



Monitoring report form for CDM project activity
(Version 06.0)

Complete this form in accordance with the instructions attached at the end of this form.

MONITORING REPORT

Title of the project activity	SHP MORRO AZUL CDM PROJECT (JUN1164)	
UNFCCC reference number of the project activity	8879	
Version number of the PDD applicable to this monitoring report	2	
Version number of this monitoring report	0	
Completion date of this monitoring report	10/07/2018	
Monitoring period number	First Monitoring Period	
Duration of this monitoring period	01/02/2015 – 30/06/2018	
Monitoring report number for this monitoring report	1	
Project participants	Risaralda Energía S.A.S. E.S.P	
Host Party	Colombia	
Sectoral scopes	Sectoral Scope 1 – Energy Industries (Renewable / Non-renewable Sources)	
Applied methodologies and standardized baselines	ACM0002 version 13 - Consolidated baseline methodology for grid-connected electricity generation from renewable sources	
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	0 tCO ₂ e	67,091 tCO ₂ e
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	81,880 tCO ₂ e	

SECTION A. Description of project activity

A.1. General description of project activity

The project activity consist in the generation of electricity by a renewable source (hydroelectric source), through the construction of a **Small Hydropower Plant (SHP) Morro Azul** with final installed capacity of 19.90 MW.

The SHP Morro Azul is located on the Risaralda River, Cauca River basin, in the municipalities of Belén de Umbria and Anserma – Risaralda and Caldas Departments, Colombia.

The SHP is managed by the **Risaralda Energía S.A.S. E.S.P**, a special purpose entity responsible for the construction and operation.

The project activity main purpose is to provide renewable electricity to the National Interconnected System, displacing the fossil-fuelled thermoelectric generation present in the system.

In this way, the CDM project activity contributes to the environmental sustainability increasing the share of renewable energy in relation to total consumption of electricity in Colombia.

Concerning the contribution for Greenhouse Gas emissions (GHG) reduction, the project activity reduces emissions of these gases avoiding thermoelectric plants operation that make use of fossil fuels as energy source. In the absence of the project activity, fossil fuels are burned in thermoelectric plants connected to the grid to supply the country's electricity consume.

The project activity initiative contributes to Colombia efforts on promoting sustainable development.

The project activity is also aligned with the specific requirements of the CDM (Clean Development Mechanism) of the host country, because:

- It contributes to environmental sustainability as reduce the use of fossil energy (non-renewable sources). Thus the project contributes to the best use of natural resources and makes use of clean and efficient technologies;
- It enlarges the opportunity for employment in areas where the project is located;
- It contributes to better conditions of local economy, reducing the amount of pollution released into atmosphere and the associated social costs related to it.

Moreover, the project diversifies the sources of electricity generation, promote the decentralized energy generation which includes other benefits as:

- Increased reliability, with shorter and less extensive interruptions;
- Fewer demands related to reserve margin;
- Energy with better quality for the region;
- Minor losses in transmission and distribution lines;
- Control over reactive energy;
- Reduction of congestion in transmission and distribution.

Table 1: SHP Morro Azul technical characteristics:

Installed Capacity (MW)	19.90
Generators Type	Synchronous
Number of Generators	3
Voltage (KV)	13.8
Turbines Type	Francis
Number of Turbines	3
Spin (rpm)	720
Frequency (Hz)	60
Assured Energy (MW average)	14.12
Annual Generation (MWh /year)	123,691
Average Flow (m ³ /s)	15.27
Reservoir Area (km ²)	0.1217

The SHP Morro Azul is connected with the national grid by a single circuit transmission line that has 5 km length (voltage 33 kV) connected to Anserma substation, owned by CHEC¹.

The Project activity has achieved a total of 67,091 tCO₂e during the monitored period.

A.2. Location of project activity

The SHP Morro Azul is located at the Risaralda river, coordinates 5°11'20,61" N and. 75° 48'43,63" W (or 5.189058 N and -75.812119 W), in Belén de Umbria and Anserma cities, respectively Risaralda and Caldas Departments, central-west region, Colombia.

