allowed to be delivered to the national grid. This is the capacity that is considered in the registered PDD.

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

**Table 2: Technical Equipment**

Equipment	Specifications
<b>Generator</b>	ALSTOM No. G0N019 Type: SH 217/68/18 Year: 2002 Cos $\phi$ 0.95 nominal P= 8,760 kVA V = 8,600 V I= 505 A f:= 60 Hz 3 phases v= 400 rpm
<b>Turbine</b>	ALSTOM Type: Francis 10 576 kW Year: 2002 Serial No.: 19272 P= 7,040 kW Q = 10.26 m <sup>3</sup> /s n= 514.29 rpm
<b>Metering 1 (Main)</b>	Commissioning date: March 2003 Instrument Type: Electricity meter bidirectional Serial Number: S/N PR-0506A068-02 Manufacturer Model Nr.: ION 8400 Specific Location: Trojes Power Plant, CFE's Substation, Presa Trojes
<b>Metering 2 (Backup)</b>	Commissioning date: March 2003 Instrument Type: Electricity meter bidirectional Serial Number: N/S AR-0012A368-02 Manufacturer Model Nr.: ION 8400 Specific Location: Trojes Power Plant, CFE's Substation, Presa Trojes

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

The project applies the baseline and monitoring methodology "AMS-I.D. - Grid connected renewable electricity generation" Indicative simplified baseline and monitoring methodology selected small-scale CDM project activity (barrier analysis, baseline scenario development and baseline emission rate, using combined margin) for small grid-connected zero-emissions renewable electricity generation" (version 8).

**A.6. Registration date of the project activity:**

The CDM project activity was registered on 4/11/2006.

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

The first crediting period is from 01/04/2003 to 31/03/2010 (7-years renewable).

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

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Email: [casiopea.ramirez@enel.com](mailto:casiopea.ramirez@enel.com)

Enel Green Power Mexico is not a project participant

## **SECTION B. Implementation of the project activity**

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

The hydroelectric plant started commercial operation on 01/04/2003. Since then, the project has been operating as planned and described in the registered PDD. So far, the project activity has carried out three CDM verifications for the monitoring periods from 01/04/2003 to 30/11/2006; 01/12/2006 to 30/09/2007 and 01/10/07 to 31/03/2009. This is the fourth verification process that aims at verifying real emission reductions that result from the implementation of the project activity during the monitoring period from 01/04/2009 to 31/03/2010.

During this monitoring period, 20,000.84 MWh were delivered to the Mexican power grid and 145.48 MWh consumed for the grid, therefore a total of 19,855.37MWh are considered for this monitoring period. There have not been any events or situations that occurred during this monitoring period, which impact the applicability of the baseline and monitoring methodology. No changes from the project activity as described in the registered PDD were realized.

### **B.2. Revision of the monitoring plan**

The monitoring plan has not been revised.

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

There is no deviation requested for the current monitoring period.

### **B.4. Notification or request of approval of changes**

A notification of changes from the project activity as described in the registered PDD was submitted via DOE to the EB on September 15, 2011(accepted on 31/10/2011) in order to correct a mistake in the registered PDD regarding the statement of the installed capacity of the turbine and the generator. In the revised PDD, it is correctly stated that the installed capacity of the generator is 8 760 kW and that the installed capacity of the turbine is 10 576 kW.

## **SECTION C. Description of the monitoring system**

The monitoring methodology used by the project activity consists basically in metering the electricity generated and delivered to the grid by the project activity (net electricity). 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, and will be valid during the entire crediting period. The emission factor used for the first crediting period of the project is 0.531tCO<sub>2</sub>/MWh.

Monitoring the electricity generation data is a relatively simple process, as the Mexican power grid relies on a regulated metering setup established by the Federal Electricity Commission (CFE<sup>1</sup>), which is required for the invoicing of power generation. This means that for the CDM project the main role for monitoring data is keeping copies of the generation records from the CFE.

