MONITORING REPORT FORM (CDM-MR) *
Version 01 - in effect as of: 28/09/2010

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* as contained within the document entitled "Guidelines for completing the monitoring report form (CDM-MR)" (EB 54 meeting report, annex 34).

MONITORING REPORT
Version number 01, dated 03/03/2011

Fundão-Santa Clara Energetic Complex Project (FSCECP)
Reference number 1279
2nd monitoring period: 01/05/2009 – 30/04/2010

SECTION A. General description of the project activity

A.1. Brief description of the project activity:

The primary objective of the Project Activity 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.

This indigenous and cleaner source of electricity will also have 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.

The project is located in the southern region of Brazil in the cities of *Candói*, *Foz do Jordão* and *Pinhão*, *Paraná* state under the following geographic coordinates: 25°42' S and 52°00' W. The project consists of a hydroelectric complex, located in *Jordão* River, composed by *Fundão* and *Santa Clara* hydroelectric power plants, which present a small hydropower plant each. *PCH*[1] *Fundão I* and *PCH Santa Clara I* were built at the *UHE*[2] *Fundão* and *UHE Santa Clara*, respectively, using part of the sanitary flow of each facility to generate electricity. *Fundão* Complex presents a total installed capacity of 122.5 MW and a reservoir area of 2.15 km^2 and *Santa Clara* Complex presents 123.6 MW of total installed capacity and a reservoir area of 6.13 km^2. For the electricity generation, it was employed in each hydropower plant 2 units of Kaplan Turbine, manufactured by Impsa with 61 MW each and one turbine in *PCH Santa Clara I* with 3.6 MW and one turbine in *PCH Fundão I* with 2.5 MW.

Fundão-Santa Clara Energetic Complex Project is a two phase project, consisted of construction of two dams, to produce electricity in two different sites:

- Phase 1 (2005): operation of *Santa Cl*ara Complex comprehending *UHE Santa Clara* (120 MW) and *PCH Santa Clara I* (3.6 MW) started in 2005 with Santa Clara Complex operation and;
- Phase 2 (2006): operation of *Fundão* Complex comprehending *UHE Fundão* (120 MW) and *PCH Fundão* I (2.5 MW).

The table below summarizes the relevant dates for the project activity:

Table 1: Important dates for the project activity.

Actions	*Santa Clara* Complex	*Fundão* Complex

[1] UHE from the Portuguese "*Usina Hidrelétrica*".

[2] PCH from the Portuguese "*Pequena Central Hidrelétrica*", small hydro facility.

	UHE	PCH	UHE	PCH
Construction Date	01/12/2002	01/12/2002	01/04/2004	01/04/2004
Commissioning Phase	03/03/2005	25/05/2005	03/02/2006	13/09/2006
Test Operation Phase[3]	16/07/2005	17/07/2005	08/06/2006	17/11/2006
Commercial Operation Phase[4]	31/07/2005	13/08/2005	23/06/2006	29/12/2006

The GHG emission reductions during the period from May, 1st 2009 to April, 30st 2010 were achieved through the dispatched electricity generated by *Fundão-Santa Clara* Complex Project which displaced a mix of electricity generation in the Brazilian South-Southeast-Midwest interconnected grid. This monitoring report presents information related to the **second** verification of project activity which covers the period from May, 1st 2009 to April, 30th 2010. The total emission reductions by the project activity over the monitored period are **334,290 tCO_2e**.

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 whishes to be considered as project participant (Yes/No)**
Brazil (host)	Centrais Elétricas do Rio Jordão S.A. – ELEJOR	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:

The project activity is located in *Jordão* River, in *Candói*, *Foz do Jordão* and *Pinhão* municipalities, state of *Paraná*, Southern region of Brazil under the following geographic coordinates 25°42' S and 52°00' W.

A.4. Technical description of the project

Fundão-Santa Clara Complex Project is composed by *UHE Fundão* and *UHE Santa Clara* which present a small hydropower plant each, *PCH Fundão I* and *PCH Santa Clara I*, respectively.

Fundão Complex consists of a hydropower with 120 MW of installed capacity and a reservoir area of 2.15 km^2 and a small hydropower plant with 2.5 MW of installed capacity. The complex presents two turbo-generators with 60 MW each and one generator with 3.6 MW.

