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

CONTENTS

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

MONITORING REPORT
Version 1 (14/11/2011)
San Jacinto Tizate Geothermal Project
Reference Number: 0198
7th Monitoring Period: 30/06/2009 - 31/12/2010

SECTION A. General description of the project activity

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

>>

1. **Purpose of the project activity**
   San Jacinto Tizate Geothermal project is currently operating at 10 MW but will be undergoing a two-phase 72 MW expansion. The current 10MW will be decommissioned upon the successful deployment of the 72MW (expected to be completed in 2012). Development of both phases will be completed with the addition of two 36 MW rated capacity steam turbines manufactured by Fuji Electric. Construction for Phase I and Phase II is concurrent, and the completed expansions are expected to go on-line in late 2011 and in last quarter of 2012, respectively

2. **Brief description of the installed technology and equipments;**

   The San Jacinto Tizate Geothermal project is currently operating with 2 x 5MW backpressure units. Steam is transferred from production wells to a steam separator, which separates the two-phase fluid into brine and saturated steam; the brine portion is re-injected back into the ground and the saturated steam is used to move two backpressure turbines, which then drive the electrical generators.

3. Relevant dates for the project activity (e.g. construction, commissioning, continued operation periods, etc.).
   - The San Jacinto Tizate geothermal project was registered as a CDM project by the UNFCCC on 8 April 2006 under reference number 0198. Construction of the project activity started in April 2004 and it went into commercial operation in June 2005.

   - Phase I Expansion 36MW-Fuji Turbines to begin Commercial opertaions in December 2011 (under comissioning)

   - Phase II 36 MW-Fuji Turbines, to begin Commercial operations last quarter of 2012.

4. Total emission reductions achieved in this monitoring period.

   - For the monitoring period of 549 days a total of **107,747** MWh Net were generated. This resulted in emission reductions of **76,651** tone CO_2 eq.

A.2. Project Participants

>>

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	
Nicaragua (Host Party)	Polaris Energy Nicaragua S.A (previously called San Jacinto Power SA)	Private Entity
UK and Northen Ireland	Blues Travelers Environmental Limited	Private Entity
UK and Northen Ireland Switzerland (involved indirectly)	EcoSecurities	Private Entity

A.3. Location of the project activity:

>>

The San Jacinto Tizate geothermal project is located in the town of San Jacinto, municipality of Telica, Department of León, Nicaragua. The geographical location of the project based on the following UTM-NAD27-16N Coordinate System:

Table 1: San Jacinto Tizate geothermal project geographical location

Vertex	Northing	Easting
A	1396000	519000
B	1396000	527000
C	1392000	519000
D	1392000	523000
E	1390000	523000
F	1390000	527000
B	1396000	527000

A.4. Technical description of the project

>>

Currently, the Project operates 2 x 5 MW back pressure turbines with direct exhaust of steam to the atmosphere via dedicated silencers; the turbines have a design speed of 6183 rpm and are connected to 2 x 6250 kVA generators, each driven individually by 5MW back pressure turbines through a mechanical gear reducer.

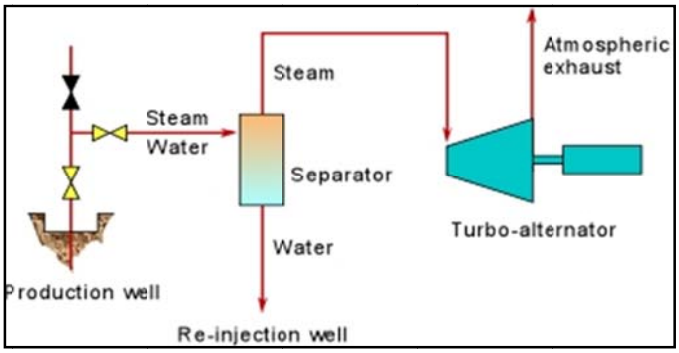

Figure 1: Back Pressure Geothermal Unit Concept / Source: International Geothermal Association.

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

>>

The calculation of emission reductions applies methodology ACM0002, version 04 -*Consolidated methodology for grid-connected electricity generation from renewable sources.*

A.6. Registration date of the project activity:

>>

The San Jacinto Tizate geothermal project was registered as a CDM project by the UNFCCC on 8 April 2006 under reference number 0198.

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

>>

Start date of crediting period: 01/06/2005
Choice of crediting period: renewable crediting period

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

>>

Contact information for the person/entity responsible for the Monitoring Report (MR) is Mr. José Antonio Rodríguez Rivas, VP Operations and COO for Latin America; his registered address is Ofiplaza El Retiro #735 | Edificio # 7 | Rotonda El Periodista |150 mts al Sur |Managua, Nicaragua. Tel (505) 2253-8340; Fax (505) 2253-8344.

SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

>>

The project has been generating energy since June 2005. Currently, Phase I 36 MW is under commissioning and Phase II 36 MW is under construction.

