

**MONITORING REPORT FORM (CDM-MR)**
Version 01 - in effect as of: 17/09/2010**CONTENTS**

- A. General description of the project activity
 - A.1. Brief description of the project activity
 - A.2. Project participants
 - A.3. Location of the project activity
 - A.4. Technical description of the project
 - A.5. Title, reference and version of the baseline and monitoring methodology applied to the project activity
 - A.6. Registration date of the project activity
 - A.7. Crediting period of the project activity and related information
 - A.8. Name of responsible person(s)/entity(ies)
- B. Implementation of the project activity
 - B.1. Implementation status of the project activity
 - B.2. Revision of the monitoring plan
 - B.3. Request for deviation applied to this monitoring period
 - B.4. Notification or request of approval of changes
- C. Description of the monitoring system
- D. Data and parameters monitored
 - D.1. Data and parameters used to calculate baseline emissions
 - D.2. Data and parameters used to calculate project emissions
 - D.3. Data and parameters used to calculate leakage emissions
 - D.4. Other relevant data and parameters
- E. Emission reductions calculation
 - E.1. Baseline emissions calculation
 - E.2. Project emissions calculation
 - E.3. Leakage calculation
 - E.4. Emission reductions calculation
 - E.5. Comparison of actual emission reductions with estimates in the registered CDM-PDD
 - E.6. Remarks on difference from estimated value

**MONITORING REPORT**
Version 01 - in effect as of: 17/09/2010**Amayo 40 MW Wind Power Project - Nicaragua**
Reference Number: 2315
2nd Monitoring Period (01/10/2009 - 31/08/2010)**SECTION A. General description of project activity****A.1 Brief description of the project activity:**

The purpose of the project activity is to produce and provide electricity to the Nicaraguan grid by using wind power as the energy source. In order to accomplish this objective, the project installed nineteen 2.1 MW, 60HZ Suzlon wind turbine generators model S88, for a total power capacity of 39.9 MW. The electricity is injected to the 230 kv transmission line through a substation that was built by the project owner, and then distributed to the national grid.

Amayo wind farm was connected to the grid on 9th February 2009 and started to produce electricity on 12th February 2009, as the first days were required to energize the main transformer and test the electrical circuits. Since then, the wind farm has been fully operational.

Table 1: Implementation of the Project

DATE (DD/MM/YY)	Key events
01/01/08	The construction activities started
09/02/09	Connection to the grid / internal tests
12/02/09	First production of energy
12/04/09	Registration date and starting date of the crediting period
12/04/09-30/09/09	The 1 st monitoring period
01/10/09-31/08/10	The 2 nd monitoring period (this report)

The project was registered as a CDM project by the UNFCCC on April 12th 2009, under reference number 2315: Amayo 40 MW Wind Power Project - Nicaragua. More background information can be found in the Project Design Document (PDD) and related documents, available on the UNFCCC website: <https://cdm.unfccc.int/Projects/DB/SGS-UKL1227712726.26/view> .

The total emissions reductions achieved in this monitoring period (from October 1st 2009 to August 31st 2010) are 78,297.9 tCO₂.

**CDM – Executive Board**EB 54
Report
Annex 34
Page 3**A.2 Project Participants**

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Nicaragua (Host Party)	Consorcio Eólico Amayo S.A. (Private Entity)	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party (ies) involved is required.		

A.3 Location of the project activity:

Amayo 40 MW Wind Power Project – Nicaragua is located in the Department of Rivas, on the Pan-American Highway at 129 kilometers to the south of the capital city, Managua. The site is located on the south west coast of Lake Nicaragua. The area for the wind farm is centered at the geographical coordinates 11°19'32" N and 85°43'05" W and has a total area of 276.36 ha.

A.4 Technical description of the project

The project implemented a total of nineteen 2.1 megawatt Suzlon S88 60HZ wind turbine generators (hereafter, "WTGs"), with the following operating data: cut-in wind speed 4 m/s, rated wind speed 14 m/s, cut-out wind speed 25 m/s, survival wind speed 60 m/s. The robust design of the wind turbine, with its uniform weight distribution, ensures high levels of safety, reliability and enhanced service life. Suzlon's Advanced Control System includes precisely calibrated sensors installed at each critical junction that closely monitors factors like temperature, wind speed and vibrations. The remote monitoring and control option enhances ease of operation.

The wind turbine S88-2.1 MW is a variable slip wind turbine with an electrical pitch system that has been designed in accordance with Germanischer Lloyd GLIIa Type Certification. With the pitch system the pitch angle of each blade is accurately adjusted to the requirements of the control and/or safety system. It has been designed in order that which means that each blade has its own drive system consisting of a motor, a gearbox and a converter.

The Suzlon wind turbine generator (WTG) has a rated power of 2.1 MW, a standard rotor height of 80 metres and a rotor diameter of 88 meters, and it is designed to withstand harsh environmental conditions. Its robust design and uniform weight distribution ensure high levels of safety and

CDM – Executive Board

EB 54
Report
Annex 34
Page 4

reliability. The main parts of the Suzlon S88-2.1 MW are the nacelle, the tower and the rotor with the blades. All parts have been designed in line with approved industry standards to guarantee operational safety and efficient operation. See below a summary with the main specifications of this equipment:

Table 2: Summary of the main specifications of WTG S88

Main data	Description
Nominal Power	2.1 MW
Rotor diameter	88.0 m
Swept area of rotor	6,082 m ²
Rotor height	79.0 m
Tower height	77.5 m
Rotational speed	15.0 to 17.6 rpm
Number of blades	3
Rotor cone angle	5°
Power regulation	Pitch / SUZLON-FLEXISLIP SYSTEM
Rotor orientation	Upwind
Blade length	43.25 m
Material of the blades	Fibre glass / epoxy
Type of rotor air brake	Pitch / Full blade
Pitch system	
Type description	Electrical
Drives	1 electric motor with gearbox and electrical brake per blade
Backup system	1 battery set per blade
Pitch angle range	95°
Pitch speed	0.1 to 10.0 °/s
Generator system	
Type description	Single fed induction generator with slip rings, variable rotor resistance via SUZLON-FLEXISLIP System
Rated power	2.100 MW
Voltage stator (phase to phase)	600 V
Frequency	60 Hz
Number of poles	4
Synchronous speed	1,800 rpm
Speed range for constant power with SUZLON-FLEXISLIP	1,836 to 2,100 rpm
Yaw System – Bearing	Slide bearing with gear ring, automatic greasing system



The Project also built a control centre and a 230/kV outdoor substation. The control centre consists of the following:

- A control room, where the computer control centre of the wind farm is housed.
- 13.8 kV (LV) cabinets, (one for each of the lines coming from each of the generators).
- Energy meters.
- A warehouse, where the critical spares and other material are located for the operation and maintenance of the wind farm.
- Restrooms and changing rooms for the use of the operation and maintenance personnel and visitors.
- A Meeting Room, for the wind farm personnel and for the reception of any institutional visits to the wind farm.

The outdoor 230 kV substation is equipped with the following electrical components: transformer of power 100 MVA, autovalves, voltage transformers, switch, disconnecting switch with earthing blades. Also are the corresponding elements of protection and control (such as relays) and metering equipment as well as a short 230 kV transmission line that connects to the 230kV line which transverses the site.

Each turbine has a low voltage transformer outside the tower. The electricity produced in the generator at 600 v is delivered to its own transformer where the voltage is increased from 600 v to 13.8 kv. Then this electricity is delivery to the 13.8 kv cabinets at the control room, divided by circuits. This electricity is finally sent to the 100 MVA main transformer at the substation to elevate the voltage to 230 kv so it can be injected to the 230 kv transmission line and distributed to the grid.

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

Approved baseline and monitoring methodology applied:

ACM0002: "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (Version 07 – December 2007).

The following tools were applied together with the methodology:

- "Tool to calculate the emission factor for an electricity system (Version 01)"
- "Tool for demonstration and assessment of additionality" (Version 05)

A.6 Registration date of the project activity:

The project was registered as a CDM project activity on April 12th 2009, under reference number 2315: Amaya 40 MW Wind Power Project - Nicaragua.

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

The project is registered under a renewable crediting period (7 years * 3) as stated on the PDD.

The starting date of the first crediting period is: April 12th, 2009 (project's registration date).

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

The persons responsible for completing the monitoring report are:

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

Amayo wind farm was connected to the grid on February, 9th 2009 and started producing electricity on February, 12th 2009, as the first days were required to energize the main transformer and test the electrical circuits. Since then the wind farm has been fully operational.

Suzlon Wind Energy Nicaragua (SWENI) a branch in Nicaragua of Suzlon Wind Energy (the provider of the wind turbines generators) is currently in charge of the operation and maintenance of the wind farm, as it was established in the contract for a period of five years.

Suzlon wind turbines are bundled with specific software and hardware for data monitoring. The SC-Turbine software provides control for each single wind turbine, allowing for all process data to be monitored. The SC-Commander software is the control and monitoring user interface, with which it is possible to read the data and create reports and statistics easily by having direct access to the SC-Turbine for detailed analysis and operation purposes. All these data can be used as well by the SC-



SCADA Reporting Server which is a central Suzlon database where wind power plant data is hosted for reporting.

A second phase (Amayo Phase II Wind Power Project) of the wind farm is currently operating with a total capacity of 23.1 MW, and consists of eleven wind turbines of 2.1 MW 60HZ Suzlon wind turbine generators model S88. The electricity is delivered to the grid through the same substation constructed for Phase I, and has been fully operational since 18th March 2010. However, Phase II has been managed as an independent project throughout: it has separate power purchase agreements, land agreements and is owned by a separate company. This second phase is also seeking CDM registration, and is currently at the validation stage with a designated operational entity (DOE).

As per the special events that occurred during this monitoring period (from October 1st 2009 to August 31st 2010 (both dates included)) we can mention that:

1. During this monitoring period the second phase of the wind farm -Amayo Phase II Wind Power Project- began operations on February 9th 2010. Since then, the electricity generated by Amayo Phase II has been added to the electricity generated by Amayo I. Both phases are located side by side on the same geographical area of the Department of Rivas. Both have their own collector for energy at 13.8 kV level that goes into one 13.8 kV common bus bar at the entrance of the low side of the transformer located at the 230 kV substation, which is the common point where Phase I and Phase II deliver power to the Nicaraguan Grid. There are meters on the low voltage side of the transformer, which separately measure the exact production of Energy of Phase I and Phase II. These meters can identify the energy delivered as well the energy received. This allows the exact calculation of net energy contributed by Phase I and Phase II.
2. It is important to mention that during the current year the wind behavior has been affected by “La Niña” phenomenon, which explains the reduction in the wind regimen as well as a stronger rain regime. This phenomenon has caused a reduction in electricity generation, which has been lower than expected. This results in a lower generation of CERs.
3. The plant availability was below the expected for some months due to technical issues related to the operation of the wind turbines generators (WTG), individual transformer (kiosks) and technical issues related to the wind farm substation (CEA Substation). This situation caused lower plant availability and therefore a lower electricity generation for said periods. Once the problems were solved the plant operated normally. Please refer to table 3 below for a summary of the main events of this kind and the affected months.