Santa Clara Complex also presents a hydropower plant and a small hydropower plant with 120 and
3.6 MW of installed capacity due to the two turbo-generators with 60 MW and one turbo-generator with 3.6 MW, respectively.

[3] It corresponds to the date when the first generating unit of *UHE Santa Clara* and *UHE Fundão* started its test operation phase, according to ANNEL Ordinance which will be supplied during the auditing.

[4] It corresponds to the date when the first generating unit of *UHE Santa Clara* and *UHE Fundão* started its commercial operation phase, according to ANEEL Ordinance which will be supplied during the auditing.

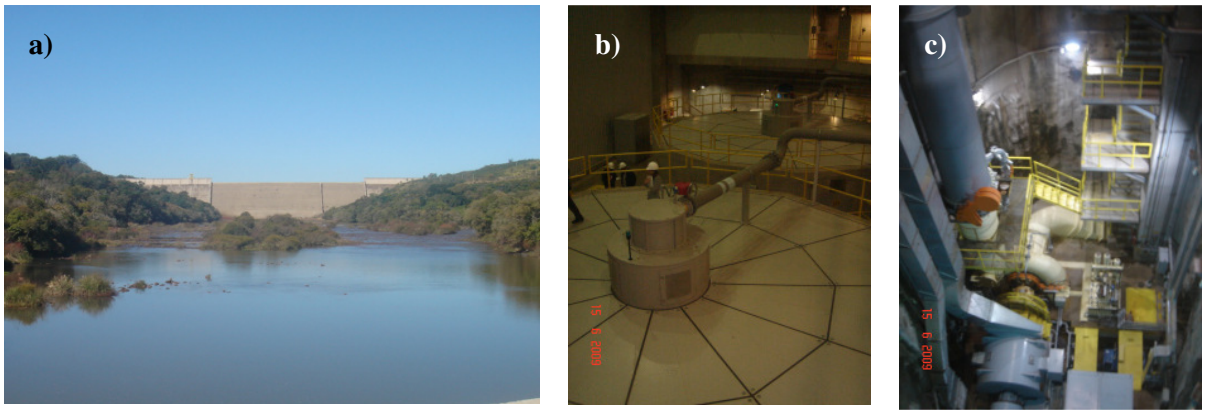

Figure 1: *Santa Clara* Complex. a) Dam of the Large Hydropower Plant *Santa Clara*, b) Large Hydropower Plant *Santa Clara* powerhouse and c) Small Hydropower Plant *Santa Clara* I equipment.

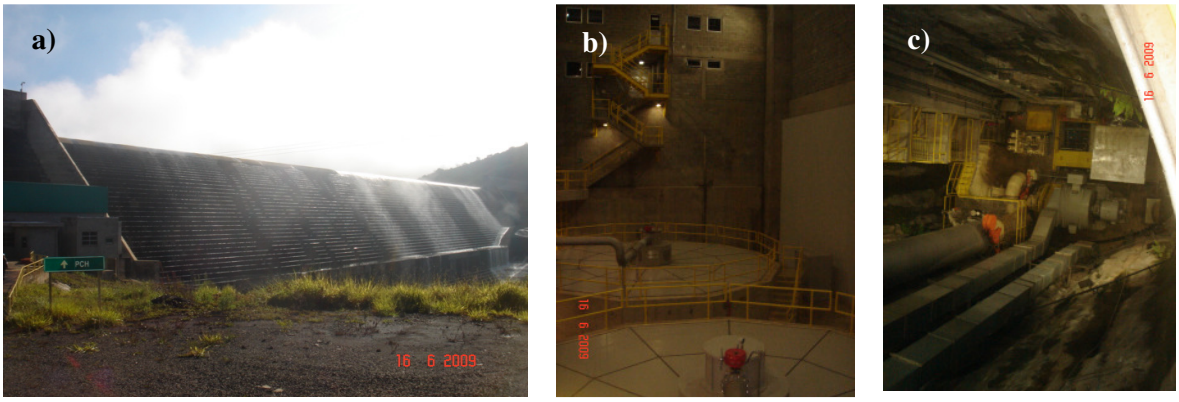

Figure 2: *Fundão* Complex. a) Dam of the Large Hydropower Plant *Fundão*, b) Large Hydropower Plant *Fundão* powerhouse and c) Small Hydropower Plant *Fundão I* powerhouse.

