CLEAN DEVELOPMENT MECHANISM
MONITORING REPORT

ARAPUtanga **C**entrais **EL**étricas S. A. - **ARAPUCEL** - Small Hydroelectric Power Plants Project

(CDM Registration Reference Number 0530)

Monitored Period: 01 September 2002 to 31 December 2006
Crediting Period: 01 September 2002 to 31 August 2009

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Section A. General description of project activity

A.1. Title of the project activity

ARAPUtanga **C**entrais **EL**étricas S. A. - **ARAPUCEL** - Small Hydroelectric Power Plants Project (hereafter referred to as "Arapucel Project").

Document version number: 01, 31/December/2006.

Monitoring Report based on the PDD Version Number: 05, from 01/June/2006.

A.2. Description of the project activity

The primary objective of the Arapucel Project is to help meet Brazil's rising demand for energy due to economic growth and to improve the supply of electricity, while contributing to the environmental, social and economic sustainability by increasing renewable energy's share of the total Brazilian (and the Latin America and the Caribbean region's) electricity consumption.

The Latin America and the Caribbean region countries have expressed their commitment towards achieving a target of 10% renewable energy of the total energy use in the region. Through an initiative of the Ministers of the Environment in 2002 (UNEP-LAC, 2002), a preliminary meeting of the World Summit for Sustainable Development (WSSD) was held in Johannesburg in 1992. In the WSSD final Plan of Implementation no specific targets or timeframes were stated, however, their importance was recognized for achieving sustainability in accordance with the Millennium Development Goals[1].

The privatization process initiated in 1995 arrived with an expectation of adequate tariffs (less subsidies) and better prices for generators. It drew the attention of investors to possible alternatives not available in the centrally planned electricity market.. At the end of the 1990's a strong increase in demand in contrast with a less-than-average increase in installed capacity caused the supply crisis/rationing from 2001/2002. One of the solutions the government provided was flexible legislation favoring small independent energy producers. Furthermore the possible eligibility under the Clean Development Mechanism of the Kyoto Protocol drew the attention of investors in small hydropower projects.

In this scenario, *Brennand Energia Group,* began to consider investing in small renewable energy power projects (thermo and hydro) in Brazil. One of the main ventures of the Group, the Arapucel Project – through Araputanga Centrais Elétricas S.A., Arapucel Indiavaí S.A. and Arapucel Ombreiras S.A. companies – , started to be developed in 2001, exploring the hydropower potential in three locations of the Jaurú River, near the cities of Araputanga and Jaurú, in the State of Mato Grosso, Midwest of Brazil.

1 WSSD Plan of Implementation, Paragraph 19 (e): "Diversify energy supply by developing advanced, cleaner, more efficient, affordable and cost-effective energy technologies, including fossil fuel technologies and renewable energy technologies, hydro included, and their transfer to developing countries on concessional terms as mutually agreed. With a sense of urgency, substantially increase the global share of renewable energy sources with the objective of increasing its contribution to total energy supply, recognizing the role of national and voluntary regional targets as well as initiatives, where they exist, and ensuring that energy policies are supportive to developing countries' efforts to eradicate poverty, and regularly evaluate available data to review progress to this end."

The project consists of three small hydroelectric power plants ("PCH", from the Portuguese, *Pequena Central Hidrelétrica*), PCH Alto Jauru (20.0 MW), PCH Indiavaí (28.0 MW) and PCH Ombreiras (26.0 MW), totalizing 74 MW installed capacity. The project was developed in three phases. The first phase was initiated in the first semester of 2001 and concluded in September 2002, when PCH Alto Jauru started its operations. The second phase finished in August 2003 when PCH Indiavaí started to operate adding 28 MW to the Arapucel Project. The third phase of the project is the implementation of the PCH Ombreiras, which added more 26 MW to project installed capacity. Ombreiras is operational since July 2005. The PDD registered applies to the three phases.

This indigenous and cleaner source of electricity has an important contribution to environmental sustainability by reducing carbon dioxide emissions that would have occurred otherwise in the absence of the project. The project activity reduces emissions of greenhouse gas (GHG) by avoiding electricity generation by fossil fuel sources (and CO_2 emissions), which would be generating (and emitting) in the absence of the project.

A.3. Arapucel Monitoring Report

The Monitoring Report is based on the electricity delivered to the grid by Arapucel project. The GHG emissions reduction during the period from September 2002 to December 2006 was achieved through the dispatched electricity generated by PCH Alto Jauru (20.0 MW), PCH Indiavaí (28.0 MW) and PCH Ombreiras (26.0 MW), that displaced a mix of electricity generation in the Brazilian South-Southeast-Midwest Interconnected National Electric System - SIN grid.