The quality of the net generation (Quality Control and Quality Assurance) is assured by carrying out double measurement:

1. Meter N/S AR-0012A368-02: this is the main electricity meter that is used by CFE, which also applies the measurement, control and QA/AC procedures. The project proponent does not have

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<sup>1</sup> in Spanish: *Comisión Federal de Electricidad (CFE)*

access to this meter. Therefore, it is the CFE that officially determines the electricity generated by the project on a monthly basis.

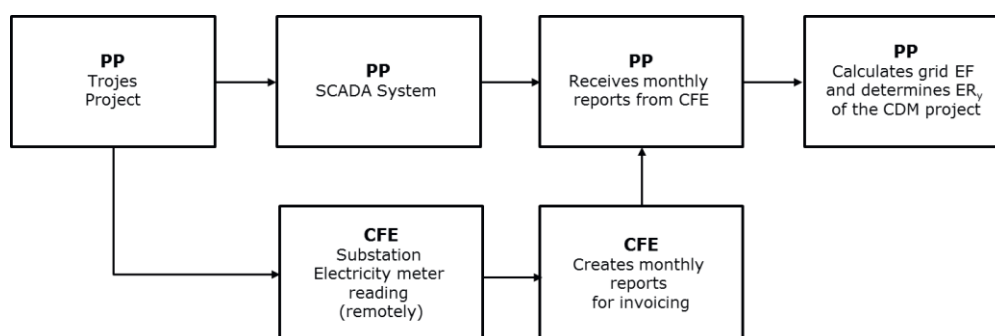
2. Meter S/N PR-0506A068-02: this is the backup meter at Trojes power plant, which is also controlled by CFE and applies the same measurement, control and QA/QC procedures of the main meter. Only CFE has access to this meter.

The Interconnection Agreement signed with CFE defines the calibration periods for the electricity meters that measure the net energy delivered to the grid. The meters accuracy shall assure that the measurement error does not exceed 0.2% of full-scale rating, which is annually checked by CFE. The net electricity generation registered by the meters is used for invoicing and calculation of real emission reductions achieved by the project activity.

On November 5, 2007 CFE annual calibration process took place at Trojes plant. The main 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 main meter for CFE invoices. The meter was calibrated and tested to corroborate it complies with CFE requirements. Therefore, during the 2008 calibration, the only available meter was the S/N PR-0506A068-02.

On May 8, 2009 CFE returned the N/S AR-0012A368-02 meter calibrated, which is now operating as the backup meter. Finally, on June 27, 2009 the annual calibration took place, complying with the required parameters.

MYOCEN team supports Enel Mexico to collect the required 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 back up the information presented in the monitoring report. The rest of the data is collected by the Regulatory Area of Enel Mexico. In the following a diagram of the net energy measurement and data collection is given.



## 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

<b>Data / Parameter:</b>	<b>EF<sub>v</sub></b>
<b>Data unit:</b>	tCO <sub>2</sub> /MWh
<b>Description:</b>	Emission factor of the power grid <i>ex-ante</i>
<b>Source of data used:</b>	Trojes Hydroelectric Project registered PDD, version 4 dated August 31, 2011. All input data for the calculation of the EF come from the annual reports "Prospectiva del Sector Eléctrico 2003-2012, 2004-2013, 2005-2014" of the <i>Secretaría de Energía</i> based on information reported by

	<i>Comisión Federal de Electricidad (CFE)</i> and the 1996 IPCC Guidelines on National GHG Inventories.
Value(s):	0.531 tCO <sub>2</sub> /MWh
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions
Additional comment:	NA

## **D.2. Data and parameters monitored**

As per the registered PDD the following parameters are monitored.