During the construction stage for Phase I, two plant outages were required (mainly for mechanical and electrical work connection). They took place as follows:

1. March 2010 (mechanical works and partial construction of 138kV II Circuit Line). During this outage, major maintenance work was performed on Unit # 2. As for Unit # 1, a preventive inspection was carried out.
2. August 2010 (mechanical works and partial construction of 138kV II Circuit Line). During this outage, minor inspection work was performed on both Units.
3. No further events to report.

B.2. Revision of the monitoring plan

>>

Monitoring plan has not been revised.

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

>>

No request for deviation has been applied to this monitoring period.

B.4. Notification or request of approval of changes

>>

No notification or request of approval of changes has been made.

SECTION C. Description of the monitoring system

>>

The actual-running monitoring system consists of the following main exercises exemplified in the illustration below; each step covers numerous actions that are depicted in the subsequent tables under section D of this Document.

Step	General Procedure	Unit/Area Responsible
1	Management	- Power Plant Manager (in charge of CDM- PDD).
2	Data Monitoring	- Electrical and I&C Coordinator with the support of the Operations Coordinator. - Regional Geochemical Laboratory.
3	Calculations of CERs	- Electrical and I&C Coordinator with the support of the Operations Coordinator. - Power Plant Manager – review process and final submittal.
4	MR Completion	- Power Plant Manager - VP Business Development
5	CERs Verification and Request of Issuance	- Authorized DOE appointed by PENSA
6	Data Storage	- Power Plant Manager - VP Business Development - Electrical Coordinator

Figure 2: Monitoring System Process

Notes:

1. QA/QC procedure is achieved all throughout the process by all parties involved at different stages; nonetheless, stages 2, 3 and 4 require the most effort. Once the MR is prepared in its earliest version, it is reviewed by the responsible parties at point 4. Once evaluated and modified accordingly, it is sent officially to the DOE. Any changes suggested by the DOE are implemented by the responsible parties at point 4 (this may take various *back-and-forth* submittals).
2. Both the main revenue meter and the back-up meter are calibrated in a yearly basis in accordance to the PPA Contract. They have a precision of 0.06% and comply with ANSI C-12 y IEC 687.
3. The downloading of the data follows an established and clear internal procedure.
4. The calculation of CERs follows an established and clear method as well.
5. Emergency procedures for each parameter have been considered.

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

The following two (2) parameters were established at the registration period and have suffered no change since then. They were either not monitored or calculated.

>>

Table 2: Global Warming Potential

Data / Parameter:	**$GWPCH_4$**
Data unit:	$t.CO_2$ / $t.CH_4$
Description:	Global warming potential of methane, valid for the relevant commitment period.
Source of data used:	IPCC
Value(s) :	21(default value for the first commitment period)[1]
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	The value is used for calculating project emissions ($PE_{GP,y}$) from CH_4 mass fraction in geothermal steam sampling
Additional comment:	Nil.

>>

Table 3: Calculated Emissions Factor for Project

Data / Parameter:	**$EF_{Grid,CM,y}$**
Data unit:	tCO_2/MWh
Description:	Calculated Emissions Factor for the Nicaraguan National Grid.
Source of data used:	Project Design Document (CDM-PDD)
Value(s) :	0.754
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This factor is used for Base Line Emission Calculation.
Additional comment:	Nil.

[1] *See http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html as reference.*

D.2. Data and parameters monitored

D.2.1. Parameters used to calculated base line emissions

Electricity supplied (delivered) to the grid is obtained from the commercial revenue metering system. The Net Energy delivered in each hour is multiplied by the Emission Factor to produce the Baseline Emission. Table 4 below illustrates how net electricity is monitored.

Table 4: Net Electricity Monitoring

Data / Parameter:	**EG_y**
Data unit:	**MWh**
Description:	Net electricity supplied to the National Grid by the Project Activity.
Measured /Calculated /Default:	Measured parameter.
Source of data:	Electrical Revenue Meters.

Value(s) of monitored parameter:

Month	**Electricity delivered to the Grid (MWh)**	**Electricity Consumed from the Grid (MWh)**	**EG_y (MWh) Net Electricity delivered to Grid**
June/30/2009	214	0.00	214
Jul-09	6,543	1.44	6,541
Aug-09	6,524	1.22	6,522
Sep-09	6,265	1.98	6,263
Oct-09	6,647	0.71	6,646
Nov-09	6,326	0.84	6,325
Dec-09	6,621	0.36	6,621
Jan-10	6,623	0.34	6,623
Feb-10	5,936	0.72	5,935
Mar-10	2,945	2.11	2,943
Apr-10	5,360	2.17	5,358
May-10	5,094	2.66	5,092
Jun-10	6,809	1.58	6,807
Jul-10	6,710	0.77	6,710
Aug-10	3,378	1.89	3,376
Sep-10	5,943	2.09	5,941
Oct-10	6,803	0.46	6,803
Nov-10	6,453	0.13	6,453
Dec-10	6,573	0.00	6,573
Total:	**107,768**	**21.47**	**107,747**

Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Calculation of Project's baseline emissions

<table>
<tr><td>Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)</td><td>
<table>
<tr><th>Parameters</th><th>Main Meter</th><th>Back-up Meter</th></tr>
<tr><td>Make</td><td>E.I.G</td><td>E.I.G</td></tr>
<tr><td>Type</td><td>NEXUS 1262</td><td>NEXUS 1262</td></tr>
<tr><td>Serial Number</td><td>135803</td><td>135802</td></tr>
<tr><td>Precision</td><td>0.06%</td><td>0.06%</td></tr>
<tr><td>Compatibility</td><td>MV-90</td><td>MV-90</td></tr>
<tr><td>Communication Protocol</td><td>Modbus y DNP 3.0</td><td>Modbus y DNP 3.0</td></tr>
<tr><td>Norm</td><td>ANSI C-12 y IEC 687</td><td>ANSI C-12 y IEC 687</td></tr>
<tr><td>Last Calibrated</td><td>September 08, 2009
September 07, 2010</td><td>September 08, 2009
September 07, 2010</td></tr>
<tr><td>Due for next calibration</td><td>September 08 2011,</td><td>September 08 2011</td></tr>
</table>
</td></tr>
<tr><td>Measuring/ Reading/ Recording frequency:</td><td>Commercial and official metering:
The revenue meters measures energy automatically and constantly. They are programmed to integrate the instantaneous values each fifteen (15) minutes and accumulative values are registered hourly in the massive memory of the principal and back-up meter.

The Shift Engineer accesses the meter data base for downloading and saving of the daily, weekly and monthly values. Daily, all values are sent via electronically by the Shift Engineer to the Grid Operator, the Utility Company and PENSA Management.

Also, once a month, Utility Personnel downloads the readings in situ

Monitoring/Recording:

This parameter is continuously measured and daily recorded. As per CDM-PDD, its recording frequency is yearly as well (kept in monthly reports). The Shift Engineer examines the data on a daily basis as part of his daily routine. The recorded data is downloaded and distributed as mentioned above.

The Operations Coordinator is the person ultimately responsible for guaranteeing the whole process.</td></tr>
<tr><td>Calculation method (if applicable):</td><td>Net Electricity delivered to Grid, EG_y = [Electricity delivered to the Grid (MWh)] - [Electricity Consumed from the Grid (MWh)]</td></tr>
<tr><td>QA/QC procedures applied:</td><td>Quality is assured following plant established procedures, good practices, and training of operations personnel. Two certified electricity meters are installed in tandem arrangement in full compliance of the local Nicaraguan Electricity Market Rules and Procedures. These Rules are publicly available on the Grid Operator Website (www.cndc.org.ni) under "Normativas de Operacion Comercial." and can be checked for reference.[2] No Market Agent is allowed to participate in the local Nicaraguan Electrical Market unless is in full compliance with the aforesaid Rules.</td></tr>
<tr><td>Emergency procedures for the monitoring system</td><td>As per Commercial Annex in the "Normativa de Operacion Comercial."</td></tr>
</table>

[2] *Inside of the Commercial Annex from the "Normativas de Operación Comercial", technical requirements for the revenue meters can be found. That in itself serves as QA/QC procedures for all Market Agents.*

D.2.2. Parameters used to calculate project emissions

The gathered data for monitoring emissions from the project activity, due the condensable gases confined in the geothermal steam, were:

- Mass quantity of steam produced during the monitored period.
- Average mass fraction of CO_2 in the produced steam.
- Average mass fraction of CH_4 in the produced steam.

D.2.2.1. Mass quantity of steam produced during the monitoring period, Ms,y.

Table 5 depicted below exemplifies how this parameter has been monitored during the MR period.

Data / Parameter:	**Ms,y**
Data unit:	**Tonnes**
Description:	Mass quantity of steam produced during the monitoring period.
Measured /Calculated /Default:	Measured parameter.
Source of data:	Monthly Production Report
Value(s) of monitored parameter:	
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Calculation of Project's emissions

Month	Unit 1 Steam Demand (tones/hr)	Unit 2 Steam Demand (tones/hr)	Total tones (Ms,y)
June/30/2009	1,872	1,836	3,708
Jul-09	56,481	56,910	113,391
Aug-09	56,489	57,185	113,674
Sep-09	52,982	54,391	107,373
Oct-09	56,085	57,738	113,823
Nov-09	53,447	54,808	108,255
Dec-09	55,948	57,938	113,886
Jan-10	56,549	58,253	114,802
Feb-10	50,463	52,314	102,777
Mar-10	26,019	24,525	50,544
Apr-10	44,880	45,075	89,955
May-10	49,844	31,061	80,905
Jun-10	54,738	51,488	106,226
Jul-10	53,896	51,075	104,971
Aug-10	26,476	26,561	53,037
Sep-10	47,300	47,188	94,488
Oct-10	54,001	53,437	107,438
Nov-10	50,933	50,136	101,069
Dec-10	51,719	51,029	102,748
Total:	**900,122**	**882,948**	**1,783,070**