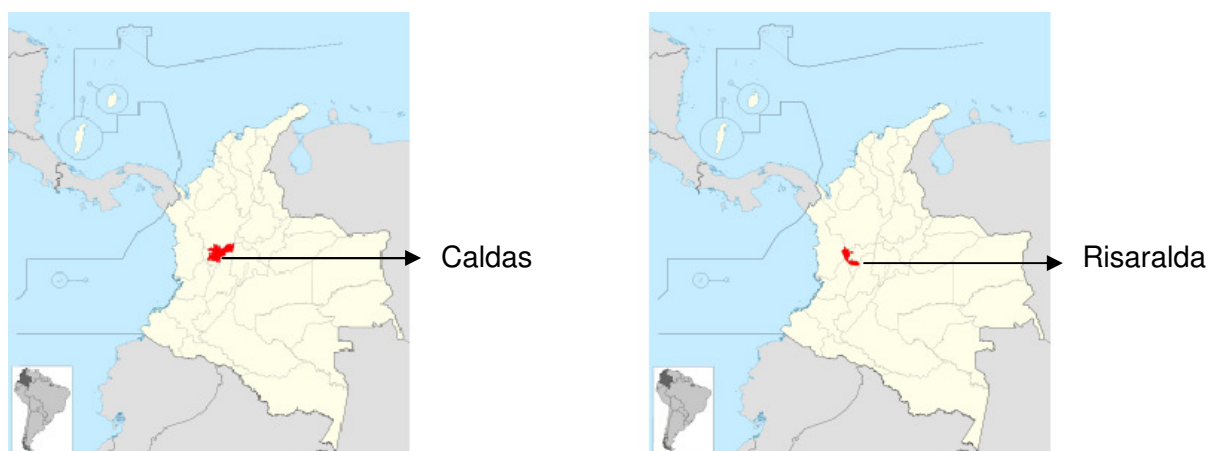


Figure 1: Caldas and Risaralda Departments

¹ CENTRAL HIDROELÉCTRICA DE CALDAS S.A ESP. - <http://www.chec.com.co>



Figure 2: Anserma and Belén de Umbria cities

A.3. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Colombia (host Party)	Risaralda Energía S.A.S. E.S.P.	No

A.4. Reference to applied methodologies and standardized baselines

The methodology used was ACM0002²: *Consolidated baseline methodology for grid-connected electricity generation from renewable sources* - Version 13.0.0. This one already contains the standardized baseline.

And:

- TOOL07: *Tool to calculate the emission factor for an electricity system* - Version 02.2.1³

A.5. Crediting period type and duration

01/02/2015 until 31/01/2022 (Renewable)

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

The project activity is a newly built **run-of-river hydropower plant**.

Prior to the construction of the proposed project activity, the equivalent SHP Morro Azul electricity has been supplied by an power plant matrix that has strong participation of fossil-fuelled power plants.

Considering the plants connected to the national grid, the electrical generation using fossil fuel represented 30.8%⁴ of the national generation (data from December 2011). The project activity reduces GHG emissions avoiding the operation entrance of thermoelectric power plants connected

² <http://cdm.unfccc.int/methodologies/view?ref=ACM0002>

³ <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v6.pdf>

⁴ <http://www.xm.com.co/Pages/DescripciondelSistemaElectricoColombiano.aspx> - December 2011

to the grid, that use fossil fuel as energy source. In absence of the project activity, those plants would operate in order to supply the electrical demand of the country.

The Project facility contains a small dam, which stores water in order to generate electricity for short periods of time. It was designed to function as a run of river scheme. A typical run of river scheme involves a low-level diversion dam. A low-level diversion dam raises the river water level sufficiently to enable an intake structure to be located on the river side. The intake consists of a trash screen and a submerged opening with an intake gate. Water from the intake is normally taken through a pipe (called a penstock) downhill to a power station constructed downstream of the intake and as low level as possible to gain the maximum head on the turbine.