Data / Parameter:	EG <sub>v</sub>				
Data unit:	MWh				
Description:	Net electricity supplied to the grid by the project activity				
Measured /Calculated /Default:	Directly measured every 5 minutes. Monthly recording				
Source of data:	Data supplied by the CFE				
Value(s) of monitored parameter:	20,000.84 MWh				
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions				
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The energy meters involved in the monitoring process are:				
	Model	No.	Code	Last calibration events	
	ION 8400	N/S AR-0012A368-02	VM7Y	05/11/07	27/06/09
	ION 8400	S/N PR-0506A068-02	VM7Y	05/12/08	05/11/09
	Both meters follow the accuracy class established by the CFE: ± 0.2%				
	<div>1. Meter N/S AR-0012A368-02: this is the main electricity meter that is read by CFE, which also applies the measurement, control and QA/AC procedures. The project proponent does not have access to this meter. Therefore it is the CFE that officially determines the electricity generated by the project.</div> <div>2. Meter S/N PR-0506A068-02: this is the backup meter at Trojes power plant, which is also controlled by CFE and applies the same measurement, control and QA/AC procedures of the main meter. Only CFE has access to this meter.</div>				
Measuring/ Reading/ Recording frequency:	Measurements are made each five minutes. The data is read on an hourly basis and registered in daily, monthly and annual reports.				
Calculation method (if applicable):	NA				
QA/QC procedures applied:	QA/QC is guaranteed through the measurement procedures that are applied by a third party (CFE) and the annual calibration of electricity meters.				

<b>Data / Parameter:</b>	<b>EG<sub>y</sub></b>
Data unit:	MWh
Description:	Auxiliary electricity consumed from the grid

Measured /Calculated /Default:	Directly measured. Monthly recording						
Source of data:	Data supplied by the CFE						
Value(s) of monitored parameter:	145.48 MWh						
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions						
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	<p>The energy meters involved in the monitoring process are:</p> <table border="1"> <thead> <tr> <th>Model</th><th>No.</th></tr> </thead> <tbody> <tr> <td>ION 8400</td><td>7EY981</td></tr> <tr> <td>Vectron SVX4SR</td><td>0X5F62</td></tr> </tbody> </table> <p>The meters follow the accuracy class established by the CFE: <math>\pm 0.2\%</math></p> <ol style="list-style-type: none"> <li>1. Meter 7EY981 (or N/S AR-0012A368-02): is the main electricity bidirectional meter that is read by CFE, which also applies the measurement, control and QA/AC procedures. The project proponent does not have access to this meter. Therefore it is the CFE that officially determines the electricity consumed and generated by the project.</li> <li>2. Meter 2X3W60: this is the meter recording the auxiliary electricity consumed in OM tariff and is also controlled exclusively by CFE.</li> </ol>	Model	No.	ION 8400	7EY981	Vectron SVX4SR	0X5F62
Model	No.						
ION 8400	7EY981						
Vectron SVX4SR	0X5F62						
Measuring/ Reading/ Recording frequency:	Measurements are made each five minutes. The data is read on an hourly basis and registered monthly reports.						
Calculation method (if applicable):	NA						
QA/QC procedures applied:	QA/QC is guaranteed through the measurement procedures that are applied by a third party (CFE).						

## SECTION E. Emission reductions calculation

### E.1. Baseline emissions calculation

Baseline emissions are CO<sub>2</sub> emissions from electricity generation in fossil fuel fired power plants that are displaced due the project activity.

The project uses the combined margin methodology to compute the baseline emission rate, which reflects the proposed project's effects on both the operating margin (affecting the operation of current and/or future power plants) and the build margin (delaying or avoiding the construction of future power plants). The baseline emission rate is thus:

$$BaselineEmissionRate(gCO_2/kWh) = \frac{OM + BM}{2}$$

Where:

OM = the calculated operating margin value factor (in grams CO<sub>2</sub>/kWh) of the weighted average of the last 3 years data, and

BM = the calculated build margin value factor (in grams CO<sub>2</sub>/kWh).