Table 3: Technical issues that affected plant availability

	EVENT	DOWNTIME (WTG or PLANT)	MONTH
KIOSKS	Wind turbine generator 9 was offline due to electrical low voltage panel damaged in its kiosk.	17 days offline	October 2009
	WTG 4 offline due to kiosk damages.	30 days offline	April 2010
	WTG 4 offline due to kiosk damages.	31 days offline	May 2010
	WTG 4 offline due to kiosk damages.	30 days offline	June 2010
	WTG 9 offline due to kiosk damages.	50 days offline	July and August 2010
CEA Substation	The entire plant was offline due to works performed in the metalclad.	2 days offline	November 2009
	The entire plant was offline due to works performed in the metalclad.	1 day offline	December 2009

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 has not been any request for deviation.

B.4. Notification or request of approval of changes

There has not been any notification or request of approval of changes.

SECTION C. Description of the monitoring system

This monitoring period includes the CERs generated from October 1st 2009 to August 31st 2010 (both dates included), of Amayo 40 MW Wind Power Project - Nicaragua for a total amount of 78,297.9 CERs.



Data Generation

In order to obtain the results of the emission reduction calculation, we have divided the calculation period into two different periods (and spreadsheets): The CERs produced from October 1st 2009 to January 31st 2010 (before the beginning of operation of Amayo II), and the CERs produced from February 1st 2010 to August 31st 2010.

The data is first generated at the metering system of the plant. The main parameter monitored is the electricity supplied to the grid by the project activity (EGy), as indicated in the PDD section B.7.1. The electricity supplied to the national grid is continuously measured and recorded by the metering system which includes:

- The main revenue meter and a back up meter both installed at the high voltage side of the main transformer at the plant facilities.
- Four main meters and four back up meters installed at the 13.8 kv low voltage side of the main transformer, which measures separately the energy from Phase I and Phase II.

For the period from October 1st 2009 to January 31st 2010, the data was only taken from the main revenue meter at the high voltage side of the transformer.

The data for the period from February 1st 2010 to August 31st 2010 was collected both from the main revenue meter (which now measures the total amount delivered by the entire wind farm, i.e. Phases I and II) and the meters at the low voltage side (which separately measure the exact energy production corresponding to each phase). The proportion of energy generated by each phase at the 13.8 kv low voltage side (gross energy) is then applied to the net generation by the entire farm measured on the high voltage side, thus allowing to obtain the *net* contribution of energy corresponding to each phase of the project (these calculations are further explained on section D).

As from now on the project will continue to use the mechanism depicted above, the PDD has been updated in order to reflect this changes in the monitoring plan.