<table>
<tr><td>Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)</td><td>
<table>
<tr><th></th><th>Unit 1</th><th>Unit 2</th></tr>
<tr><td>Brand</td><td>Rosemount</td><td>Rosemount</td></tr>
<tr><td>Model</td><td>3051HD2A22AD21AB6L4T1</td><td>3051HD2A22AD21AB6L4T1</td></tr>
<tr><td>Type</td><td>DP Transmitter (Orifice Plate)</td><td>DP Transmitter (Orifice Plate)</td></tr>
<tr><td>Serial Number</td><td>610083</td><td>609610</td></tr>
<tr><td>Installation Date[3]</td><td>June 2005</td><td>June 2005</td></tr>
<tr><td>Calibration Date</td><td>March 2010</td><td>March 2010</td></tr>
<tr><td>Accuracy Class</td><td></td><td></td></tr>
<tr><td>Calibration Frequency</td><td>Every 2 years.</td><td>Every 2 years.</td></tr>
</table>
</td></tr>
<tr><td>Measuring/ Reading/ Recording frequency:</td><td>Monitoring frequency is set daily as per PDD but Operations takes readings hourly. The Operator saves the data in the data base for further reporting.</td></tr>
<tr><td>Calculation method (if applicable):</td><td>Quantity of Steam (t/h) = ∑[Unit 1 flow rate (t/h) + Unit 2 flow rate (t/h)][4]</td></tr>
<tr><td>QA/QC procedures applied:</td><td>Quality is assured following plant established procedures, good practices, and training of operations personnel.</td></tr>
<tr><td>Emergency procedures for the monitoring system:</td><td>In case the Differential Pressure Transmitter fails, the steam quantity passing through the Generating Units can be estimated using the electrical production of the plant (MW/MWh) and the related efficiency, this being: ≅15 t of steam per MW.</td></tr>
</table>

The steam flow measurement is an indirect measurement achieved by the pressure difference (DP) created by an orifice plate. This pressure difference is measured by the differential pressure transmitter which in turn calculates the steam flow. They are located at the discharge outlet of each Unit's stream scrubbers. See picture below as reference.

The instruments used to calibrate the flow meters are the Fluke Model 743B process calibrators and the Fluke 700P07 pressure module as well as the Hart 475 communication protocol.

Figure 2: Location of steam flow transmitters (outlet of Unit's steam scrubbers).

[3] *The calibration is made in house using previously calibrated patterns. Certificates of these calibrations are available for verification at site.*

[4] *These values are taken by the Operator in hourly basis; the total value per period is the sum of all hours covered in this MR for both Units.*

D.2.2.2. Average Mass fraction of CH_4 in produced steam

Table 6 depicted below exemplifies how this parameter has been monitored during the MR period.

Data / Parameter:	**$\omega Main,CH_4$**
Data unit:	**tCH_4/t steam**
Description:	Average mass fraction of CH_4 in produced steam.
Measured /Calculated /Default:	Measured parameter.
Source of data:	NCG Report from LaGeo Geo-Chemical Laboratory.
Value(s) of monitored parameter:	

Date	Time	Location		CH_4 (mmoles/100 moles)	CH_4 tonnes/tonne	Average CH_4 tonnes/tonne
05/07/09	1:00 PM	Unit 1	In	0.1432	1.27628E-06	
05/07/09	12:40 PM	Unit 1	Out	0.1394	1.24173E-06	
05/07/09	11:40 AM	Unit 2	In	0.1567	1.39637E-06	
05/07/09	10:30 AM	Unit 2	Out	0.1625	1.44800E-06	1.34059E-06
02/10/09	9:55 AM	Unit 1	In	0.0598	5.32582E-07	
02/10/09	9:50 AM	Unit 1	Out	0.0531	4.73468E-07	
02/10/09	10:40 AM	Unit 2	In	0.0581	5.17973E-07	
02/10/09	10:35 AM	Unit 2	Out	0.0578	5.14693E-07	5.09679E-07
27/01/10	9:52 AM	Unit 1	In	0.1063	9.47404E-07	
27/01/10	10:48 AM	Unit 1	Out	0.0292	2.60161E-07	
27/01/10	11:40 AM	Unit 2	In	0.0942	8.39537E-07	
27/01/10	12:34 AM	Unit 2	Out	0.0950	8.46341E-07	7.23361E-07
23/04/10	9:05 AM	Unit 1	In	0.1159	1.03267E-06	
23/04/10	9:40 AM	Unit 1	Out	0.1077	9.59607E-07	
23/04/10	11:00 AM	Unit 2	In	0.1112	9.90792E-07	
23/04/10	10:20 AM	Unit 2	Out	0.1147	1.02198E-06	1.00126E-06
20/08/10	9:00 AM	Unit 1	In	0.0830	7.39114E-07	
20/08/10	9:20 AM	Unit 1	Out	0.0827	7.36780E-07	
20/08/10	10:45 AM	Unit 2	In	0.0889	7.92522E-07	
20/08/10	10:05 AM	Unit 2	Out	0.0818	7.28894E-07	7.49328E-07
14/12/10	10:07 AM	Unit 1	In	0.0744	6.63127E-07	
14/12/10	10:20 AM	Unit 1	Out	0.0732	6.52354E-07	
14/12/10	11:10 AM	Unit 2	In	0.0706	6.28672E-07	
14/12/10	11:15 AM	Unit 2	Out	0.0768	6.84091E-07	6.57061E-07

Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Used for the calculation of project's emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Laboratory equipment from LaGeo Geochemical laboratory. Certificates may be shown at site during visit.
Measuring/ Reading/ Recording frequency:	Recurring monitoring every four months.

Calculation method (if applicable):	The average mass fraction of CH_4 in the produced steam is determined using a gas chromatographer. The geothermal steam samples are analyzed in the Geo-chemical Laboratory of LaGeo to determine the mass fraction of methane in present in the steam.[5] LaGeo laboratory is accredited by "*El Consejo Nacional de Ciencia y Tecnología*" under "*Registro No. LEA-09:03*" and Norm **NSR ISO/IEC 17025:2005**[6].
QA/QC procedures applied:	Quality is assured following plant established procedures, good practices, and training of operations personnel. PENSA O&M personnel are appointed to support LaGeo personnel while samples are being taken. A Safe Work Permit is issued to guarantee proper management of the sample taking process. Other internal process from LaGeo Laboratory may apply. Available upon request at site.
Emergency procedures for the monitoring system:	PENSA and LAGEO have a strong and good relationship; in case this lab could not perform the NCG testing, PENSA may contact another Regional Laboratory to perform the sampling and analysis. The Nicaraguan Ministry of Energy and Mines is setting up a well-equipped laboratory to carry out these tests.

[5] *As explained above, the samples are taken in situ by LaGeo personnel every four months; these samples are then taken to El Salvador where the Geo-Chemical Lab is located. The results are submitted electronically no later than two weeks. All results are available for scrutiny at site.*

[6] *See http://www.conacyt.gob.sv/ for further references. The Certificates are valid for the MR period.*

D.2.2.3. Average Mass fraction of CO_2 in produced steam

Table 7 depicted below exemplifies how this parameter has been monitored during the MR period.

Data / Parameter:	**$\omega Main,CO_2$**
Data unit:	**tCO_2/t steam**
Description:	Average mass fraction of CO_2 in produced steam.
Measured /Calculated /Default:	Measured parameter.
Source of data:	NCG Report from LaGeo Geo-Chemical Laboratory.

Value(s) of monitored parameter:

Date	Time	Location		CO_2 (mmoles/100 moles)	CO_2 tonnes/tonne	Average CO_2 tonnes/tonne
05/07/09	1:00 PM	Unit 1	In	104.882	0.0025591216	
05/07/09	12:40 PM	Unit 1	Out	99.6523	0.0024315152	
05/07/09	11:40 AM	Unit 2	In	79.6889	0.0019444096	
05/07/09	10:30 AM	Unit 2	Out	82.2677	0.0020073321	0.002235595
02/10/09	9:55 AM	Unit 1	In	106.1633	0.0025903845	
02/10/09	9:50 AM	Unit 1	Out	107.4227	0.0026211143	
02/10/09	10:40 AM	Unit 2	In	107.5214	0.0026235214	
02/10/09	10:35 AM	Unit 2	Out	104.5960	0.0025521434	0.002596791
27/01/10	9:52 AM	Unit 1	In	107.1140	0.0026135805	
27/01/10	10:48 AM	Unit 1	Out	110.2847	0.0026909470	
27/01/10	11:40 AM	Unit 2	In	107.7678	0.0026295337	
27/01/10	12:34 AM	Unit 2	Out	108.5553	0.0026487490	0.002645703
23/04/10	9:05 AM	Unit 1	In	107.3100	0.0026183640	
23/04/10	9:40 AM	Unit 1	Out	106.2100	0.0025915240	
23/04/10	11:00 AM	Unit 2	In	105.1600	0.0025659040	
23/04/10	10:20 AM	Unit 2	Out	106.7900	0.0026056760	0.002595367
20/08/10	9:00 AM	Unit 1	In	112.4634	0.0027441078	
20/08/10	9:20 AM	Unit 1	Out	109.6884	0.0026763960	
20/08/10	10:45 AM	Unit 2	In	109.5639	0.0026733594	
20/08/10	10:05 AM	Unit 2	Out	111.4575	0.0027195628	0.002703357
14/12/10	10:07 AM	Unit 1	In	83.8895	0.0020469027	
14/12/10	10:20 AM	Unit 1	Out	81.3144	0.0019840702	
14/12/10	11:10 AM	Unit 2	In	80.0259	0.0019526322	
14/12/10	11:15 AM	Unit 2	Out	82.1912	0.0020054663	0.001997268

Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Used for the calculation of project's emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Laboratory equipment from LaGeo Geochemical laboratory. Certificates may be shown at site during visit.