The operating margin and build margin emission coefficients have been determined using data on electricity generation and CO<sub>2</sub> emissions published by Mexican Energy Secretariat (SENER) *Emisiones del Sector Eléctrico* (CFE).

For some power plants operated by independent power producers no CO<sub>2</sub> emissions and fuel consumption data are publicly available and a proxy for these plants' emission factor has been determined, using conservative assumptions for the efficiency of these plants.

Total emissions, E, are given as the sum product of the fuels used in generation multiplied by the specific CO<sub>2</sub> emission rate for that fuel.

$$E(\text{tonCO}_2 / \text{year}) = \sum_j E_j$$

Where:

$E_j$  = CO<sub>2</sub> emissions per year in tons for fuel j.

For each  $E_j$ , the emissions are calculated as:

$$E_j = Q_j * F_j$$

Where:

$Q_j$  = quantity of fuel j in year, and

$F_j$  = CO<sub>2</sub> emissions per unit for each fuel j.

Thus E can be calculated directly as the following sum product:

$$E = \sum_j Q_j * F_j \text{ for all } j$$

The Operating Margin Emissions are defined as the generation-weighted average emissions per electricity unit (g/kWh), excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation and are derived from the following equation:

$$OM = \sum_j E_j \div K_j$$

Where:

$K_j$  = electricity generation from fuel j, and generation by source is listed in the *Prospectiva* (p. 70). The weighted average OM for the years 2002, 2003 and 2004 is 659 g/kWh.

The Build Margin Emissions are defined as the emissions from the most recent 20% of the generating units built.

$$BM(\text{tCO}_2 / \text{MWh}) = \frac{\sum_{j=1}^m e_j \times G_j}{\sum_{j=1}^m G_j} = \frac{e_1 \times G_1 + e_2 \times G_2 + \dots e_m \times G_m}{G_1 + G_2 + \dots G_m}$$

The Build Margin for 2004 is 403 g/KWh

The CM is then:

$$BaselineEmissionRate(gCO_2/kWh) = \frac{659 + 403}{2} = 531$$

## E.2. Project emissions calculation

The proposed CDM project activity is a hydroelectric power plant that does not generate project GHG emissions. This is in accordance with methodology AMS-I.D. version 08

$$PE_y = 0 \text{ tCO}_2$$

## E.3. Leakage calculation

The project activity does not result in any leakage emissions.

$$LE_y = 0 \text{ tCO}_2$$

## E.4. Emission reductions calculation / table

Emission reductions are calculated as follows:

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

Total baseline emissions:  $BE_y = 10,543 \text{ tCO}_2$

Total project emissions:  $PE_y = 0 \text{ tCO}_2$

Total leakage:  $LE_y = 0 \text{ tCO}_2$

**Total emission reductions:  $ER = 10,543 \text{ tCO}_2$**

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

In the PDD the annual emission reductions were estimated to be 20,550 tCO<sub>2</sub>. As an approximation, the equivalent for this monitoring period is determined by calculating the emission reductions proportionally to the length of this period (12 months from 01/04/2009 to 31/03/2010). This gives the following comparison, which shows that the actual values are below the *ex-ante* estimation.

Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
<b>Emission reductions (tCO<sub>2</sub>e)</b>	Equivalent for this monitoring period: 20,550	10,543

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

The amount of emission reductions 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 0.531tCO<sub>2</sub>e/MWh and an expected 38,700 MWh of electric-energy output per year. The actual annual net generation for the period under consideration was 20,000.84 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 *Comisión Nacional del Agua*, and 2) the rainy season. For this monitoring period, the rainy season was not favorable, reporting a diminution of the generation and, therefore a decrease of 48.6% of the expected CERs in the PDD.

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### History of the document

Version	Date	Nature of revision
01	EB 54, Annex 34 28 May 2010	Initial adoption.
<b>Decision Class:</b> Regulatory <b>Document Type:</b> Guideline, Form <b>Business Function:</b> Issuance		