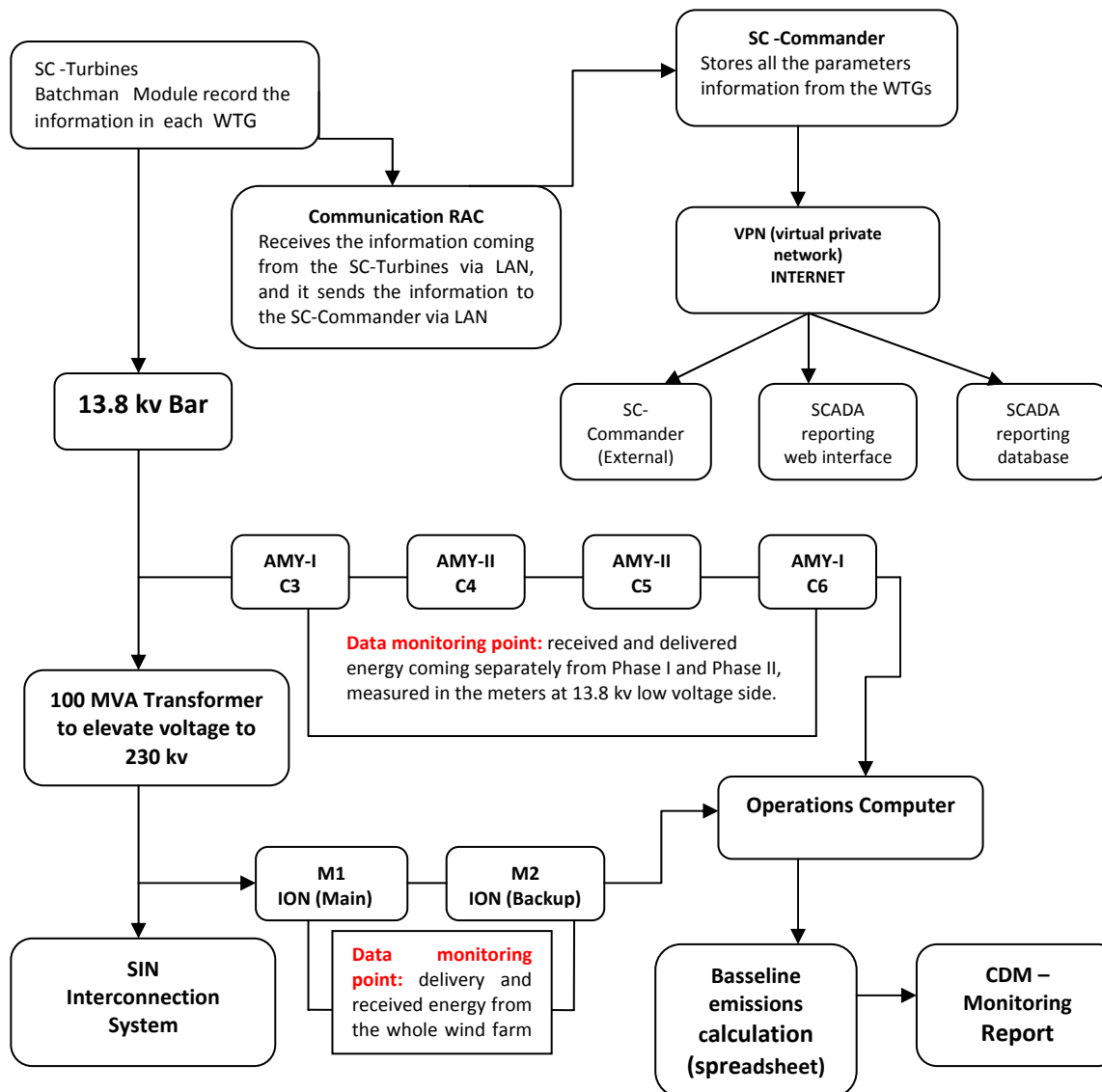
Data Recording and Calculation

All the meters mentioned above keep track of both the electricity supplied and received from the grid. Daily records are kept by the plant operator in the operation data files. Additionally these same files are kept in back up CD's.

The data readings used for calculation methodology are taken from the metering system, which are the monitoring points. They keep track of both the electricity supplied and received from the grid. In turn, net energy delivered is used to calculate baseline emissions. The input data is pasted into the spreadsheets to calculate the net energy, which is obtained by subtracting the received energy from the delivered electricity to the grid. The net energy delivered in each hour is multiplied by the

emission factor to obtain baseline emissions. The emission factor for Amayo 40 MW Wind Power Project - Nicaragua is 0.7127 tCO₂ / MWh¹.

Figure 1: Flow diagram of data recording for baseline emissions calculations.



¹ As indicated in the PDD, project participants chose an *ex-ante* emission factor, which was calculated and presented in sections B.6.1 and B.6.3 of the above mentioned document.

As it can be seen in the figure above, wind turbines (WTG) data parameters are sent from each WTG to the Suzlon server SC-Commander and to the SCADA, allowing the wind farm to easily follow up the performance of the parameters and generate reports. In turn, the energy generated at each WTG is transported through several circuits to the 13.8 kv Bar, where the electricity coming from each of the two phases is measured in separate cells, which each one has separate meters (one as main meter and another as back up meter). Cells 3 and 6 measure energy from Amayo I, and cells 4 and 5 from Amayo II. After that stage, energy is sent to the main transformer at the 230 kv side, where the voltage is increased from 13.8 kv to 239 kv so it can be delivered to the 230 kv transmission line. At that side of the transformer, both the main revenue Ion meter and the back up meter (M1 and M2 in the figure above) are located.

Quality Assurance (QA) and Quality Control (QC) procedures applied

The emission reductions achieved by the project have to be verified internally, so the following steps are taken to ensure the best possible data quality:

1. Ensure that the data is complete and transparent. Ensure that they are in the same format.
2. Make sure that the data is checked on consistency and transposition errors (these can occur when data is transported from one system to another).
3. Crosschecking of the data from the spreadsheet by comparing the delivered energy from the spreadsheet with the delivered energy specified in the invoices.
4. Crosschecking the hourly delivery energy values of the spreadsheet with the values of the reports from CNDC (national entity).
5. The main revenue Ion meter and the backup Ion meter are located at the 230 kV side of the main transformer, are calibrated every two years and have an error percentage of 2%, in accordance to the Nicaraguan norm “Normativa de Operacion”. These meters measure the total energy delivered to the grid from the entire wind farm (Phase I + Phase II).

Organizational structure, roles and responsibilities of personnel for the monitoring plan

The purpose of the monitoring organization is that:

- All staff involved in monitoring know what to do and how often;
- Quality assurance and quality control measures are operated. This ensures that the generated data is complete, transparent and reliable.

The project has implemented a management structure where monitoring responsibilities are explicitly defined. The O&M department's is responsible for ERs monitoring, record keeping and the implementation of proper QA procedures. All O&M procedures have been adapted to include the carbon monitoring component and the adequate accounting of the emission reductions.

The person in charge of the carbon credits monitoring is in charge of the following activities:

- Calculation and record keeping of the emissions reduced by the project activity, according to the general guidelines described in the monitoring plan.

CDM – Executive Board

EB 54
Report
Annex 34
Page 12

- Managing all the validation, registration and certification process of the project's GHG emission reduction.
- Coordination and management of the marketing of the CERs in the relevant carbon markets.
- Providing reliable evidence during verification allowing the uniquely identification of ER reductions from each phase (e.g. invoices from each company showing the amount sold by each phase of the project).

Table 4: Roles and Responsibilities Matrix

	Plant Manager	Environmental Coordinator	Operations Manager
Collect data			
Power delivered to grid	R	E	
Ensure calibrations and data quality	R	I	E
Process data			
Input of raw data in spreadsheet		R	E
Cross check data and correct		R	E
Calculate emission reductions		R	E
Quality check calculated emission reductions	R/E	I	R/E
Reporting and archiving			
Report data gaps and errors (**)	I	R	E
Report emission reductions to date	R/E	I	R/E
Archiving of procedures and certificates (***)		R	E
Archiving of data	R	E	E

E = Execute

R = Responsible

I = To be informed

**CDM – Executive Board**EB 54
Report
Annex 34
Page 13Record Keeping Arrangements

The sections below provide an overview of what relevant documents (files, manuals, reports, etc.) are kept and where they are stored.

