

**MONITORING REPORT FORM (F-CDM-MR)**
Version 02.0**MONITORING REPORT**

| | |
|--|---|
| Title of the project activity | Malagone SHP CDM Project, Minas Gerais, Brazil (JUN1122) |
| Reference number of the project activity | 4676 |
| Version number of the monitoring report | 1 |
| Completion date of the monitoring report | 13/04/2012 |
| Registration date of the project activity | 15/06/2011 |
| Monitoring period number and duration of this monitoring period | First monitoring period. 9.5 months (15/06/2011-31/03/2012) |
| Project participant(s) | Hidrelétrica Malagone S.A. and Carbotrader Assessoria e Consultoria em Energia Ltda (both Private Entity) |
| Host Party(ies) | Brazil |
| Sectoral scope(s) and applied methodology(ies) | Sectoral Scope 1 – Energy Industries (Renewable / Non-renewable Sources) Methodology ACM0002 |
| Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD | 21,788 tCO ₂ e |
| Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period | 24,203 tCO ₂ e |

SECTION A. Description of project activity**A.1. Purpose and general description of project activity**

The present project activity consists in the electricity generation by renewable sources – hydro potential, through the construction of a Small Hydro Power plant (SHP) called Malagone, developed by the Special Purpose Entity: Hidrelétrica Malagone S.A.

With an installed capacity of 19MW, the SHP is located in the Uberabinha river in the Uberlândia city, Minas Gerais State – south-east region, Brazil.

The electricity delivered to the National Interconnected Grid System (SIN) replaces thermal generation from fossil fuels that would have to be inputted in the system with the generation of a renewable source of energy.

The project activity contributes to the environmental sustainability by increasing the share of renewable energy in relation to the total electricity consumption in Brazil.

Considering that the project activity consists in a SHP with a small reservoir (1.72 km²) –, it represents a virtually zero environmental impact when compared to large hydroelectric plants. This fact is very important because the construction of Small Hydro Power plants can really contribute to the efficient use of the environmental and natural resources, avoiding the growth of the environmental and social liabilities caused by new large hydroelectric power plants or fossil fuel thermal generation.

In this way, the investment in modern technology for small hydropower plants contributes for an efficient use of the water resources as a relevant factor to be emphasized, adding value to the natural resources.

The technology used in the enterprise is the Uberabinha River (Paranaíba River Basin) hydro energy potential for the electricity generation by the gravitational energy of the water, which is used to move the turbines and by doing this, trigger generators that enable the generation of electricity. This is a source of clean energy and renewable that presents minimal impact on the environment.

The Malagone SHP dispatches generated energy to the National Interconnected Grid (SIN - Sistema Interligado Nacional) through the Uberlândia SE Substation – 1 (CEMIG SE-1, which line extension has 34 Km, in 138 KV) located in the Uberlândia city, Minas Gerais state, Brazil. CEMIG is also the local distributor.

The emissions sources and GHGs involved are CO₂ emissions from electricity generation in fossil fuel fired power plants that is displaced due to the project activity and emissions of CH₄ from the reservoir.

The technical characteristics of equipments can be seen in Table 1 below:

Table 1 : SHP technical characteristics

| SHP | Malagone |
|---|-----------------|
| Installed Power (MW) | 19 |
| Reservoir (Km ²) | 1.72 |
| Assured Generation (MW) | 10.11 |
| Flow Rate River Average (m ³ /s) | 25 |
| Turbines | Francis |
| Quantity | 2 |

| | |
|-------------------------------|--------|
| Power (kW) | 9,800 |
| Flow rate (m ³ /s) | 26.36 |
| Spin (rpm) | 400 |
| Generators | |
| Quantity | 2 |
| Nominal Power (kVA) | 10,560 |
| Effective Power (MW) | 9.5 |
| Voltage (kV) | 6.9 |
| Power factor | 0.9 |
| Frequency (Hz) | 60 |

The relevant dates for the project activity were:

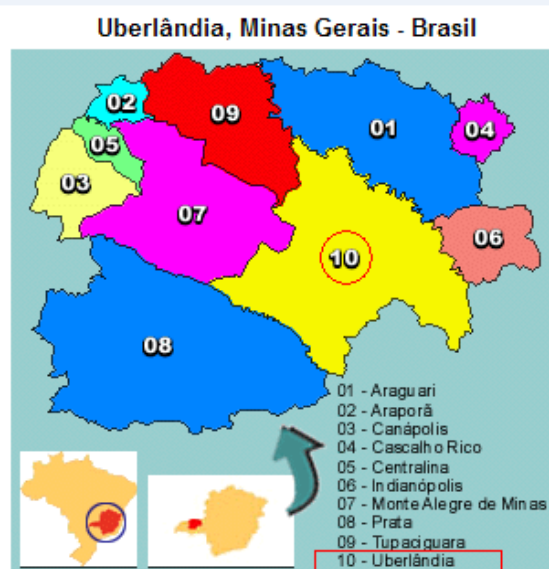
| Timeline SHP Malagone | |
|----------------------------------|----------------------------|
| Start of construction | 1 st April 2008 |
| Electromechanical installation | 30 May 2009 |
| Commissioning of the UG1 and UG2 | from 9 to 20 March 2010 |
| Start of Commercial Operation | 1 st April 2010 |

The total GHG emission reductions in this monitoring period (15 June 2011 until 31 March 2012) were **24,203 tCO₂**.

A.2. Location of project activity

The project activity is located in the Uberabinha River in the municipality of Uberlândia, Minas Gerais State, Brazil. The geographical coordinates of the location of the dam are: 18° 40' 50'' S e 48° 29' 57'' W. The Figure 1 illustrates the location of the enterprise:

Figure 1: Geographical location of Uberlândia city.



Source: Wikipedia - pt.wikipedia.org and City Brazil - www.citybrazil.com.br¹

¹ City Brasil – Percorrendo o Brasil de A a Z. <http://www.citybrazil.com.br>

**A.3. Parties and project participant(s)**

| Party involved (host) indicates a host Party) | Private and/or public entity(ies) project participants (as applicable) | Indicate if the Party involved wishes to be considered as project participant (Yes/No) |
|--|--|--|
| Brazil (Host Country) | Hidrelétrica Malagone S.A (Private Entity) | No |
| | Carbotrader Assessoria e Consultoria em Energia Ltda (Private Entity) | |

A.4. Reference of applied methodology

The methodology used was the ACM0002: "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" - version 11 (valid from 26 February 2010 to 16 September 2010).

The methodology tool used to the baseline calculation was the "Tool to calculate the emission factor for an electricity system" - version 02 (valid from 16 October 2009 to 14 April 2011).

A.5. Crediting period of project activity

15/06/2011 to 14/06/2018, renewable.

SECTION B. Implementation of project activity**B.1. Description of implemented registered project activity**

The project was implemented according its technical specification. The commissioning was done from 9 to 20 March 2010, and the commercial operation started on 1st April 2010.

The unique difference in the technical characteristics in PDD was the dimension of reservoir, which changed from 1.27km² to 1.72km².

The crediting period began in 15 June 2011 (with the project registration on the CDM EB), and for its first monitoring the measures had been done until 31 March 2012.

B.2. Post registration changes**B.2.1. Temporary deviations from registered monitoring plan or applied methodology**

Not Applicable

B.2.2. Corrections

Not Applicable

B.2.3. Permanent changes from registered monitoring plan or applied methodology

Not Applicable

B.2.4. Changes to project design of registered project activity

Not Applicable

B.2.5. Changes to start date of crediting period

Not Applicable

B.2.6. Types of changes specific to afforestation or reforestation project activity

Not Applicable

SECTION C. Description of monitoring system

The measurement system does the measure and records the value of the energy. For the measurement system of the SHP Malagone was installed a panel containing two meters (one main and one back-up). This panel measurement is exclusive of the SHP Malagone and is located in substation Uberlândia 1 from CEMIG (Companhia Energetica de Minas Gerais - the local energy utility). The measurement system measures and records the energy, and for this system is guaranteed the inviolability of the data, which is sealed for safety after the calibration.

The Monitoring and Measurement System, called SMF, consists of a meter panel and a satellite-link to communicate and send the data to the CCEE and Malagone. SMF energy measurement panel consists of a principal meter and a back-up meter (reserve meter), simultaneously connected in the panel. If there is a problem with the principal meter, the back-up meter automatically continues the measurement of energy, without any discontinuity.

Both the measurement data (CCEE and Malagone) comes from the same meters, the main one with serial number PT-0902A505-01, or the back-up with serial number PT-0902A177-01, in case of fail of the main meter.

