

# **2<sup>nd</sup> CDM MONITORING REPORT**

Brazil - Version 5

## **AQUARIUS HYDROELECTRIC PROJECT**

CDM Registration Reference # 0627

Registration Date: 15 Dec 06

Monitored Period:  
01 January 2008 – 31 December 2009  
(including both days)



**mgm** INTERNATIONAL

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## ***1. Introduction***

“Aquarius Hydroelectric Project” has been registered as a CDM Project Activity by UNFCCC on 15 December 2006 under reference number 0627.

This monitoring report aims to inform and quantify the total amount of emission reductions carried out between 01 January 2008 to 31 December 2009 (including both days).

Aquarius is a small hydropower plant which generates and deliver energy to the Brazilian Interconnected Electricity System (BIES).

The project activity is classified as a small scale project:

Type I – Renewable Energy Projects

Category I.D – Version 8 – Grid connected renewable electricity generation.

Further background on this project can be found in the PDD and its associated documents, which are available on the UNFCCC website:

<http://cdm.unfccc.int/Projects/DB/DNV-CUK1158855257.5/view>

## ***2. Reference Documents***

- The approved simplified methodology AMS ID – version 8.
- Validation report “Aquarius Hydroelectric Project in Brazil”. No. 2003-0506. Date: June 2003.
- CDM registration “Aquarius Hydroelectric Project”. Ref. 0627. Date of registration: 15 December 2006.
- Registered PDD “Aquarius Hydroelectric Project”. Version 3. Date: 26 August, 2006.

## ***3. Brief description of the project activity***

The objective of the project activity is to generate clean electricity using hydroelectric resources, provide and sell it to the regional power grid. Renewable electricity generation avoids emissions of CO<sub>2</sub> that would result from fossil fuel-fired power generation.

Aquarius generates clean electricity in a rural area of Brazil, increasing employment opportunities in the area.

The project has an installed capacity of 4.2 MW, and utilizes the water of the Correntes river, a run-of-river project with no dam or flooding, and thus with very little environmental impact.

The Aquarius Hydroelectric project was started in the 1980s, and interrupted because of uncertainties in the electric power sector. At that time, the following structures were built:

- Water intake for the channel
- Partial excavation of the conduction channel
- Three bases for blocks of anchorage of the penstock
- Access Ramp to the Power Plant area

During the 1990s the project was reactivated and linked to the 180 MW Ponte de Pedra hydropower plant which has a dam located around 10 km upstream of the proposed Aquarius project. Since mid-2005, Ponte de Pedra has been operating.

The total height difference (head) between the head pond and the turbine/generator is approximately 60 meters. The dam takes advantage of the existing natural fall and the inlet water is at 254.3 m above sea level. The project requires a 350 meter conduction channel (of trapezoidal section), and a 160 meter long penstock, and two turbines are installed.

The plant is connected to the electricity transmission network, through Sonora Substation, which is part of ENERSUL (Empresa Energética do Mato Grosso do Sul), the local electric distribution company.

Aquarius hydroelectric plant delivered, during the last 3 years, an average of 34,200 MWh/year to the Brazilian power system.

As the power plant is located at the end of the ENERSUL system, another important function of Aquarius consists of improving the quality of power supply in the region.

#### ***4. Project location***

The project will be located in the Central-Western region of Brazil (latitude: 17°37'18"S and longitude 54°53'24"W), in the Sonora Municipality, near the Correntes river, which separates the Mato Grosso do Sul state, from the state of Mato Grosso.

#### ***5. Aquarius Monitoring Report***

According to option (a) of Type I, Category D of CDM small-scale project activity categories contained in Appendix B of the simplified M&P for CDM

small-scale project activity, monitoring shall consist of metering the electricity generated by the renewable technology. At the project validation, the calculation of the CO<sub>2</sub> emission factor of the grid as well as the CO<sub>2</sub> Operating Margin and the CO<sub>2</sub> Build Margin emission factors of the grid were also required. However, these data should be checked only once, at the validation.

The GHG emissions reduction during the period from 01 January 2008 to 31 December 2009 (including both days) was achieved through the dispatched electricity generated by Aquarius Hydroelectric Project that displaced a mix of electricity generation in the Brazilian Interconnected Electricity System.

Calculation of the emissions reduction is based on validated and registered parameters fixed in the PDD and justified during the validation. The Emission Factor for electricity generation is fixed as 0.5217 tCO<sub>2</sub>/MWh. This value is stated on page 25 of the PDD.

## **6. Monitoring Period**

Period of the monitoring report: January 1<sup>st</sup>, 2008 – December 31<sup>st</sup>, 2009 (including both days).

Amount of monitored emissions reductions: 35,466 tCO<sub>2</sub>.