Table 5: Record Keeping Arrangements

Document	Responsible for generation	Storage location	Update frequency	Remarks
Calibration certificates revenue meters	AMAYO calibration engineer	Office AMAYO	2 times per year	
Power delivered to the grid	AMAYO	Office AMAYO	Monthly (power delivered to the grid), where applicable (meter audits)	Compare measured output against invoiced power
Audits of power meter	External verifier	Office AMAYO	Where applicable	Change of meter and meter problems trigger an external audit.
Calculation worksheet	AMAYO	Office AMAYO	When applicable	Make sure that this sheet holds all relevant data and back up every month.
Back up CD's with power delivered to the grid data	AMAYO	Office AMAYO	Monthly	Make sure that the delivered energy to the grid is also storage in cd's in case of any incident with the operation's computer.

Emergency Procedures

Table 6: Emergency Procedures

Measured parameter	Calibration procedures	Maintenance procedures	Procedure in case of failure	Default value to use in case of failure	Relevant documents
Power delivered to the grid [MWh] Main Meters	Every two years with an audit from the grid operator	None	Replacement of the meter by an equivalent unit, upon which an audit must be carried out by grid operator.	Value to be taken from backup meter. In case that both meters fail values to be taken according to the procedures of “Normativa de Operación” using the voltage and current values of the Dispatch Center.	Audit reports commissioned by grid operator in Spanish and meter documentation according to “Normativa de Operación vigente”.
Power delivered to the grid [MWh] BackUp Meters	As above	As above	As above	Value to be taken from main meter.	As above

**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 values are presented on section B.6.2 of the registered PDD.

Data / Parameter:	$NCV_{i,y}$
Data unit:	TJ/Gg
Description:	Net calorific value (energy content) per mass unit of fuel i in year y .
Source of data used:	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value applied:	Fuel Oil: 39.8 TJ/Gg Diesel: 41.4 TJ/Gg
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Emission factor for baseline emissions, as stated on section B.6.3 of the registered PDD.
Any comment:	-

Data / Parameter:	$EF_{CO_2,i,y}$
Data unit:	tCO ₂ /TJ
Description:	CO ₂ emission factor of fossil fuel i in year y .
Source of data used:	IPCC default values at the lower limit if the uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National Greenhouse Gas Inventories.
Value applied:	Fuel Oil: 75.5 tCO ₂ /TJ Diesel: 72.6 tCO ₂ /TJ
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Emission factor for baseline emissions, as stated on section B.6.3 of the registered PDD.
Any comment:	

Data / Parameter:	D_i
Data unit:	tons/gal
Description:	Density of fuel i in year y .
Source of data used:	Table A.4 “Emissions of Greenhouse Gases in the United States” - Energy Information Administration (US Department of Energy).



CDM – Executive Board

EB 54
Report
Annex 34
Page 16

	Available at http://www.eia.doe.gov/oiaf/1605/archive/87-92rpt/appa.html
Value applied:	Fuel Oil: 11 API(= 0.993 gr/cm ³) Diesel: 35.5 API (= 0.8473 gr/cm ³)
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Emission factor for baseline emissions, as stated on section B.6.3 of the registered PDD.
Any comment:	This coefficient is used to convert fuel data (originally expressed in gals) to mass units. Conversion from API to gr/cm ³ was made according to the formula, where D_A is the density expressed in API and $D_{g/gm3}$ is the same variable expressed in g/cm ³ . (Source: “Sistemas de unidades Fisicas”, Galán García, JL and Galán García, J., available at: http://books.google.com.ar/books?id=iJMTyEe0vBcC&pg=PA47&dq=conversion+de+API+a+densidad There are also many conversion tools available online, for example: http://www.ior.com.au/ecfdensity.html)

Data / Parameter:	$FC_{i,m,y}$
Data unit:	Thousand gals
Description:	Amount of fossil fuel i consumed by each power plant/unit m in year y .
Source of data used:	INE - Instituto Nicaragüense de Electricidad (Nicaraguan Electricity Institute)
Value applied:	Data for the 2005-2007 period is available in Annex 3 of the registered PDD
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Emission factor for baseline emissions, as stated on section B.6.3 of the registered PDD.
Any comment:	This data is publicly available at: http://www.ine.gob.ni/estadisticasdge/consumo%20de%20combustible%20por%20tipo%20de%20planta.pdf ; http://www.ine.gob.ni/estadisticasdge/001%20Estadisticas%20Electricas%202007%20Resumen.pdf

Data / Parameter:	$EG_{m,y}$
Data unit:	MWh
Description:	Net electricity generated and delivered to the grid by power plant/unit m in year y .



CDM – Executive Board

EB 54
Report
Annex 34
Page 17

Source of data used:	INE - Instituto Nicaragüense de Electricidad (Nicaraguan Electricity Institute)
Value applied:	Data for the 2005-2007 period is available in Annex 3 of the registered PDD
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Emission factor for baseline emissions, as stated on section B.6.3 of the registered PDD.
Any comment:	This data is publicly available at http://www.ine.gob.ni/estadisticasdge/generacion%20neta%20GWH.pdf , see also: http://www.ine.gob.ni/estadisticasdge/001%20Estadisticas%20Electricas%202007%20Resumen.pdf

Data / Parameter:	<i>Plant name</i>
Data unit:	Text
Description:	Identification of power sources for the OM (all the plants in the grid).
Source of data used:	INE- Instituto Nicaragüense de Electricidad (Nicaraguan Electricity Institute)
Value applied:	Data for the 2005-2007 period is available in Annex 3 of the registered PDD
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Emission factor for baseline emissions, as stated on section B.6.3 of the registered PDD.
Any comment:	This data is publicly available at http://www.ine.gob.ni/