Figure 3 below shows the scheme of a run of the river power plant:

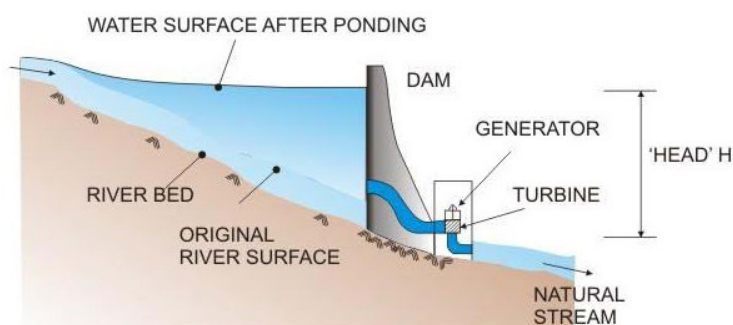


Figure 3 - Schematic view of a run of river power plant

The Small Hydropower plant Morro Azul dispatches generated energy to the National Interconnected Grid through its lift substation (13.8 to 33 kV) located near the SHP's powerhouse.

The emissions sources and GHGs involved are CO₂ emissions from electricity generation in fossil fuel fired power plants and emissions of CH₄ from the reservoir of new large hydropower plants less efficient that would be implanted to complement the availability of energy in the country in case of no additional energy input had occurred.

The baseline scenario to the project activity is the same as the scenario existing prior to the start of implementation of the project activity.

The table below presents the SHP Morro Azul technical characteristics:

Table 2: SHP Morro Azul technical characteristics

Installed Capacity (MW)	19.90
Generators Type	Synchronous
Number of Generators	3
Voltage (KV)	13.8
Turbines Type	Francis
Number of Turbines	3
Spin (rpm)	720
Frequency (Hz)	60
Assured Energy (MWaverage)	14.12
Annual Generation (MWh /year)	123,691
Average Flow (m ³ /s)	15.27
Reservoir area (km ²)	0.1217

The equipment and technology used in the Project Activity has been successfully applied to similar projects in Colombia and around the world.

Follow below the Table 3 with the main PA milestones:

Table 3: Main milestones

Construction Start	January/2012
Start of test operation	20/08/2016
Start of commercial operation	10/09/2016 ⁵

And below the Table 4 with the meters identification:

Table 4: Meters Identification

Nº	METERS IDENTIFICATION		DATE OF ISSUE	VALIDITY
1	Number: 51385987 Manufacturer: Landys & Gyr	Main meter	16/03/2016	4 years
2	Number: 51385981 Manufacturer: Landys & Gyr	Backup meter	08/03/2016	4 years

B.2. Post-registration changes

B.2.1. Temporary deviations from the registered monitoring plan, applied methodologies or standardized baselines

Not Applicable

B.2.2. Corrections

Not Applicable

B.2.3. Changes to the start date of the crediting period

Not Applicable

B.2.4. Inclusion of monitoring plan

Not Applicable

⁵ See document: "GC-008 2016 XM Declaración en Operación Comercial PCH Morro Azul 19.9 MW - Firma G Comercial.pdf"

B.2.5. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other applied standards or tools

Not Applicable

B.2.6. Changes to project design

Not Applicable

SECTION C. Description of monitoring system

The monitoring plan for this project activity is based on CDM methodology **ACM0002** - “**Consolidated baseline methodology for grid-connected electricity generation from renewable sources**”, and consists of monitoring: SHP electricity generation, the power plant installed capacity and the surface area of the reservoir at their full level.

The process is carried out in accordance with the requirements from EB on monitoring and verification to ensure that the emission reductions are monitored recorded and reported accurately. The following are the key items that are considered in the monitoring plan:

i) Monitoring equipment and installation

Given that, the emission factor is calculated *ex-ante*, and referring to the Monitoring Methodology ACM0002, the data to be monitored is the electricity delivered to the grid by the SHP according to the Methodology.

The main electricity meters for establishing the electricity delivered to the grid was installed at the input end of the transmission line (Anserma Substation - that belongs to the local electricity transmission company).

All equipment used to monitor the electricity production is provided by certified entities and calibration certificates up-to-date are available. Records of the meters (type, manufacturer, model and calibration documentation) are being recorded and filed.