The monitoring methodology shall be used in conjunction with the approved baseline methodology ACM0002 ("Consolidated baseline methodology for grid-connected electricity generation from renewable sources") and applies to electricity capacity additions from run-of-river hydro power plants.

The methodology is applicable to the project activity. It consists in using meter equipment projected to registry and verify bi-directionally the energy generated by the facility. This energy measurement is fundamental to verify and monitor the GHG emission reductions. The Monitoring Plan permits the calculation of GHG emissions generated by the project activity in a straightforward manner, applying the baseline emission factor.

The baseline emission factor for project activities as Arapucel Project for the Brazilian South-Southeast-Midwest grid is 0.2611 tCO2/MWh.

A.4. Period of the monitoring report and amount of monitored emissions reductions

Period of the monitoring report: 01/September/2002 – 31/December/2006

Amount of monitored emissions reductions: 405,221.88 tCO_2

Total crediting period of the project: 01/September/2002 – 31/August/2009

A.5. Date of completing the monitoring report

The date of completing the monitoring report was 31/December/2006.

A.6. Personnel Responsible

Executive President – Mozart de Siqueira Campos Araújo (Grupo Brennand Energia)
Monitoring Report – Ricardo Esparta (Ecoinvest Assessoria Ltda.)

Section B. Monitoring methodology and plan

B.1. Name and reference of approved monitoring methodology applied to the project activity

ACM0002 - "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" Version 5.

B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

The chosen methodology is applicable to grid-connected renewable power generation projects, under the condition of electricity capacity additions from run-of-river hydro power plants, as is the case with the Arapucel Project.

During a period of restructuring the entire electricity market, as is the current Brazilian situation, investment uncertainty is the main barrier for small renewable energy power projects. In this scenario these projects compete with existing plants (operating margin) and with new projects (build margin), which usually attract the attention of financial investors. Operating and Build Margins have been used to calculate the emission factor for the connected grid.

Although the dispatching information is considered strategic to power agents, the national dispatch center, through the Independent System Operator – ISO, " in portuguese ONS – *Operador Nacional do Sistema* – will make it available for grid emission factor calculation. The data from ONS and CCEE, Chamber of Electric Energy Commercialization (from the Portuguese *Câmara de Comercialização de Energia Elétrica)* or Distribution Companys will be collected every year and the project participants through CDM consultants will calculate of the emission factor.

According to the selected approved methodology (ACM0002), the baseline emission factor is calculated as (EF_y) is calculated as a combined margin (*CM*), consisting of the combination of operating margin (OM) and build margin (BM) factors. For the purpose of determining the build margin and the operating margin emission factors, a project electricity system is defined by the spatial extent of the power plants that can be dispatched without significant transmission constraints. Similarly a connected electricity system is defined as an electricity system that is connected by transmission lines to the project electricity system and in which power plants can be dispatched without significant transmission constraints.

B.3. Data to be monitored:

ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (Electronic/ paper)	Comment
1. EG_y	*Electricity generation of the Project delivered to grid*	*Energy metering connected to the grid and Receipt of Sales*	*MWh*	*M*	*15-minutes-measurement and Monthly recording*	*100%*	*Electronic and Paper*	The electricity delivered to the grid is monitored both by the project owner (seller). A Brazilian government entity, CCEE – *Câmara Comercializadora de Energia Elétrica* - controls and monitors the electricity available on the national interconnected grid. The amount of electricity delivered to the grid by the project activity is available on CCEE's and CEMAT – Centrais Elétricas do Estado do Mato Grosso web-sites.
2. EF_y	*CO_2 emission factor of the grid*	*Calculated*	*tCO_2/MWh*	*C*	*Every year*	*n.a.*	*Electronic and Paper*	*Data will be collected every year during the crediting period according the approved methodology – ACM0002.*
3. $EF_{OM,y}$	*CO_2 Operating Margin emission factor of the grid*	*Data provided by ONS (National dispatch center). Calculated according the approved methodology – ACM0002*	*tCO_2/MWh*	*C*	*Every year*	*n.a.*	*Electronic and Paper*	*Data will be collected every year during the crediting period according the approved methodology – ACM0002*
4. $Ef_{BM,y}$	*CO_2 Build Margin emission*	*Data provided by ONS. Calculated*	*tCO_2/MWh*	*C*	*Every year*	*n.a.*	*Electronic and Paper*	*Data will be collected every year during the crediting period according the approved*

	factor of the grid	*according the approved methodology – ACM0002*						*methodology – ACM0002*
5. λ_y	*Fraction of time during which low-cost/must-run sources are on the margin*	*Data provided by ONS. Calculated according the approved methodology – ACM0002*		*C*	*Every year*	*n.a.*	*Electronic and Paper*	*Data will be collected every year during the crediting period according the approved methodology – ACM0002*