Measuring/ Reading/ Recording frequency:	Recurring monitoring every four months.
Calculation method (if applicable):	The average mass fraction of CO_2 in the produced steam is calculated through a laboratory analysis of steam samples carried out by LaGeo Geo-Chemical Laboratory.[7] LaGeo laboratory is accredited by "*El Consejo Nacional de Ciencia y Tecnología*" under "*Registro No. LEA-09:03*" and Norm **NSR ISO/IEC 17025:2005**[8].
QA/QC procedures applied:	Quality is assured following plant established procedures, good practices, and training of operations personnel. PENSA O&M personnel are appointed to support LaGeo personnel while samples are being taken. A Safe Work Permit is issued to guarantee proper management of the sample taking process. Other internal process from LaGeo Laboratory may apply. Available upon request at site.
Emergency procedures for the monitoring system:	PENSA and LAGEO have a strong and good relationship; in case this lab could not perform the NCG testing, PENSA may contact another Regional Laboratory to perform the sampling and analysis. The Nicaraguan Ministry of Energy and Mines is setting up a well-equipped laboratory to carry out these tests.

Note:

- For the aforementioned analysis, information on the applied technique and equipment used are available upon request.

[7] *As explained above, the samples are taken in situ by LaGeo personnel every four months; these samples are then taken to El Salvador where the Geo-Chemical Lab is located. The results are submitted electronically no later than two weeks. All results are available for scrutiny at site.*

[8] *See http://www.conacyt.gob.sv/ for further references. The Certificates are valid for the MR period.*

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

In full accordance with the CDM-PDD, baseline emissions are calculated as follows:

BE_y = $[EG_y\,(MWh)]$ x $[EF\ (t\ CO_2/MWh)]$ (Equation 1)

Where:

BE_y = Emission reductions given in tones of CO_2 equivalent in year y.[9]

EG_y = Net electricity supplied to the grid by the project activity.

EF = Emission factor equal to **0.754 tCO_2/MWh**, set *ex-ante* according to the PDD.

Baseline emissions described in Equation 1 are calculated by means of the Excel Spreadsheets identified as "*Carbon Credit Data Analysis from 30 June 2009 up to 31 Dec 2009 (Version 1).xlsx*" and "*Carbon Credit Data Analysis from 01 January 2010 up to 31 Dec 2010 (Version 1).xlsx*". The subsequent steps are followed:

1. Step 1: input variable value of net electricity supplied to the national grid, EG_y.
2. Step 2. The baseline emissions of the project are calculated automatically for each month of the MR in the sheets aforementioned, whose results are tabulated below in Table 8.

Table 8: Baseline Emissions Tabulated Calculations

Month	EG_y	EF	BE_y
	Net Electricity delivered to Grid (MWh)	Emission Factor tCO_2/MWh	Equivalent Emission Reductions tCO_2e
June/30/2009	214	0.754	162
Jul-09	6,541	0.754	4,932
Aug-09	6,522	0.754	4,918
Sep-09	6,263	0.754	4,722
Oct-09	6,646	0.754	5,011
Nov-09	6,325	0.754	4,769
Dec-09	6,621	0.754	4,992
Jan-10	6,623	0.754	4,994
Feb-10	5,935	0.754	4,475
Mar-10	2,943	0.754	2,219
Apr-10	5,358	0.754	4,040
May-10	5,092	0.754	3,839
Jun-10	6,807	0.754	5,133
Jul-10	6,710	0.754	5,059
Aug-10	3,376	0.754	2,546
Sep-10	5,941	0.754	4,480
Oct-10	6,803	0.754	5,129
Nov-10	6,453	0.754	4,866
Dec-10	6,573	0.754	4,956
Totals	**107,747**	**0.754**	**81,241**

[9] *In this case, the MR covers from June 30 2009 up to Dec 31 2010.*

E.2. Project emissions calculation

Project emissions, PE_y, are calculated using the spreadsheets mentioned above (see section E1). The spreadsheet was designed according to the version 04 of the ACM0002 methodology.