The CCEE reads the data through a GPRS system and the software: Sinercom. The same data is send to Malagone through the CAS system and the software Hemera Technology Platform.

The procedures designed for monitoring electricity generation by the project activity follows the parameters and rules of the Brazilian energy sector. The National Grid Operator (ONS) and the Electric Power Commercialization Chamber (CCEE) are the entities responsible for specification of the technical requirements of energy measurement system for billing.

Data monitoring:

The meter readings are used to calculate the emission reductions. The monitoring steps are as follows:

- (1) The data will be measured hourly and recorded monthly;
- (2) Spreadsheets containing the electricity dispatched to the grid are generated; CCEE data measured (from CCEE databank – SINERCON) are used to calculate the emissions reductions and, if necessary, sales receipts will be used to cross check the monitored data;
- (3) The Malagone provides to Carbotrader their recorded datas from the meters, CCEE datas and, when necessary, copies of energy bills.
- (4) The emissions reductions are managed by the project manager responsible at Carbotrader;

Details regarding the parameter to be monitored can be founded in the section D.2.

Quality control:**(1) Calibration of meters**

The calibration of meters is conducted by a qualified organization that complies with national standards and industrial regulations to ensure the accuracy. After calibration, the meters are sealed for safety and the calibration certificates are archived with the monitoring datas.

(2) Emergency treatment

In case of unavailability of measures from any point of measurement, due to maintenance, commissioning or for any other reason, will be used the methodology to estimate data as the item 14.3 of the Procedure of Energy Commercialization PdC ME.01²

Data Management:

All data gathered in the monitoring range will be electronically filed and kept for at least 2 years after the last crediting period. The crediting to be generated will be calculated regularly by the project proponents and kept for the verification phase.

Procedures:

The procedures are the described in the ONS site – “Module 12: Measurement for billing”, as well as in sub-modules:

- 12.1 - Billing Measurement: An Overview,
- 12.2 - Installation of the measuring system for billing,
- 12.3 - Maintenance of the measurement system for billing,
- 12.4 - Collection of metering data for billing,
- 12.5 - Certification of labor standards,
- 12.6 - Settings for measuring revenue.

These procedures are available in http://www.ons.org.br/procedimentos/modulo_12.aspx, and are being followed by the agents responsible for the generation of the SHP Malagone. Thus, here are defined procedures for collection of data generation, frequency calibration of the measuring system, equipment accuracy class of the measuring system, etc.

Authority and Responsibility

The Hidrelétrica Malagone S.A is responsible for the maintenance and calibration of the monitoring equipments, compliance to operational requirements and corrective actions related to the functionality of the project activity. Moreover, the company has authority and responsibility for registration, monitoring, and measurement as well as managing the project, to organize staff training to use appropriated techniques in those procedures.

The Baseline, Project Emissions (if applicable) and Emissions Reductions calculations will be performed by Carbotrader Assessoria e Consultoria em Energia Ltda which should report the results in a proper way to the entities related with the CDM process.

² <http://www.ccee.org.br/cceeinterdsm/v/index.jsp?vgnextoid=67778d3ef9a3c010VgnVCM1000005e01010aRCRD>

**SECTION D. Data and parameters****D.1. Data and parameters fixed ex ante or at renewal of crediting period**

| | |
|---------------------------|--|
| Data/Parameter | <i>C_{appJ}</i> |
| Unit | W |
| Description | Installed capacity of the hydro power plant after the implementation of the project activity. |
| Source of data | Project site |
| Value(s) applied | 19,000,000 |
| Purpose of data | Calculation of the project emissions. |
| Additional comment | In Brazil, the installed capacity of hydropower plants is determined and authorized by the competent regulatory agency. Furthermore, any modification must be authorized and made public available. Thus, annually, any new authorization to increase the installed capacity of plan is monitored. |

| | |
|---------------------------|--|
| Data/Parameter | <i>A_{PJ}</i> |
| 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. |
| Source of data | Project site |
| Value(s) applied | 1,717,174 |
| Purpose of data | Calculation of the project emissions. |
| Additional comment | |