Section C. Monitored data

As the project is neither associated with leakage effects nor with new emissions of pollutants and all other pertinent data is necessary to be analyzed and presented only at the validation phase of the project, the only data that has to be monitored going forward during the life of the contract is the electricity supplied to the grid by the project (EG_y), besides the emission factor, given that the parameters chosen for the calculation of emission reductions were ex-post. Data monitored and required for verification and issuance will 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.

The main data to be considered in determining the emissions reductions is the electricity exported to the grid. The emissions reduction is reached by applying an emissions factor through the electricity dispatched to the grid, that is verified and monitored by the power plant that sells the electricity.

The project sponsor proceeded with the necessary measures for the power control and monitoring. Together with the information produced by ANEEL (National Agency of Electric Energy) , ONS (ISO) and Regional Distribution Companies, it was possible to monitor the power generation of the project and the grid power mix. Beyond that, information about power generation and energy supplied to the grid are controlled by the CCEE and Distribution Companies make feasible and regulate the electricity energy commercialization and are responsible for monitors monthly the energy delivered to the grid.

The energy meters are specified by the energy distribution company and approved by ONS(ISO) and CCEE. Each PCH utilizes a pair of SL7000 meter, manufactured by Actaris Metering Systems. These meters are calibrated by CEMAT - *Centrais Elétricas Matogrosses S.A.* according CCEE. Measurements are controlled in real time by the PCH Digital System and compared between the two meters, so that any problems can be detected (like water shortage, materials inside the turbines, meter inaccuracy, etc). In case of any problem, plant personnel will be put in action.

C.1. Data collected in order to monitor project emissions

GHG emissions by the project activity are zero.

C.2. Data collected in order to monitor baseline emissions

Following the electricity generation by plant:

PCH ALTO JAURU Generation (MWh)					
Years/Months	**2002**	**2003**	**2004**	**2005**	**2006**
January	-	14,130.16	14,372.38	11,902.96	14,237.54
February	-	12,632.19	13,288.52	11,417.73	13,026.70
March	-	13,981.02	13,309.76	13,991.63	11,787.95
April	-	13,582.85	13,459.78	13,959.61	16,148.33
May	-	14,205.38	13,617.63	14,507.99	14,098.98
June	-	13,179.46	14,160.86	13,578.56	14,066.17
July	-	14,219.11	14,342.50	14,301.15	13,578.63
August	-	14,383.20	14,541.46	14,425.78	14,069.61
September	5,066.59	13,907.25	13,995.24	13,849.04	12,222.66
October	13,178.55	14,200.69	14,193.71	14,308.54	11,679.86
November	13,466.91	13,885.33	13,752.17	14,220.78	13,943.27(*)
December	13,380.10	14,215.72	14,442.21	14,724.72	14,326.31(*)
TOTAL	**45,092.14**	**166,522.34**	**167,476.22**	**165,188.48**	**163,186.01**

Table 1 – Electricity generation delivered to grid by PCH Alto Jauru
(*) Value to be confirmed by CCEE

PCH INDIAVAÍ Generation (MWh)					
Years/Months	**2002**	**2003**	**2004**	**2005**	**2006**
January	-	-	16,027.00	16,813.35	16,991.09
February	-	-	15,278.00	15,963.44	17,201.80
March	-	-	16,359.00	16,959.67	20,578.07
April	-	-	16,178.14	16,020.20	16,035.71
May	-	-	16,134.90	15,380.76	16,338.71
June	-	-	14,301.79	14,374.32	14,490.63
July	-	-	14,594.39	14,331.10	14,288.11
August	-	10,016.44	13,506.09	13,729.05	13,616.55
September	-	12,811.11	12,640.32	13,813.72	13,661.59
October	-	14,054.08	13,633.96	14,336.74	16,098.16
November	-	13,799.72	14,659.01	14,875.62	14,752.89(*)
December	-	16,391.72	15,045.65	16,158.86	17,292.46(*)
TOTAL	-	**67,073.08**	**178,358.26**	**182,756.83**	**191,345.77**