The production of electricity is possible using unevenness on a river which allows the use of energy associated with the waterfalls and the volume of water that will be stored in the reservoir. The implementation of a power plant on a river involves the construction of a dam to form the reservoir, the powerhouse, substation and the transmission lines. Also, there are two main structures on a dam: the penstock where the water flows to the powerhouse through the forced pipes to spin the turbines and the spillway in which the water excess flows during intense rainfalls.

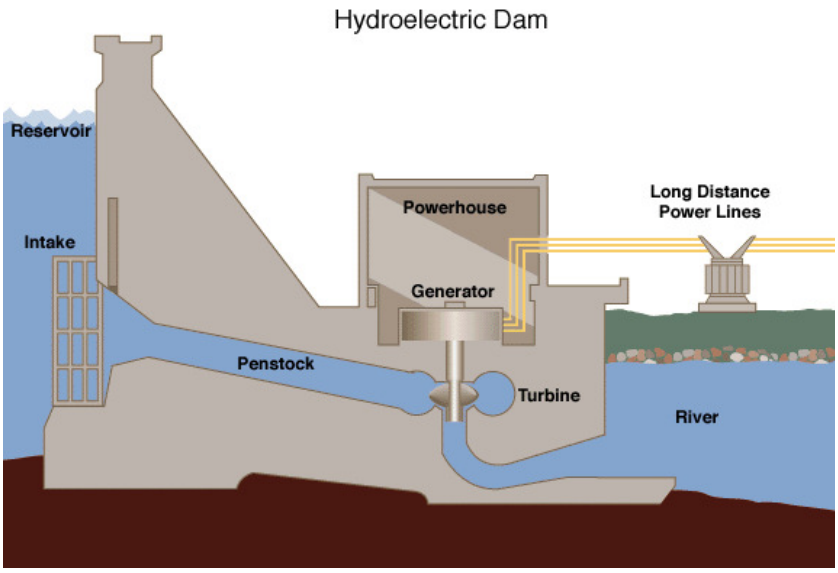

Figure 3: Schematic of a Hydroelectric Power Plant.

The main design characteristics are of the Complex are presented in the table below:

Table 1: *Fundão-Santa Clara* Complex main characteristics.

Characteristics	***Santa Clara* Complex**		***Fundão* Complex**	
	UHE	PCH	UHE	PCH
Installed Capacity (MW)	120	3.6	120	2.5
Reservoir area (km^2)	2.15	-	20.14	-
Power density (W/m^2)	56.97	-	6.13	-

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

The methodology applied to the project is ACM0002 – "Consolidated methodology for grid-connected electricity generation from renewable sources" (version 6).

A.6. Registration date of the project activity:

The CDM project activity was registered on May, 25th 2008.

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

The project activity opted for the renewable crediting period which started on May, 25th 2008. Therefore, the first crediting period lasts until May, 24th 2015.

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

Name of person/entity responsible for completing the monitoring report form (CDM-MR):

Company:	Ecopart Assessoria em Negócios Empresariais Ltda.
Address:	Rua Padre João Manoel, 222
Zip code:	01411-000
City address:	São Paulo, SP
Country:	Brazil
Telephone number:	+55 (11) 3063-9068
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Contact person:	Ms. Ana Paula Veiga and Ms. Bruna Marigheto
E-mail:	ana.veiga@eqao.com.br and bruna.marigheto@eqao.com.br

SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

Fundão-Santa Clara Energetic Complex Project was implemented and is currently operational accordingly to what was stated in the registered PDD, *i.e.* no modifications took place since the CDM project activity was registered. The plant is operational since May, 2008.

No special events - such as overhaul times, downtimes of equipment, exchange of equipment – occurred during the monitored period. Therefore, there were no events or situations that could have impacted the applicability of the methodology.

B.2. Revision of the monitoring plan

Not applicable.

B.3. Request for deviation applied to this monitoring period

Not applicable.

B.4. Notification or request of approval of changes

Not applicable.