D.2. Data and parameters monitored

| | |
|--|---|
| Data/Parameter | $EG_{facility,y}$ |
| Unit | MWh/year |
| Description | Quantity of net electricity generation supplied by the project plant/unit to the grid in year y. |
| Measured/Calculated /Default | Measured |
| Source of data | Project site - Energy Meters |
| Value(s) of monitored parameter | 80,489.96 in 9.5 months |
| Monitoring equipment | 2 meters (main and back-up), Type: ION-8600, Manufacturer: Schneider Electric, accuracy class 0.2; Serial number: PT-0902A505-01 and PT-0902A177-01; calibration frequency: each 2 years; Last calibration: 20 July 2011; validity: 20 July 2013. |
| Measuring/Reading/Recording frequency | Hourly measurement and reading and monthly recording. |
| Calculation method (if applicable) | - |
| QA/QC procedures | These data will be used for calculate the emission reductions. The data will be archived monthly (electronic) and will be archived during the credit period and two years after. The data from the energy meters will be cross checked with the CCEE databank in order to verify the coherency of the data. |
| Purpose of data | Calculation of baseline emissions |
| Additional comment | - |

| | |
|--|--|
| Data/Parameter | $EF_{grid,CM,y}$ |
| Unit | tCO ₂ /MWh |
| Description | Combined margin CO ₂ emission factor for grid connected power generation in year y |
| Measured/Calculated /Default | Calculated |
| Source of data | Based on data provided by the DNA (Designated National Authority). |
| Value(s) of monitored parameter | 0.3007 |
| Monitoring equipment | - |
| Measuring/Reading/Recording frequency | Annually |
| Calculation method (if applicable) | The Combined Margin is calculated through a weighted-average formula, considering the $EF_{grid,OM-DD,y}$ and the $EF_{grid,BM,y}$ and the weights w_{OM} and w_{BM} default 0.5. as defined in the "Tool to calculate the emission factor for an electricity system", version 02. |
| QA/QC procedures | |
| Purpose of data | Calculation of baseline emissions |
| Additional comment | |



| | |
|--|---|
| Data/Parameter | $EF_{grid,OM-DD,y}$ |
| Unit | tCO ₂ /MWh |
| Description | CO ₂ Operating Margin emission factor of the grid, in a year y |
| Measured/Calculated /Default | Calculated |
| Source of data | Data provided by the DNA (Designated National Authority) monthly |
| Value(s) of monitored parameter | 0.4611 |
| Monitoring equipment | Not applicable. |
| Measuring/Reading/Recording frequency | Monthly |
| Calculation method (if applicable) | As defined in the “Tool to calculate the emission factor for an electricity system” |
| QA/QC procedures | This data, updated, will be applied in <i>ex-post</i> calculation of the Emission Factor. |
| Purpose of data | Calculation of baseline emissions |
| Additional comment | |

| | |
|--|---|
| Data/Parameter | $EF_{grid,BM,y}$ |
| Unit | tCO ₂ /MWh |
| Description | CO ₂ Build Margin emission factor of the grid, in a year y |
| Measured/Calculated /Default | Default |
| Source of data | Data provided by DNA (Designated National Authority) to the year y. |
| Value(s) of monitored parameter | 0.1404 |
| Monitoring equipment | Not applicable. |
| Measuring/Reading/Recording frequency | Annual |
| Calculation method (if applicable) | As defined in the “Tool to calculate the emission factor for an electricity system” |
| QA/QC procedures | This data, updated, will be applied in <i>ex-post</i> for the calculation of the Emission Factor. |
| Purpose of data | Calculation of baseline emissions |
| Additional comment | |

D.3. Implementation of sampling plan

Not applicable.

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

The baseline methodology considers the determination of the emissions factor to the grid which the project activity is connected as the core data to be determined in the baseline scenario. In Brazil, the grid is interconnected by the National Interconnected System (SIN) in a single system³.

³ http://www.mct.gov.br/upd_blob/0024/24834.pdf

“Operating Margin *OM* Emission Factor” calculation ($EF_{grid,OM-DD,y}$)

The calculation of the $EF_{grid,OM-DD,y}$ was done using the form and datas below. The $EF_{grid,OM-DD,y}$ is published by the Brazilian DNA monthly.

$$EF_{grid,OM-DD,y} = \frac{\sum_m EG_{PJ,m} \cdot EF_{OM,DD,m}}{EG_{PJ,y}}$$

Where:

$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/year);

The calculation of the $EF_{grid,OM-DD,y}$ was done using the form above and the datas from the table below. The $EF_{grid,OM-DD,y}$ is published by the Brazilian DNA monthly.