Data / Parameter:	<i>Plant name</i>
Data unit:	Text
Description:	Identification of power sources for the BM (recent additions to the grid).
Source of data used:	INE- Instituto Nicaragüense de Electricidad (Nicaraguan Electricity Institute)
Value applied:	Table B.8 of the registered PDD



CDM – Executive Board

EB 54
Report
Annex 34
Page 18

Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Emission factor for baseline emissions, as stated on section B.6.3 of the registered PDD.
Any comment:	This data is publicly available at http://www.ine.gob.ni/

D.2. Data and parameters monitored**Data and parameters for the calculation of CERs for the period from October 1st 2009 to January 31st 2010**

As explained in Section C, for the period from October 1st 2009 to January 31st 2010, the data was only taken from the main revenue meter at the high voltage side of the transformer, as stated in the PDD section B.7.1. Then, the parameter monitored in order to calculate the baseline emissions was the following:

Data / Parameter:	EG_y
Data unit:	MWh
Description:	Electricity supplied to the grid by the project activity.
Measured /Calculated /Default	Measured at on site metering system.
Source of data to be used:	On-site metering system (same data submitted to INE / SIN).
Value(s) of monitored parameter:	52.916,2 MWh
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission reductions
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	• Main meter: Schneider Electric, Power Logic, ION 8600, serial No.: PT-0901A531-01. • Back up meter: Schneider Electric, Power Logic, ION 8600, serial No.: PT-0901A532-01 The date of last calibration is June 14 th 2009 and has a validity of 2 years, for both meters.
Measuring/ Reading/ Recording frequency:	Data will be measured on site on an hourly basis. Monthly records will be kept by the system operator (CNDC).



QA/QC applied:	Meter should have a maximum error of $\pm 0.2\%$ and be calibrated periodically according to local standards for electricity transactions in the SIN. Data can be double checked by receipt of sales to the grid.
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Data and parameters for the calculation of CERs for the period from February 2010 to August 2010

Since the commissioning of Phase II, the net amount of energy delivered to the grid can no longer be measured from the high voltage, outside meter, as the latter now indicates the overall generation of the entire wind farm (Phase I and Phase II).

Consorcio Eólico Amayo, S.A. (Phase I) and Consorcio Eólico Amayo Fase II, S.A. (Phase II) are located side by side on the same geographical area of the Department of Rivas. Both have their own collector for energy at 13.8 kV level that goes into one 13.8 kV common bus bar at the Entrance of the low side of the transformer located at the 230 kV substation, which is the common point where Phase I and Phase II deliver power to the Nicaraguan Grid. Phase II connects into the same Substation that Phase I does since this is the nearest point to deliver power to grid. Said substation has one main 100 MVA transformer that can handle the total output of Phase I and Phase II, which is approximately 71 MVA at its peak. This way, Phase II has been able to connect to the grid faster by using the same Substation that Phase I is using.

The Normative “Normativa de Operación” in place allows two Commercial Agents to deliver energy through the same connection point. In case that the Energy Delivery Point is the same -as in this case- the energy produced by each Agent (Phase I and Phase II) must be identified at each Commercial Agent’s metering point². If the latter are not of the same voltage as the delivery point, a calculation (which must be registered at the CNDC³) may be established in order to account the exact amount of net energy provided by each agent⁴.

There are meters on the low voltage side of the transformer, which will separately measure the exact production of Energy of Phase I and Phase II. However, given that the point of delivery of the power of Phase I coincides with the Supply Node of the power of Phase II, and the total power is measured with only one Revenue Metering Point (SIMEC) meter located on the high side, 230 kV Delivery Point of the AMAYO Substation, then the Energy corresponding to Phase I, will be subject to be identified as follows⁵:

² Recall that each Phase of the project is registered as an independent commercial agent.

³ National Load Dispatch Centre

⁴ See section 4.1 (metering location) on page 2 of the Commercial Annex IV (Commercial Metering System) of the Operating Regulations (*Normativa de Operación*), available to the DOE (original document in Spanish).

⁵ A diagram of the metering procedure is presented on Annex 4. INE authorization for the formula used is available as evidence.



CDM – Executive Board

EB 54
Report
Annex 34
Page 20

The Meters for Phase I and Phase II can identify the energy delivered as well the energy received. This allows the exact calculation of net energy contributed by Phase I and Phase II.

The description of each parameter in the formula above is as follows:

Data / Parameter:	$EG^{230kV}_{PhaseI,y}$
Data unit:	MWh
Description:	Quantity of net electricity generation supplied to the grid (230 kV transmission line) in year <i>y</i> by the units of Phase I
Measured /Calculated /Default:	Calculated based on on-site metering system for each Phase (same data submitted to INE / SIN).
Source of data:	On-site metering system (same data submitted to INE / SIN)
Value(s) of monitored parameter:	56.944.6 MWh
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This parameter is used to calculate Baseline / Emission reduction calculation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/ Reading/ Recording frequency:	Data will be calculated monthly using the data from the metering system on site. Monthly records will be kept by the system operator (CNDC).
Calculation method (if applicable):	As the project shares the 230 kV connection point with Phase I, the amount of net energy corresponding to each Phase will be determined according to the proportion of Phase I/Phase II energy measured at the respective 13.8 kV meters Monthly records will be kept by the system operator (CNDC) (see formula above).
QA/QC applied:	Data can be double checked by receipt of sales to the grid.