SECTION C. Description of the monitoring system

The monitoring report is based on electricity delivered to the grid by *Fundão-Santa Clara* Energetic Complex Project. The amount of electricity generated by the plants and delivered to the grid is verified and monitored by the following entities:

1) *ELEJOR – Centrais Elétricas do Rio Jordão*, the energy producer (seller);

2) *COPEL – Companhia Paranaense de Energia* which is the local power utility. *COPEL* operates the hydroelectric complexes and monitors the quantity of energy exported to the grid. Also *COPEL* remotely registers the total amount of energy generated and dispatched to the grid by each plant which is informed to *CCEE* from its headquarters in *Curitiba* on a daily basis.

COPEL is also responsible for the calibration of the energy meters which follows the procedures[5] determined by the National Electric System Operator (from the Portuguese *Operador Nacional do Sistema Elétrico – ONS*). Section 12.3 of the above mentioned document sets the requirements regarding the maintenance of the Billing Commensuration System (from the Portuguese, *Sistema de Medição e Faturamento - SMF*) according to which the calibration of the energy meters is to be done every two years or postponed depending on the history of failure registered by the project owner.

3) National Chamber of Electric Energy Commercialization (from the Portuguese *Câmara de Comercialização de Energia Elétrica* - CCEE –) which is a state-owned company that checks and writes up the electricity delivered to the grid by all the plants and consumers connected to it, *i.e. CCEE* makes feasible and regulates the electricity energy commercialization in Brazil. In a process called Accounting Commensuration Aggregation (from the Portuguese, *Agregação Contábil da Medição*) *CCEE* compares the energy generation reported by every seller connected to the national grid with the consumption registered during the month under consideration. After the adjustments due to energy losses occurring in the transmission system are made, *CCEE* issues several official reports certifying the amount of energy generated by each seller. Whenever a discrepancy or disagreement is found between the generation and consumption data informed, *CCEE* re-processes the information performing the necessary adjustments. The final results are published at *CCEE*'s website and are publicly available. Hence, *CCEE*'s information - which is an official and publicly available source - was used to cross-check information provided by the project participant.

Each large hydro power plant has two generating units (GU) and each generating unit is monitored by two meters (principal and backup). Therefore, each large power plant has four meters. The small hydro power plants present one GU each, *i.e*, a principal and a backup meters. Hence, the project activity has twelve meters which monitor the net energy generated by the plants which is dispatched to the grid. The table below presents technical specifications of the meters used at FSCECP:

Table 2: Energy meters of FSCECP.

Description			***Manufacturer***	***Type /Model***	***Number***
UHE Santa Clara	**1st GU***	*Principal*	Schneider	ION 8600	PT-0710A307-01
					PT-0901A223-01
		Backup	Schneider	ION 8600	PT-0708A396-01
					PT-0901A224-01
	2nd GU	*Principal*	Schneider	ION 8600	PT-0710A306-01
					PT-0902A253-01
		Backup	Schneider	ION 8600	PT-0710A310-01
					PT-0902A295-01
PCH Santa Clara I	**GU**	*Principal*	Schneider	ION 8600	PT-0901A238-01
		Backup	Schneider	ION 8600	PQ-0505A059-03
					PT-0901A240-01
UHE	**1st GU**	*Principal*	Schneider	ION 8600	PT-0808A278-01

[5] Sub-módulo 12.3. Metering System Maintenance for Invoicing (in a free translation from the Portuguese *Manutenção do Sistema de Medição para Faturamento*). Available at: <http://www.ons.org.br/download/procedimentos/modulos/Modulo_12/Submodulo%2012.3_Rev_1.0.pdf>.

Fundão		*Backup*	Schneider	ION 8600	PT-0808A286-01
	2nd GU	*Principal*	Schneider	ION 8600	PT-0901A059-01
		Backup	Schneider	ION 8600	PT-0710A309-01
PCH Fundão I	**GU**	*Principal*	Schneider	ION 8600	PT-0708A426-01
		Backup	Schneider	ION 8600	PT-0708A427-01

** GU = Generating Unit*

For each generating unit of both large and small scale hydropower plants of the complexes there are two net energy meters, one functioning as the principal and another as the backup meter. The type, model, precision class and calibration of this equipments are in accordance with the requirements set by *ONS*. The table below presents the dates in which the meters mentioned above were last calibrated as well as the correspondent calibration certificates number. All of the meters possess a precision class of 0.2%.

Table 3: Calibration fates of the energy meters.