Table 2 – Electricity generation delivered to grid by PCH Indiavaí
(*) Value to be confirmed by CCEE

PCH OMBREIRAS Generation (MWh)					
Years/Months	**2002**	**2003**	**2004**	**2005**	**2006**
January	-	-	-	-	13,929.76
February	-	-	-	-	14,611.46
March	-	-	-	-	15,135.80
April	-	-	-	-	15,871.96
May	-	-	-	-	13,983.21
June	-	-	-	-	12,737.62
July	-	-	-	2,942.96	12,559.46
August	-	-	-	12,039.14	11,116.99
September	-	-	-	8,821.31	12,215.08
October	-	-	-	11,796.13	14,216.88
November	-	-	-	10,783.46	13,513.53(*)
December	-	-	-	13,425.57	15,280.21(*)
TOTAL	-	-	-	**59,808.57**	**165,171.95**

Table 3 – Electricity generation delivered to grid by PCH Ombreiras
(*) Value to be confirmed by CCEE

ARAPUtanga Centrais ELétricas S. A. *ARAPUCEL - Small Hydroelectric Power Plants Project Generation (MWh)*					
PCH	**2002**	**2003**	**2004**	**2005**	**2006**
Alto Jauru	45,092.14	166,522.34	167,476.22	165,188.48	163,186.01
Indiavaí		67,073.08	178,358.26	182,756.83	191,345.77
Ombreiras				59,808.57	165,171.95
TOTAL	45,092.14	233,595.42	345,834.47	407,753.88	519,703,73

Table 4 – Electricity generation delivered to grid by Arapucel Project
(Sources: Araputanga Centrais Elétricas S. A., Arapucel Indiavaí S.A and Arapucel Ombreiras S.A)

Emission factors for the Brazilian South-Southeast-Midwest interconnected grid				
Baseline (including imports)	EF_{OM} [tCO2/MWh]	Load [MWh]	LCMR [MWh]	Imports [MWh]
2003	0.9823	288,933,290	274,670,644	459,586
2004	0.9163	302,906,198	284,748,295	1,468,275
2005	0.8086	314,533,592	296,690,687	3,535,252
	Total (2003-2005) =	906,373,081	856,109,626	5,463,113
	$EF_{OM,simple-adjusted}$ [tCO2/MWh]	$EF_{BM,2005}$	Lambda	
	0.4349	0.0872	λ_{2003}	
	Alternative weights	Default weights	0.5312	
	w_{OM} = 0.75	w_{OM} = 0.5	λ_{2004}	
	w_{BM} = 0.25	w_{BM} = 0.5	0.5055	
	Alternative EF_y [tCO2/MWh]	Default EF_y [tCO2/MWh]	λ_{2005}	
	0.3480	0.2611	0.5130	

Table 5 – CO_2 emission factor of the grid/ CO_2 Operating Margin emission factor of the grid/ CO_2 Build Margin emission factor of the grid

Section D. Calculation of GHG emission by sources

The Monitoring Report applies the *ex post* emission factor for project activities for the Brazilian South-Southeast-Midwest interconnected grid. Calculation of the emissions reduction is based on parameters monitored at every verification and justified during it. As shown in the table above, the CO2 emission factor of the grid is 0.2611 tCO2e/MWh.

D.1 Describe the formulae used to calculate emissions reductions

The emission reductions by the project activity (ERy) during a given period of year y are the product of the baseline emissions factor (*EFy*, in tCO2e/MWh) times the electricity supplied by the project to the grid at the same period of year y (*EGy*, in MWh), as follows:

$$ER_y = EF_y \cdot EG_y \qquad \textbf{Equation 1}$$

D.2 Tables providing values obtained when applying formulae above

ARAPUtanga Centrais ELétricas S. A.
ARAPUCEL - Small Hydroelectric Power Plants Project Generation (MWh)

Year	Electricity Generation (MWh)	Baseline Emission Factor (tCO2e/MWh)	Emissions Reduction (tCO2e)
2002 (01/Sep/2002 to 31/Dec/2002)	45,092.14	0.2611	11,773.56
2003 (01/Jan/2003 to 31/Dec/2003)	233,595.42	0.2611	60,991.76
2004 (01/Jan/2004 to 31/Dec/2004)	345,834.47	0.2611	90,297.38
2005 (01/Jan/2005 to 31/Dec/2005)	407,753.88	0.2611	106,464.54
2006 (01/Jan/2006 to 31/Dec/2006)	519,703,73	0.2611	135,694,64
		Total (tCO2e)	**405,221.88**

Annexes

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