As indicated by methodology ACM0002, version 04, the project emissions comprise both the fugitive carbon dioxide and methane emission due to the discharge of non-condensable gases from the produced steam, which are greenhouse gases plus project emissions from combustion of fossil fuel.

$$PE_y\ (t\ CO_2\ e) = PE_{FF,\,y} + PE_{GP,\,y} \qquad \text{(Equation 2)}$$

Where:

PE_y = Project emissions in year *y* (tCO_2e/year).
$PE_{FF,\,y}$ = Project emissions from fossil fuel consumption in year *y* (tCO_2/year).
$PE_{GP,\,y}$ = Project emissions from the operation of geothermal power plants (NCG tCO_2e/year).

Important note: because project emissions due to combustion of fossil fuels are negligible, $PE_{FF,\,y}$ is zero; as a result, PE_y results equal to $PE_{GP,\,y}$.

Therefore:

The project emissions, CO_2 emissions and CH_4 emissions are calculated from the fractional content of CO_2 emissions and CH_4 in the geothermal steam, respectively as follows:

$$PE_{GP,\,y} = [(\omega Main,\ CO_2) + (\omega Main,\ CH_4)*(GWP\ CH_4)] * [M_{s,\,y}] \qquad \text{(Equation 3)}$$

Where:

$PE_{GP,\,y}$ = Project emissions due release of CO_2 and CH_4 from geothermal steam (tCO_2 e)
$\omega Main,\ CO_2$ = Average mass fraction of carbon dioxide in the produced steam.
$\omega Main,\ CH_4$ = Average mass fraction of methane in the produced steam.
$GWP\ CH_4$ = Global warming potential of methane (default value of 21 tCO_2e/tCH_4).[10]
Ms, y = Quantity of steam produced.

Subsequently, $PE_{GP,\,y}$ is computed using the spreadsheets mentioned in section E1 by means of the following steps:

1. Step 1: variable data entry $\omega Main,\ CO_2$, $\omega Main,\ CH_4$, $GWP\ CH_4$ and Ms, y in abovementioned Excel calculation sheet.

[10] *See Section D, Table 2.*

2. Step 2. Project emissions are calculated for each month of the monitoring period in the sheet called "TOTAL CERS JUN3009- DEC3110.xlsx", whose results are shown in Table 9.

Table 9: Project emissions during the monitoring period

Variable per PDD	ωMain, CO_2	ωMain, CH_4	GWP CH_4	Ms, y	$PE_{GP, y}$	PEFF, y	PEy
Variable Description	Average mass fraction of carbon dioxide in the produced steam.	Average mass fraction of methane in the produced steam.	Global warming potential of methane (21, ex ante).	Quantity of steam produced.	Project emissions due to release of CO_2 and CH_4 from geothermal steam	Project emissions from fossil fuel consumption in year y	Project emissions in MR
Unit of measure	tCO_2/t steam	tCH_4/t steam	tCO_2e/tCH_4)	t	tCO_2 e	tCO_2 e	tCO_2 e
June/30/2009	0.001918163	2.61377E-07	21	3,708	7	0	7
Jul-09	0.002235595	1.34059E-06	21	113,391	261	0	261
Aug-09	0.002235595	1.34059E-06	21	113,674	261	0	261
Sep-09	0.002235595	1.34059E-06	21	107,373	247	0	247
Oct-09	0.002596791	5.09679E-07	21	113,823	301	0	301
Nov-09	0.002596791	5.09679E-07	21	108,255	287	0	287
Dec-09	0.002596791	5.09679E-07	21	113,886	302	0	302
Jan-10	0.002596791	5.09679E-07	21	114,802	304	0	304
Feb-10	0.002645703	7.23361E-07	21	102,777	278	0	278
Mar-10	0.002645703	7.23361E-07	21	50,544	137	0	137
Apr-10	0.002645703	7.23361E-07	21	89,955	243	0	243
May-10	0.002595367	1.00126E-06	21	80,905	215	0	215
Jun-10	0.002595367	1.00126E-06	21	106,226	282	0	282
Jul-10	0.002595367	1.00126E-06	21	104,971	279	0	279
Aug-10	0.002595367	1.00126E-06	21	53,037	141	0	141
Sep-10	0.002703357	7.49328E-07	21	94,488	261	0	261
Oct-10	0.002703357	7.49328E-07	21	107,438	297	0	297
Nov-10	0.002703357	7.49328E-07	21	101,069	279	0	279
Dec-10	0.001997268	6.57061E-07	21	102,748	210	0	210
Totals:				**1,783,070**	**4,590**	**0**	**4,590**

E.3. Leakage calculation

The project's activity as expressed in the CDM-PDD does not involve emissions past its limits; consequently, this element is said to be zero (0).

L_y = nil (0) (Equation 4)

Where.

L_y = leakages occurred during the monitoring period.

E.4. Emission reductions result/table

Emission reductions, ERs, are calculated according to the internal procedure using the same Excel spreadsheet referenced in section E1, which was designed in full compliance with the actual CDM-PDD and version 4 of the methodology ACM0002.