Description			***Number***	***Certificate Number***	***Date of the Last Calibration***	***Status***
UHE Santa Clara	**1st GU**	*Principal*	PT-0710A307-01	RCM010/2008	08/04/2008	Replaced
			PT-0710A307-01	RCM018/2010	24/03/2010	
			PT-0901A223-01	RCM012/2010	23/03/2010	In Use
		Backup	PQ0411A147-03	CCL04/2005/001	14/04/2005	Replaced
			PT-0708A396-01	RCM020/2009	26/05/2009	Replaced
			PT-0708A396-01	RCM019/2010	24/03/2010	
			PT-0901A224-01	RCM013/2010	24/03/2010	In Use
	2nd GU	*Principal*	PT-0710A306-01	RCM006/2009	27/01/2009	Replaced
			PT-0710A306-01	RCM020/2010	24/03/2010	
			PT-0902A53-01	RCM01/2010	24/03/2010	In Use
		Backup	PT-0710A310-01	RCM001/2009	27/01/2009	Replaced
			PT-0710A310-01	RCM021/2010	24/03/2010	
			PT-0902A295-01	RCM015/2010	24/03/2010	In Use
PCH Santa Clara I	**GU**	*Principal*	PQ0505A054-03	RCM03/2006/003	06/03/2006	Replaced
			PT-0901A238-01	RCM017/2009	26/05/2009	In Use
		Backup	PQ0505A056-03	RCM03/2006/005	06/03/2006	Replaced
			PQ-0505A059-03	RCM018/2009	26/05/2009	Replaced
			PQ-0505A059-03	RCM053/2009	11/11/2009	
			PT-0901A240-01	RCM052/2009	11/11/2009	In Use
UHE Fundão	**1st GU**	*Principal*	PT-0808A278-01	RCM074/2008	28/10/2008	In Use
		Backup	PT-0808A286-01	RCM075/2008	28/10/2008	In Use
	2nd GU	*Principal*	PT-0901A059-01	RCM016/2009	14/04/2009	In Use

		Backup	PT-0710A309-01	RCM032/2008	27/08/2008	In Use
PCH Fundão I	**GU**	*Principal*	PT-0708A26-01	RCM028/2008	14/08/2008	In Use
		Backup	PT-0708A427-01	RCM029/2008	14/08/2008	In Use

As it can be seen from data presented in the **Fehler! Verweisquelle konnte nicht gefunden werden.**4, the recalibrations of the *UHE Santa Clara* meter of the 1st generating unit (GU) (# PQ0411A147-03) and *PCH Santa Clara I* principal (# PQ0505A054-03) and backup (# PQ0505A056-03) meters were delayed. Therefore, the "*Guidelines for assessing compliance with the calibration frequency requirements*" was to be used when calculating the emission reductions by the CDM project activity.

Considering that the recalibration date of the energy meters of *Santa Clara* Complex were delayed the provisions of paragraph 4.(a) of the guidelines were applied. The results of the delayed calibration show that the error is smaller than the maximum permissible error. Therefore, the maximum permissible error of the meter (*i.e.* 0.2%) should be discounted from energy generation between May, 1st 2009 and May, 25th 2009. In a conservative manner the discount was applied to the entire month (May, 2009).

SECTION D. Data and parameters

Parameters used to calculate baseline, project, and leakage emissions as well as other relevant parameters required by the approved methodology and the monitoring plan; and specific information on how data and parameters have been monitored during the monitoring period are presented in this section.

Data determined only once for the crediting period which were used after registration of the project activity were included under section D.1.

D.1. Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors

Data / Parameter:	$EF_{Baseline,\ ex\text{-}ante\ 2003\text{-}2005}$
Data unit:	tCO_{2e}/MWh
Description:	Combined margin CO_2 emission factor of the grid
Source of data used:	Calculated
Value(s):	0.2611
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This parameter is used to calculate the baseline emissions.
Additional comment:	Calculated as a weighted average of the OM and BM emission factors.

Data / Parameter:	$EF_{OM,\ 2003\text{-}2005y}$
Data unit:	tCO_{2e}/MWh
Description:	CO_2 Operating Margin emission factor of the grid.
Source of data used:	Factor calculated with data from ONS.
Value(s):	0.4349
Indicate what the data are used for (Baseline/ Project/	This parameter is used to calculate the baseline emissions.