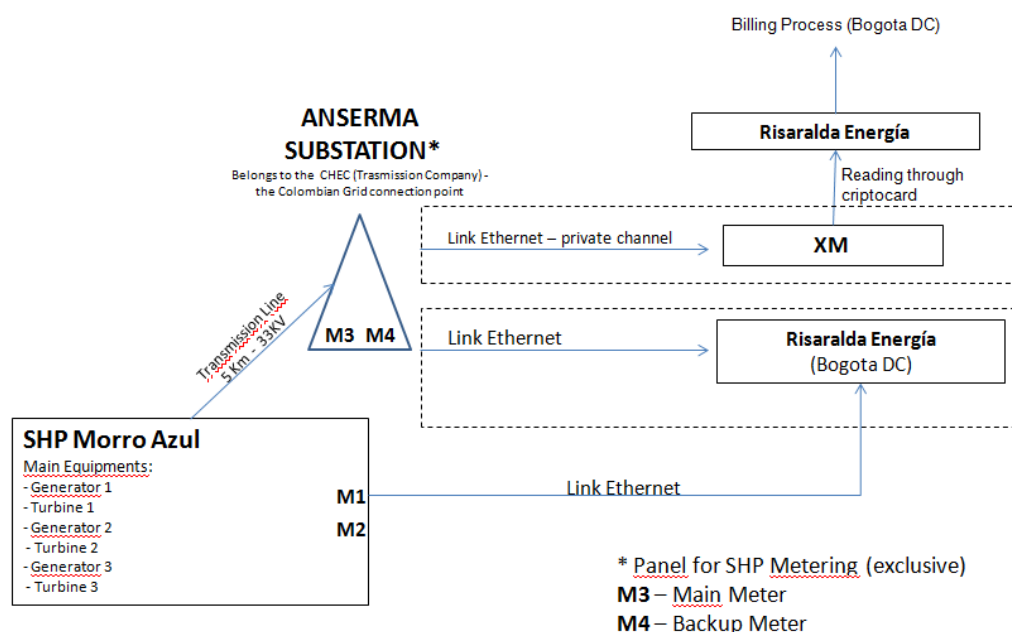


Figure 4: Metering Scheme

ii) Technological elements

For the readings and reports of generated energy was required to install the measurement equipment at the substation of the power plant or in a place that from the technical point of view is highly recommended, these elements are comprised mainly of current transformers, transformers power and electronic meter, all calibrated by a legally registered entity and approved by regulators.

iii) Central Reading and reports

Risaralda Energía S.A.S. E.S.P is the entity responsible for metering readings through their own access to the meters registrations and also could access the readings made public available by the XM's (the communication link between Meters and XM's shall be done by a private channel with properly security and encrypted).

iv) Procedure of data recording and archive

- Electricity is monitored using a continuous meter and recorded through the main meter.
- Grid Company confirms the electricity transactions.
- Records of the meter readings obtained to reflect the actual data of supplied electricity to the grid.
- Project owner will archive the data electronically until two years after the end of the crediting period.
- Quality assurance and Quality control has being applied: The quality of data generated by this project will be maintained through the development of an overarching monitoring system. This system may include procedures used to double check data, for staff training, meter calibration, accreditation of the facility completing calibration and the adherence to the relevant standards.

v) Monitoring Management Structure

An organization structure for monitoring SHP Morro Azul was created just before the project activity start date. An executive is responsible for monitored parameters (data acquisition and recording) for CDM purposes. The monitoring organization structure includes the employees responsible for monitoring, data collection and storage and archiving as well as reporting. A plant Manager was designated to take charge for supervising measurement and recording works, related to data collection (meter readings) that will be performed by operational staffs. The CDM manager is responsible for the overall data.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

Data/Parameter	<i>Cap_{BL}</i>
Unit	W
Description	Installed capacity of the hydro power plant before the implementation of the project activity. For new hydro power plants, this value is zero.
Source of data	Project site.
Value(s) applied	0
Choice of data or measurement methods and procedures	Not applicable.
Purpose of data/parameter	Calculation of the project emissions.
Additional comments	

Data/Parameter	A_{BL}
Unit	m ²
Description	Area of the reservoirs measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m2). For new reservoirs, this value is zero.
Source of data	Project site.
Value(s) applied	0
Choice of data or measurement methods and procedures	Not applicable.
Purpose of data/parameter	Calculation of the project emissions.
Additional comments	