Data / Parameter:	EG^{230kV}_{AMAYO}
Data unit:	MWh
Description:	Quantity of net electricity delivered to the grid (230 kV transmission line) by the entire wind farm (Phase I + Phase II) (Energy injected in the Delivery Point on the 230 kV side).



CDM – Executive Board

EB 54
Report
Annex 34
Page 21

Measured /Calculated /Default:	Measured data (on-site metering system).
Source of data:	On-site metering system
Value(s) of monitored parameter:	84.116.5 MWh
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Used to calculate $EG^{230kV}_{PhaseI,y}$
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	• Main meter: Schneider Electric, Power Logic, ION 8600, serial No.: PT-0901A531-01. • Back up meter: Schneider Electric, Power Logic, ION 8600, serial No.: PT-0901A532-01 The date of last calibration is June 14th 2009 and has a validity of 2 years, for both meters.
Measuring/ Reading/ Recording frequency:	Data will be measured on site on an hourly basis.
Calculation method (if applicable):	
QA/QC applied:	This meter should have a maximum error of $\pm 0.2\%$ and be calibrated periodically according to local standards for electricity transactions in the SIN ⁶ .

Data / Parameter:	$EG^{13.8kV}_{PhaseI,y}$
Data unit:	MWh
Description:	Quantity of electricity generation in year y produced by the generators of Phase I measured on the 13.8 kV side by its corresponding 13.8 kV meters.
Measured /Calculated /Default:	Measured On-site metering system
Source of data to be used:	On-site metering system

⁶ According to INE regulations, meters are audited at least once every two years. (See page 9 of the Comercial Annex in the Operation Regulations issued by INE (in Spanish: [Normativa de Operación, Anexo Comercial: Sistema de Mediciones Comerciales, inciso VII.: Revisión de los medidores habilitados](#) – available to the DOE)



CDM – Executive Board

EB 54
Report
Annex 34
Page 22

Value(s) of monitored parameter:	58,900 MWh
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Used to calculate $EG^{230kV}_{PhaseI,y}$
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	• Main meter at Cell 3: Meter Landis, Type RXRS4, Class 20. Serial No. 98423904. • Back up meter at Cell 3: Meter Landis, Type RXRS4, Class 20. Serial No. 87732080 • Main meter at Cell 6: Meter Landis, Type RXRS4, Class 20. Serial No. 98423956. • Main meter at Cell 6: Meter Landis, Type RXRS4, Class 20. Serial No.87732072.
Measuring/ Reading/ Recording frequency:	Data will be measured on site on an hourly basis.
QA/QC applied:	

Data / Parameter:	$EG^{13.8kV}_{AMAYO}$
Data unit:	MWh
Description:	Quantity of electricity generation in year y produced by the generators of Phase I + Phase II measured on the 13.8 kV side by its corresponding 13.8 kV meters.
Measured /Calculated /Default:	Measured On-site metering system
Source of data to be used:	On-site metering system
Value(s) of monitored parameter:	87,022 MWh
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Used to calculate $EG^{230kV}_{PhaseI,y}$
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity):	• Main meter at Cell 3: Meter Landis, Type RXRS4, Class 20. Serial No. 98423904. • Back up meter at Cell 3: Meter Landis, Type RXRS4, Class 20. Serial No. 87732080 • Main meter at Cell 6: Meter Landis, Type RXRS4, Class 20. Serial No. 98423956. • Main meter at Cell 6: Meter Landis, Type RXRS4, Class 20. Serial No.87732072. • Main meter at Cell 4: Meter Landis, Type RXRS4, Class 20. Serial No. 98423908



	• Back up meter at Cell 4: Meter Landis, Type RXRS4, Class 20. Serial No. 98423954 • Main meter at Cell 5: Meter Landis, Type RXRS4, Class 20. Serial No. 98423966 • Main meter at Cell 5: Meter Landis, Type RXRS4, Class 20. Serial No. 98423955
Measuring/ Reading/ Recording frequency:	Data will be measured on site on a hourly basis.
QA/QC applied:	

SECTION E. Emission reduction calculation

E.1. Baseline emissions calculation

The presentation of the data in this section is separated into two parts, the calculation of the emission reductions before and after the beginning of operation of Amayo Phase II: *Emission reductions calculation from October 2009 to January 2010*, and *Emission reductions calculation from February 2010 to August 2010*.

Emission reductions calculation from October 2009 to January 2010

The data used for the emission reduction calculation was taken from the revenue metering system, which keeps track of both the electricity supplied and received from the grid.

In turn, net energy delivered is used to calculate baseline emissions. The input data from the metering system is pasted into the spreadsheet “CERs Oct-Jan2009” and “CERs Feb- Aug 2010” to calculate the net energy, which is given subtracting the received energy from the delivered electricity to the grid. According to ACM0002 (version 07), the baseline emissions of the project are equal to:

$$BE_y = EG_y * EF_{grid,CM,y}$$

where EG_y is the electricity generated by the Project in year y supplied to the Grid (in MWh), and $EF_{grid,CM,y}$ is the ex ante emission factor (0.7127 tCO₂/MWh).

Table 7: CERs Calculation Oct 2009-Jan2010

Month	Net Energy (MWh)	Total Baseline Emissions (tCO ₂ e)	Total Project Emissions (tCO ₂ e)	Total Leakage	Total Emission Reductions (tCO ₂ e)
October 2009	5,409.4	3,855.3	0	0	3,855.3
November 2009	10,825.1	7,715.0	0	0	7,715.0
December 2009	16,560.4	11,802.6	0	0	11,802.6
January 2010	20,121.4	14,340.5	0	0	14,340.5
Total	52,916.2	37,713.4	0	0	37,713.4

Note: This period goes from October 1st 2009 to January 31st 2010, both dates included.