Leakage emission calculations)	
Additional comment:	Calculated *ex-ante* (2003-2005) as indicated in section B.6.1 of the registered PDD.

Data / Parameter:	$EF_{BM, 2005}$
Data unit:	tCO_{2e}/MWh
Description:	CO_2 Build Margin emission factor of the grid.
Source of data used:	Factor calculated with data from ONS.
Value(s):	0.0872
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This parameter is used to calculate the baseline emissions.
Additional comment:	Calculated *ex-ante* (2005) as indicated in section B.6.1 of the registered PDD.

D.2. Data and parameters monitored

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.

Data / Parameter:	EG_y
Data unit:	MWh
Description:	Electricity supplied to the grid by the project.
Measured /Calculated /Default:	Measured.
Source of data:	Onsite measurements.
Value(s) of monitored parameter:	1,552,091
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	This parameter is used to calculate the baseline and project emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Please, refer to section C for monitoring equipment description and relevant information.
Measuring/ Reading/ Recording frequency:	The energy is measured continuously and aggregated every 5 minutes. Information is reported to CCEE and data is recorded by the company once a month.
Calculation method (if applicable):	Not applicable.
QA/QC procedures applied:	These data will be directly used for calculation of emission reductions. Sales record to the grid and other records are used to ensure the consistency.

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

According to the methodology, baseline emissions (BE_y) are the product of the baseline emissions factor (EF_y) times the electricity supplied by the project activity to the grid (EG_y), calculated as follows:

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

Where:

BE_y = Baseline emissions, in tCO2e;

EG_y = Electricity supplied by the project activity to the grid, in MWh;

EF_y = Baseline emission factor, in tCO_2e/MWh

The Monitoring Report applies the *ex-ante* validated emission factor for project activities connected to the Brazilian South-Southeast-Midwest interconnected grid. The CO_2 emission factor of the grid is 0.2611 tCO_2e/MWh (**Fehler! Verweisquelle konnte nicht gefunden werden.**6). This factor was calculated based on parameters that were justified during the validation as stated in the registered PDD.

Table 4: CO_2 emission factor of the Brazilian grid.

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
	$EF_{OM,\ simple\text{-}adjusted}$ [tCO2/MWh]	$EF_{BM,2005}$	Lambda	
	0,4349	0,0872	λ_{2003}	
	Weights	Default weights	0,5312	
	w_{OM} = 0,50	w_{OM} = 0,5	λ_{2004}	
	w_{BM} = 0,50	w_{BM} = 0,5	0,5055	
	EF_y [tCO2/MWh]	Default EF_y [tCO2/MWh]	λ_{2005}	
	0,2611	0,2611	0,5130	

As mentioned above, electricity supplied to the grid by the project (EG_y) is monitored by *ELEJOR*, *COPEL* and *CCEE*. The amount of electricity generated during the monitored period by the plants comprised by this CDM project activity and the baseline emissions are presented in table 7 and 8, respectively:

Table 5: Electricity dispatched to the grid by the project activity.

***Fundão-Santa Clara* Energetic Complex Energy Generation (MWh)**							
Year	**Month**	**Santa Clara Complex**			***Fundão Complex***		
		UHE Santa Clara	***PCH Santa Clara I***	**Total**	***UHE Fundão***	***PCH Fundão I***	**Total**
2009	May	2,192	2,028	4,221	4,348	1,574	5,922
	June	17,277	2,359	19,635	20,690	1,514	22,203
	July	87,684	2,475	90,159	86,727	1,581	88,308
	August	87,574	2,431	90,006	55,974	1,513	57,487
	September	75,691	2,392	78,083	41,948	1,497	43,446
	October	79,684	2,409	82,093	71,737	1,511	73,248
	November	35,684	2,373	38,057	76,711	1,486	78,196
	December	63,494	2,467	65,961	79,796	1,559	81,355

2010	January	83,566	2,461	86,027	82,411	1,580	83,991
	February	79,726	2,242	81,968	77,128	1,437	78,565
	March	67,556	2,402	69,958	68,134	1,445	69,580
	April	80,074	2,181	82,255	79,875	1,492	81,368
	Total	**760,202**	**28,220**	**788,422**	**745,480**	**18,189**	**763,668**

TOTAL	**1,552,091**

Table 6: Baseline emissions over the monitored period.