Data/Parameter	$EF_{grid,CM,y}$
Unit	tCO ₂ e/MWh
Description	Combined Margin CO ₂ emission factor for grid connected power generation in year y calculated using the latest version of the “Tool to calculate the emission factor for an electricity system”.
Source of data	Calculation carried out by the Project Participant in accordance with the “Tool to calculate the emission factor for an electricity system” The emissions factor calculated will consider the parameters presented by the Energy and Mining Planning Unit (“UPME”) of the Ministry of Mines and Energy delegated by the Ministry of Environment, Housing and Territorial development (“MAVDT”) to carry out such calculation.
Value(s) applied	0.36777
Choice of data or measurement methods and procedures	The Combined Margin is calculated through a weighted-average formula, considering both the $EF_{grid,OM-adj}$ and the $EF_{grid,BM,y}$ and the weights w_{OM} (default 0.5 for the first crediting period and 0.25 for the second and third crediting periods) and w_{BM} (default 0.5 for the first crediting period and 0.75 for the second and third crediting periods).
Purpose of data/parameter	Calculation of baseline emissions.
Additional comments	Parameters used for the calculation of the grid's emission factor are presented in Appendix 4 of the PDD version 3.

Data/Parameter	$EF_{grid,OM-adj,y}$
Unit	tCO ₂ e/MWh
Description	CO ₂ Operating Margin emission factor of the grid, in a year y
Source of data	Calculation carried out by the Project Participant in accordance with the “Tool to calculate the emission factor for an electricity system” The emissions factor calculated took in consideration the parameters presented by the Energy and Mining Planning Unit (“UPME”) of the Ministry of Mines and Energy delegated by the Ministry of Environment, Housing and Territorial development (“MAVDT”) to carry out such calculation.
Value(s) applied	0.54340

Choice of data or measurement methods and procedures	According procedures established by “Tool to calculate the emission factor for an electricity system”.
Purpose of data/parameter	Calculation of baseline emissions.
Additional comments	Parameters used for the calculation of the grid’s emission factor are presented in Appendix 4 of the PDD version 3.

Data/Parameter	$EF_{grid,BM,y}$
Unit	tCO ₂ e/MWh
Description	CO ₂ Build Margin emission factor of the grid, in a year y
Source of data	Calculation carried out by the Project Participant in accordance with the “Tool to calculate the emission factor for an electricity system” The emissions factor calculated took in consideration the parameters presented by the Energy and Mining Planning Unit (“UPME”) of the Ministry of Mines and Energy delegated by the Ministry of Environment, Housing and Territorial development (“MAVDT”) to carry out such calculation.
Value(s) applied	0.19215
Choice of data or measurement methods and procedures	According procedures established by “Tool to calculate the emission factor for an electricity system”.
Purpose of data/parameter	Calculation of baseline emissions.
Additional comments	Parameters used for the calculation of the grid’s emission factor are presented in Appendix 4 of the PDD version 3.

D.2. Data and parameters monitored

Data/Parameter	$EG_{Morro\ Azul,y}$
Unit	MWh/year
Description	Quantity of net electricity generation supplied by the project activity to the grid, in year y.
Measured/calculated/default	Measured
Source of data	Electricity meters located in the Anserma Substation
Value(s) of monitored parameter	2015 = 0 2016 (from 10/09/2016) = 20,631 2017 = 109,991 2018 (until 30/06/2018) = 51,808
Monitoring equipment	Electricity meter at output of substation.
Measuring/reading/recording frequency	Monthly and Annual Recording.
Calculation method (if applicable)	Not applicable.
QA/QC procedures	The meter comply with national standards and industrial regulations to ensure accuracy. The meters (bidirectionals) are sealed for safety after calibration. The electricity delivered to the grid is checked against the XM results (extracted from the: http://www.xm.com.co).
Purpose of data/parameter	Calculation of baseline emissions.