## **7. Date of Completion of the Monitoring Report**

The monitoring report was completed on 10 February 2010 and updated according to DOE's requests on 14 July 2010

## **8. Data monitored**

**Table 1 - Data Monitored - Electricity supplied to the Grid**

<b>Data/Parameter:</b>	<b>EG</b>
<b>Data unit:</b>	kWh
<b>Description:</b>	Electricity supplied to the grid by Aquarius Hydropower Plant
<b>Source of data to be used:</b>	Supplied Electricity meters
<b>Value of data monitored</b>	Please refer to Table 6
<b>Recording frequency</b>	Continuously measured. Aggregated and recorded every 15 minutes
<b>Any comment:</b>	--

### 8.1. Reference of applicable documents

Information about electricity generation documents from Aquarius meters, (every 15 minutes registration frequency) are available to verification, at final form on document type “MGM\_Aquarius\_Workbook.xls”.

### 8.2. Additional information

The Monitoring Report is based on the electricity delivered to the grid by Aquarius Hydroelectric Project. The amount of energy delivered is monitored by the energy producer and the measuring equipment is connected online to the CCEE (Electrical Energy Commercialization Chamber), who is responsible for the accounting of the supplied energy by controlling all electricity delivered to the grid and assuring for the buyer that the electricity generated is delivered to the grid.

The monitoring of these measurements is done under the responsibility of Enersul. Electricity supplied to the grid is monitored by Enersul every 15 minutes, and Enersul provides the data to the project owner on a monthly basis, in an electronic file called “PCH Aquarius *month year*.RTF”.

Such files are being submitted to the Verification DOE along with the Monitoring Report. The monthly data provided by Enersul are electronically archived by the person in charge of the monitoring of Aquarius Hydroelectric Project. The summary data can be found in the excel spreadsheet “MGM\_Aquarius\_Workbook”.

## 9. Monitoring Equipment

The following table presents the specifications of monitoring equipment:

**Table 2 - Monitoring Equipment Specifications**

<b>Equipment Model</b>	Q1000
<b>Data Parameter</b>	EG (Energy supplied: kWh)
<b>Manufacturer</b>	ITRON
<b>Serial Number</b>	Principal – 43273994 Back-up - 43273997
<b>Meter location</b>	Substation belonging to the power utility ENERSUL
<b>Date of installation</b>	Principal - 18/07/2006 Back-up - 18/07/2006
<b>Date of last calibration</b>	Principal - 08/04/2009 Back-up - 08/04/2009
<b>Calibration frequency</b>	Every 2 years (according to national norm)

<b>Need for change and replacement</b>	N/A
<b>Calibration Procedure</b>	Verification of parameters deviation regarding the default reference.
<b>Involvement of third parties for calibration</b>	The calibration was carried out by Enersul, the local electricity utility. Monitoring is performed through two instruments (principal and back-up). Its precision class is 0.2%. The calibration certificates are available to the DOE.

### 9.1. Calibration Frequency

According to the National Dispatch Center (ONS as in Portuguese) norm 12<sup>1</sup> that regulates the procedures for the electricity monitoring equipment purchase, installation and commissioning, the electricity meter must be calibrated every two years.

However, as such norm is relatively new, only two calibrations were held since the SHP commissioning, as follows:

**Table 3 - Calibration Events**

<b>Responsible Entity</b>	<b>Date</b>	<b>Valid Until</b>
ENERSUL	17/07/2006	16/07/2008
ENERSUL	08/04/2009	07/04/2011

As shown in the table above, the next calibration after the calibration dated 17 July 2006 was performed only on 08 April 2009 (with a time span of 265 days between the calibrations in accordance to the ONS norm). Therefore, the electricity generated and measured during such period was adjusted in a conservative manner as established by the “Guidelines for Assessing Compliance with the Calibration Frequency Requirements”, EB52 Report, Annex 60<sup>2</sup>.

For this purpose, the electricity generation was deduced of 0.2%, which is the meter maximum permissible error according to the IEC 60687 norm for 0.2S meters, manufacturer declaration of compliance at instrument specifications and approved by ANEEL (National Electricity Energy Agency).

## 10. Special Events and Over performance

<sup>1</sup> [http://www.ons.org.br/procedimentos/modulo\\_12.aspx](http://www.ons.org.br/procedimentos/modulo_12.aspx)

<sup>2</sup> [http://cdm.unfccc.int/EB/052/eb52\\_repan60.pdf](http://cdm.unfccc.int/EB/052/eb52_repan60.pdf)

Special events are defined as events that somehow affect the generation of energy during a period of time.

During the monitored period, the following special events were observed:

- April/2008 - Low generation was due to a landslide at the energy control house area occurred in the beginning of the month and completely repaired only in the end of April. Fact that impacted on the generators operation and consequently on the supply of electricity to the grid during almost the whole month.
- The remaining months had regular generation with occasional stops, common on this type of plant operation due to several reasons, such as lightning storms and atmosphere conditions, substation problems and distribution events that impact on the necessity of stops on operations.

Over performance is defined as a higher electricity generation than the expected and estimated on the PDD.

Table 4 presents a comparison of the estimated ERs and the ERs actually generated by the Aquarius Hydroelectric Project.