In “Table C: Energy Generation and Comparison with Invoices” of the spreadsheet Summary 2, (excel file “CERs Calculation Oct 2009-Jan 2010”) can be verified that the values of the delivered energy to the grid matches with the invoices for each month.

Emission reductions calculation from February 2010 to August 2010

The steps for the calculation of the emission reduction shown in the spreadsheet CERs Feb-Aug 2010 of the attached document “CERs Feb-Aug 2010” are as follow:

1. It was necessary to paste the delivery and received energy values both from the ION Main Revenue Meter and from the meters located at the 13.8kv low voltage side. In the spreadsheet is possible to easily distinguished the delivery energy (kwh) coming from the main revenue meter (ION Main Meter) which measures the total delivery energy from the total wind farm (Phase I+ Phase II) and the energy values coming from each one of the meters installed at the 13.8 kv voltage side (Cell 3 to Cell 6), where Cell 3 and Cell 6 measures the delivered and received energy corresponding to Amayo Phase I, and C4 and C5 the energy coming from Amayo Phase II.
2. The second step was to calculate the delivery and received energy for the project (Total AMY I) using the delivery and received values from the ION Main Meter (Phase I+Phase II) and the delivery and received values from the 13.8 low voltage side meters. Then, applying the formula described in Section D.2. the value for the delivery energy of the project is calculated as follows:

$$\text{Total AMY I} = EG_{\text{Phase I, y}}^{230\text{kV}} = EG_{\text{AMAYO}}^{230\text{kV}} \cdot \frac{EG_{\text{Phase I, y}}^{13.8\text{kV}}}{EG_{\text{AMAYO}}^{13.8\text{kV}}} = \text{ION Main Meter} \times \frac{(C3+C6)}{(C3+C4+C5+C6)}$$



Please refer to “Table A: CERs Feb-Aug 2010” of spreadsheet “CERs Feb-Aug 2010” where:

- Ion Main Meter (column C) is the measured delivered energy from the entire wind farm (Phase I+ Phase II),
 - (C3 + C6) is the delivered energy from Phase I measured at the 13.8 kv low voltage side meters located at Cell 3 and Cell 4 (columns G and M).
 - (C3 + C4 + C5 + C6) is the delivery energy of the entire wind farm (Phase I+ Phase II) measured at the 13.8 kv low voltage side meters of the four Cells (columns G, I, K and M).
3. In order to obtain net energy, it is necessary to subtract the received energy from the delivered electricity to the grid (as calculated above) in each hour, using the values of the columns O and P respectively, which corresponds to the calculated delivered and received values of the project Amayo I.
4. The net energy delivered in each hour (column Q) is multiplied by the Nicaraguan emission factor in order to obtain the baseline emissions (column U), according to the formula described in the section B.6.1 of the PDD:

$$BE_y = EG_y * EF_{grid,CM,y}$$

where EG_y is the electricity generated by the Project in year y supplied to the Grid (in MWh), and $EF_{grid,CM,y}$ is the emission factor 0.7127 tCO₂.

See below a summary of the emission reduction calculation.

CDM – Executive Board

EB 54
Report
Annex 34
Page 26

Table 8: Baseline Emission Reduction Calculation February to August 2010

Month	Net Energy (MWh)	Total Baseline Emissions (tCO ₂ e)	Total Project Emissions (tCO ₂ e)	Total Leakage	Total Emission Reductions (tCO ₂ e)
February	14,578.01	10,389.75	0	0	10,389.75
March	15,436.15	11,001.35	0	0	11,001.35
April	11,236.61	8,008.33	0	0	8,008.33
May	8,778.35	6,256.33	0	0	6,256.33
June	3,446.50	2,456.32	0	0	2,456.32
July	2,303.54	1,641.73	0	0	1,641.73
August	1,665.50	830.65	0	0	830.65
Total	56,944.6	40,584.4	0	0	40,584.4

In Table B: *Energy Generation and Comparison with Invoices* of the spreadsheet Summary (excel file “CERs Feb-Aug 2010”) can be verified that the calculated delivered energy to the grid of the project matches with the invoices for each month.

E.2. Project emissions calculation

There are no project emissions attributable to wind projects. Consequently $PE_y = 0$.

E.3. Leakage calculation

There is no leakage attributable to wind projects. Consequently $L_y = 0$.

E.4. Emission reductions calculation / table

A project’s emission reduction for any year y is calculated as the difference between baseline and project emissions, the latter of which includes any leakage attributable to the project. As there are no project emissions or leakage attributable to wind projects, the total emissions reductions of the Amayo Wind Farm are identical to the estimated baseline emissions.

Therefore, the emission reductions can be calculated using the following formula:

$$BE_y = EG_y * EF_{grid,CM,y}$$

**CDM – Executive Board**EB 54
Report
Annex 34
Page 27

where EG_y is the electricity generated by the proposed CDM Project in year y supplied to the Grid (in MWh).

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 (proportional: 11 months)	Actual values reached during the monitoring period (11 months)
Emission reductions (tCO₂e)	The estimated emission reduction is 110,743.42 ⁷ tCO ₂ in 11 months based on registered PDD.	Actual emission reduction is 78,297.9 tCO ₂ during monitoring period (11 months)

The actual emission reduction is approximately 30% lower than the estimated emissions reductions in registered PDD.

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

Not applicable (the actual emission reductions are less than the emission reduction expected in the PDD)

⁷ (Annual emission estimated in registered PDD/12)*11 = (120,811/12)*11=110,743.42