Additional comments	The data will be archived monthly (electronic) should be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later.
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Data/Parameter	$Cap_{PJ} - Morro Azul$
Unit	W
Description	Installed capacity of the hydro power plant after the implementation of the project activity.
Measured/calculated/default	Measured
Source of data	Equipment technical specifications
Value(s) of monitored parameter	19,900,000
Monitoring equipment	Technical specifications on the installed equipments (turbines and generators).
Measuring/reading/recording frequency	Annual
Calculation method (if applicable)	Not applicable
QA/QC procedures	Can be checked through plaque inspection or manufacturers sheet specifications.
Purpose of data/parameter	Calculation of baseline emissions.
Additional comments	

Data/Parameter	$A_{PJ} - Morro Azul$
Unit	m ²
Description	Area of the reservoir measured in the water surface, after the implementation of the project activity, when the reservoir is full.
Measured/calculated/default	Measured
Source of data	Technical studies provided from third party and/or PP
Value(s) of monitored parameter	121,700
Monitoring equipment	Measured from topographical surveys or satellite pictures.
Measuring/reading/recording frequency	Annual
Calculation method (if applicable)	Not applicable
QA/QC procedures	
Purpose of data/parameter	This data is applied for the Power Density calculation.
Additional comments	

D.3. Implementation of sampling plan

Not applicable.

SECTION E. Calculation of emission reductions or net anthropogenic removals

E.1. Calculation of baseline emissions or baseline net removals

The Emission Reductions for this project activity are:

$$ER = BE_y - L_y - PE_y$$

The baseline emissions are then proportional to the electricity delivered to the grid throughout the project's lifetime. Baseline emissions due to displacement of electricity are calculated by multiplying the electricity baseline emissions factor ($EF_{grid, CM, y}$) for the electricity generated by the project activity.

$$BE_y = EG_{BL,y} \cdot EF_{CO2,grid,y}$$

The electricity energy generated by the SHP Morro Azul ($EG_{BL,y}$) in the year y are:

2016 (after 10/09/2016) = 20,631 MWh/year

2017 = 109,991 MWh/year

2018 (until 30/06/2018) = 51,808 MWh/year

Total (10/09/2016 until 30/06/2018) = 182,430 MWh (658 days)

So the baseline emissions are:

$$BE_y = 182,430 \cdot 0.36777 = 67,091 \text{ tCO}_2\text{e/year}$$

To this project the leakage aren't considered, so:

$$L_y = 0.$$

As mentioned the (PE_y) is zero:

$$PE_y = 0$$

Thus all this, the Emission Reductions (ER) from the project activity are:

$$ER = 67,091 - 0 - 0 = 67,091 \text{ tCO}_2\text{e/year}$$

E.2. Calculation of project emissions or actual net removals

According to the project category and the corresponding methodology, project emissions are zero.

E.3. Calculation of leakage emissions

There is no leakage associated with this project activity.

E.4. Calculation of emission reductions or net anthropogenic removals

	Baseline GHG emissions or baseline net GHG removals (t CO ₂ e)	Project GHG emissions or actual net GHG removals (t CO ₂ e)	Leakage GHG emissions (t CO ₂ e)	GHG emission reductions or net anthropogenic GHG removals (t CO ₂ e)		
				Before 01/01/2013	From 01/01/2013	Total amount
Total	67,091	0	0	0	67,091	67,091

E.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the registered PDD

Amount achieved during this monitoring period (t CO ₂ e)	Amount estimated ex ante (t CO ₂ e)
67,091	81,880

E.6. Remarks on increase in achieved emission reductions

Not applicable (GHG emission reductions achieved is lower than the amount based on the ex ante estimation in the registered PDD).

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Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
06.0	7 June 2017	Revision to: <ul style="list-style-type: none"> • Ensure consistency with version 01.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN); • Make editorial improvements.
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: <ul style="list-style-type: none"> • Include provisions related to delayed submission of a monitoring plan; • Provisions related to the Host Party; • Remove reference to programme of activities; • Overall editorial improvement.
04.0	25 June 2014	Revisions to: <ul style="list-style-type: none"> • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from <i>F-CDM-MR</i> to <i>CDM-MR-FORM</i>; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB 70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01.0	28 May 2010	EB 54, Annex 34. Initial adoption.
Decision Class: Regulatory Document Type: Form Business Function: Issuance Keywords: monitoring report		