**Table 4 ERs estimated x ERs generated**

Year	ERs Estimated in the PDD	ERs monitored and claimed.
2008	13,436	17,157
2009	13,436	18,309

As presented on Table 4, the Aquarius Hydroelectric project has generated about 32% over the estimated ERs during this monitored period. Such over performance was mainly due to the Correntes river's flow which was guaranteed by national regulations as it follows.

As stated in item A.2 of the Project Design Document, the project is linked to the 180-MW Ponte de Pedra Hydropower Plant, which is located 10 km upstream of the Aquarius Hydroelectric Project.

The Environmental State Agency legislation has established a minimum river water flow of 10 m<sup>3</sup>/s in the Rio Correntes for the Ponte de Pedra Hydropower in order to assure water supply to the inhabitants and wild life.

This minimal stream assured by the drainage of Ponte de Pedra dam, enabled Aquarius Hydroelectric Project to increase its capacity factor over the initially estimated one and to operate with 100% effectiveness.

Please refer to Project Participant Response to the Request for Review #2 from DNV during the first verification of the project:  
<http://cdm.unfccc.int/Projects/DB/DNV-CUK1158855257.5/iProcess/DNV-CUK1200044418.31/view>



## 11. Emission Reductions calculations

The Emission Reductions are calculated according to the following formulas:

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

Where:

- $ER_y$  = Emission reductions due to the project activity during the year  $y$  (tCO<sub>2</sub>)  
 $BE_y$  = Baseline emissions during the year  $y$  (tCO<sub>2</sub>)  
 $PE_y$  = Project emissions during the year  $y$  (tCO<sub>2</sub>), which is zero according to the corresponding methodology.  
 $LE_y$  = Leakage emissions during the year  $y$  (tCO<sub>2</sub>), which is zero according to the corresponding methodology.

Emission reductions are therefore the same as baseline emissions  $E_{baseline}$  given by:

$$E_{baseline} (\text{tonneCO}_2 / \text{year}) = \frac{\langle E_{baseline} \rangle (\text{kgCO}_2 / \text{kWh}) \times EG (\text{kWh} / \text{year})}{1000 \text{kg} / \text{tonne}} \quad (2)$$

Where:

- $E_{baseline}$  = Baseline emissions during the year  $y$  (tCO<sub>2</sub>)  
 $\langle E_{baseline} \rangle$  = Emission factor for electricity generation (kgCO<sub>2</sub>/kWh).  
 $EG$  = Electricity generation at the Aquarius power plant during the year  $y$  (kWh/year)

For the first crediting period, the Emission Factor for electricity generation is fixed as: 0.5217tCO<sub>2</sub>/MWh. (This value is stated on page 25 of the PDD.)

## 12. Quality Assurance and Control Measures (QA/QC)

Table 5 - Quality Assurance and Control Measures

<b>Data Parameter</b>	EG (Energy supplied: kWh)
<b>Additional Data Parameter</b>	EG1 (Generated Energy: kWh)
<b>QA/QC procedures applied</b>	<ul style="list-style-type: none"> <li>Supplied energy is monitored by two instruments where one is a back-up in case of broking down or any other event that affect the correctly running of the principal meter.</li> <li>Invoices of electricity sales to the grid are used to cross check and ensure data consistency Regular calibration of the monitoring equipment by an accredited company (Enersul).</li> </ul>

**Involvement of third parties for calibration**

Enersul, the local electric utility certifies the meters calibration periodically (every two years).

### 13. *Aquarius Electricity Generation*

**Table 6 - Electricity Generation (MWh)**

Electricity Generated (MWh)		
Year	2008	2009
January	3,034.33	3,032.98
February	2,750.03	2,687.71
March	2,989.37	2,799.75
April	893.57	2,910.38
May	3,021.60	3,022.52
June	2,939.32	2,933.97
July	3,030.48	3,030.52
August	2,992.05	3,001.74
September	2,914.03	2,925.33
October	2,936.64	2,941.37
November	2,444.50	2,844.74
December	2,948.89	2,971.58
Total	32,894.79	35,102.59

Total Generation during the monitoring period covered (from 01/01/2008 to 31/12/2009 – including both days): **67,997.38 MWh**.

### 14. *Emission Reductions*

**Table 7 - Emission Reductions (tCO<sub>2</sub>)**

Emission Reductions (tCO <sub>2</sub> )		
Year	2008	2009
January	1,583	1,582
February	1,434	1,402
March	1,559	1,460
April	466	1,518
May	1,576	1,576
June	1,533	1,530
July	1,581	1,581
August	1,560	1,566
September	1,520	1,526
October	1,532	1,534
November	1,275	1,484
December	1,538	1,550
Total	17,157	18,309

Emission Reductions over the monitoring period (from 01/01/2008 to 31/12/2009 – including both days) = **35,466 tCO<sub>2</sub>**.

## **15. Contact Information**

### **Project**

Project: Aquarius Hydroelectric Project

Client: Aquarius Energética S.A.

UNFCCC #:0627

### **Monitoring Report**

Date: July 14th, 2010

Version: 05 – updated according to the verification findings

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