According to the PDD, leakages are insignificant and there are not emissions due fuel consumption in the power plant[11]; for that reason, the emission reductions are calculated as the difference between the *baseline emissions* minus the *project activity emissions*, as equation 5 indicates.[12]

ER_y (tCO_2e) = BE_y (tCO_2e) – PE_y (tCO_2e) (Equation 5)

Where:

ER_y = Emission reductions given in tCO_2 equivalent in the monitored period.
BE_y = Baseline emissions given in tCO_2 equivalent in the monitored period.
PE_y = Project emissions equals the sum of the fugitive carbon dioxide and methane emission due to the release of non-condensable gases from the produced steam.
y = Monitoring period/year.[13]

Results of this calculation are performed in the abovementioned Excel sheet in section E1. Table 10 depicts such results.

See complete table on next page.

[11] *The power plant supplies its own electrical needs via back-feed transformers which are directly connected to the main electrical bus; additionally, in case a black-out happens, the Nicaraguan Electrical Grid can back-feed the plant via Leon I Substation or via Santa Barbara Hydro-electrical Plant.*
[12] *See CDM-PDD, Section E.5, version 2, page 35.*
[13] *For this case the MR covers from June 30 2009 up to December 31 2010.*

Table 10: emission reduction for the Monitoring Period.

Month	Baseline Emissions, BE_y tCO_2e	Leakages, L_y (tCO_2e)	Project Emissions PE_y tCO_2e	Emission Reductions, ERy tCO_2e
June/30/2009	162	0.00	7	155
Jul-09	4,932	0.00	253	4,679
Aug-09	4,918	0.00	260	4,658
Sep-09	4,722	0.00	245	4,477
Oct-09	5,011	0.00	297	4,714
Nov-09	4,769	0.00	284	4,485
Dec-09	4,992	0.00	299	4,693
Jan-10	4,994	0.00	302	4,692
Feb-10	4,475	0.00	275	4,200
Mar-10	2,219	0.00	136	2,083
Apr-10	4,040	0.00	247	3,794
May-10	3,839	0.00	214	3,625
Jun-10	5,133	0.00	280	4,853
Jul-10	5,059	0.00	276	4,783
Aug-10	2,546	0.00	147	2,399
Sep-10	4,480	0.00	259	4,220
Oct-10	5,129	0.00	294	4,835
Nov-10	4,866	0.00	277	4,588
Dec-10	4,956	0.00	238	4,718
Totals	**81,241**	**0.00**	**4,590**	**76,651**

**Note: The report starts 30 Jun 2009 and ends 31 Dec 2010.*

Therefore, the calculated emission reduction for the indicated period amounts to **76,651** tons of CO_2 eq. This time span represents a total of 549 calendar days.

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

Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reductions (tCO_2e)	**542, 836**[14]	**76,651**

Please pay attention to Reference Note #13 above in allusion to the amount of tCO_2e depicted.

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

The current value of emission reductions in this period is **78.9%** lower than that estimated for the same period in the CDM-PDD. In accordance with the registered PDD, the annual projected emission reductions were calculated to be circa **361,891 tCO_2e** for the years 2007 and beyond. See Table taken from the PDD, *E.6.2: GHG Emission Calculations* below as reference.

Table E.6.2: GHG Emission Calculations

Year	Estimation of baseline emissions reductions (tCO2e)	Estimation of project activity emissions reductions (tCO2e)	Estimation of leakage (tCO2e)	Estimation of emission reductions (tCO2e)
2005	60,766	13,418	0	47,348
2006	121,533	13,418	0	108,115
2007	401,058	39,167	0	361,891
2008	401,058	39,167	0	361,891
2009	401,058	39,167	0	361,891
2010	401,058	39,167	0	361,891
2011	401,058	39,167	0	361,891
Total	**2,187,589**	**222,670**	**0**	**1,964,919**

This variance between the existing emission reductions and the *ex-ante* estimations can be clarified as follows. The development of the expansion project known as Phase I and Phase II to improve the plant's power generating capability, has been deferred for reasons outside of the Project Developer's control. For example, external factors such as:

- The global financial crisis delayed financing of the project and hence affecting the construction starting date established on the registered PDD.

It is comprehensible that due to delays in project expansion, the project produced less CERs, thus creating an inconsistency amongst the two emission figures mentioned above. Even though it had less impact on these differences, the plant was also off line twice during the MR:

1. March 2010 – Phase I expansion works.
2. August 2010 – idem.

[14] *For a whole year, 361,891 tonnes of CO_2e were estimated in the CDM-PDD; depicted on the table are three semesters as per this specific MR covers such a span of time.*

History of the document

Version	Date	Nature of revision
01	EB 54, Annex 34 28 May 2010	Initial version of MR.
Decision Class: Regulatory **Document Type**: Guideline, Form **Business Function**: Issuance		

-