| Energy generated between 15 th June 2011 and 31 st March 2012 (MWh) | | | | | | | | | |
|---|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|
| JUN | JUL | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR |
| 4246.671 | 6978.043 | 5741.202 | 4321.582 | 6833.335 | 6972.492 | 9707.770 | 13322.948 | 11465.160 | 10900.757 |
| EF_{OM} 2010 (tCO ₂ /MWh) | | | | | | | | | |
| JUN | JUL | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR |
| 0.4809 | 0.4347 | 0.6848 | 0.7306 | 0.7320 | 0.7341 | 0.6348 | 0.2111 | 0.2798 | 0.2428 |

$$EF_{grid,OM-DD,y} = 0.4611 \text{ tCO}_2/\text{MWh}$$

“Building Margin *BM* Emission Factor” ($EF_{grid,BM,y}$)

The $EF_{grid,BM,y}$ is published by the Brazilian DNA annually. The last data available is of the year 2010.

$$EF_{grid,BM,y} = 0.1404 \text{ tCO}_2/\text{MWh}$$

“Baseline Emission Factor” calculation ($EF_{grid,CM,y}$)

The baseline emission factor ($EF_{grid,CM,y}$) is calculated through a weighted-average formula, considering both the $EF_{OM,y}$ and the $EF_{BM,y}$ weighted 50% each, by definition, that gives:

$$EF_{grid,CM,y} = EF_{grid,OM-DD,y} * 0,5 + EF_{grid,BM,y} * 0,5 \text{ (tCO}_2/\text{MWh)}$$

$$EF_{grid,CM,y} = 0.4611 * 0.5 + 0.1404 * 0.5$$

$$EF_{grid,CM,y} = 0.3007 \text{ tCO}_2/\text{MWh}$$

Baseline Emissions

Baseline emissions (BE_y in tCO₂) are the product of the baseline emissions factor ($EF_{grid,CM,y}$ in tCO₂/MWh) multiplied by the electricity supplied by the project activity to the grid ($EG_{PJ,y}$ in MWh), as follows:

$$BE_y = EF_{grid,CM,y} * EG_{PJ,y}$$

Where:

- BE_y = Baseline emissions in year y (tCO₂e/year);
- $EF_{grid,CM,y}$ = Combined margin CO₂ 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” (tCO₂/MWh).
- $EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/year);

$$BE_y = 80,489.96 * 0,3007$$

$$BE_y = 24,203 \text{ tCO}_2$$

E.2. Calculation of project emissions or actual net GHG removals by sinks

The power density of the project activity is calculated as follows:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}}$$

Where:

- PD Power density of the project activity, in W/m².
- Cap_{PJ} Installed capacity of the hydro power plant after the implementation of the project activity (W).
- Cap_{BL} Installed capacity of the hydro power plant before the implementation of the project activity (W). For new hydro power plants, this value is zero.
- A_{PJ} Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m²).
- A_{BL} Area of the reservoir 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.

$$PD = \frac{19,000,000 - 0}{1,717,174 - 0} = 11.06 \text{ W/m}^2$$

As the Power Density of the project activity is greater than 10W/m², then Project Emissions are zero.

E.3. Calculation of leakage

There is no leakage associated with this project activity.

E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

| Time Period | Baseline emissions or baseline net GHG removals by sinks (tCO ₂ e) | Project emissions or actual net GHG removals by sinks (tCO ₂ e) | Leakage (tCO ₂ e) | Emission reductions or net anthropogenic GHG removals by sinks (tCO ₂ e) |
|--------------|---|--|------------------------------|---|
| Total | 24,203 | 0 | 0 | 24,203 |

**E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD**

| Item | Values estimated in ex-ante calculation of registered PDD | Actual values achieved during this monitoring period |
|---|---|--|
| Emission reductions or GHG removals by sinks (tCO ₂ e) | 21,788 | 24,203 |

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

The little increase in the measured value of emissions reduction (11.1%) occurred because the emission factors measured (year 2010) were, in average, greater than the emission factors used in the forecast in the PDD (year 2008 - that were the datas available in that time).

History of the document

| Version | Date | Nature of revision |
|---|--------------------------------|--|
| 02.0 | EB 66 13 March 2012 | Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20). |
| 01 | EB 54, Annex 34 28 May 2010 | Initial adoption. |
| Decision Class: Regulatory Document Type: Form Business Function: Issuance | | |