***Fundão-Santa Clara* Energetic Complex Baseline Emissions (tCO2e)**							
Year	**Month**	***Santa Clara* Complex**			***Fundão* Complex**		
		UHE Santa Clara	***PCH Santa Clara I***	**Total**	***UHE Fundão***	***PCH Fundão I***	**Total**
2009	May[6]	571	529	1,102	1,135	411	1,546
	June	4,511	616	5,127	5,402	395	5,797
	July	22,894	646	23,541	22,644	413	23,057
	August	22,866	635	23,500	14,615	395	15,010
	September	19,763	625	20,388	10,953	391	11,344
	October	20,806	629	21,434	18,731	394	19,125
	November	9,317	620	9,937	20,029	388	20,417
	December	16,578	644	17,222	20,835	407	21,242
2010	January	21,819	642	22,462	21,518	413	21,930
	February	20,817	585	21,402	20,138	375	20,513
	March	17,639	627	18,266	17,790	377	18,167
	April	20,907	569	21,477	20,855	390	21,245
	Total	**198,488**	**7,367**	**205,855**	**194,645**	**4,749**	**199,394**

TOTAL	**405,249**

E.2. Project emissions calculation

According to the "Thresholds and criteria for the eligibility for the hydroelectric power plants with reservoirs as CDM project activity"[7], emissions from reservoirs, if there is any, shall be estimated considering the power density (W/m^2) of the plant.

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}}$$ **Equation 2**

[6] Following the provisions of EB 52, Annex 60, a discount was applied to the energy generated by *Santa Clara* Complex in May, 2009. The maximum permissible error in the calibration test was applied (paragraph 4a of the guidelines) in *UHE Santa Clara* and *PCH Santa Clara I* energy generation. The values were adjusted in order to represent the lower baseline emissions.

[7] EB 23 Report, Annex 5

Where:

PD = Power density of the project activity, in W/m^2;

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 (m^2);

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 (m^2). For new reservoirs, this value is zero.

The power density of *Fundão* and *Santa Clara* Complexes were calculated in the registered PDD. The result is presented in the table below:

Table 7: Power density of *Fundão* and *Santa Clara* Complexes.

Characteristics	***Fundão* Complex**	***Santa Clara* Complex**
Installed Capacity (MW)	122.5	123.6
Reservoir Area (km^2)	2.15	20.14
Power Density (W/m^2)	56.98	6.14

As it can be seen, *Santa Clara* Complex presents a power density of 6.14 W/m^2. Therefore, project emissions are calculated according to the equation below:

$$PE_y = EG_y \times EF_{Res} \qquad \textbf{Equation 3}$$

Where:

PE_y = project emissions (tCO_{2e}/year);

EF_{Res} = Default emission factor for emissions from reservoirs of hydro power plants in year y ($kgCO_2e$/MWh).

Considering equation above, the emission factor of the project reservoir of 0.09 tCO_{2e}/MWh and the electricity exported to the grid by the project as presented section E.1, project emissions are as reported in the table below:

Table 8: Project emissions over the monitored period.

***Fundão-Santa Clara* Energetic Complex Project Emissions (tCO_{2e})**			
Year	**Month**	***Santa Clara* Complex**	***Fundão* Complex**
2009	May[8]	381	0
	June	1,767	0

[8] The highest project emissions.

	July	8,114	0
	August	8,101	0
	September	7,027	0
	October	7,388	0
	November	3,425	0
	December	5,936	0
2010	January	7,742	0
	February	7,377	0
	March	6,296	0
	April	7,403	0
	Total	**70,959**	**0**

TOTAL	**70,959**

E.3. Leakage calculation

According to the applicable methodology, leakage emissions by the project activity are **zero**.

E.4. Emission reductions calculation / table

According to the registered PDD, emission reductions by the project activity (ER_y) during a given period of year *y* are the product of the baseline emissions factor (EF_y, in tCO_2e/MWh) multiplied by the electricity supplied by the project to the grid (EG_y, in MWh), minus the project emission (PE_y, in tCO_{2e}) as follows:

$$ER_y = (EF_y \times EG_y) - PE_y \qquad \textbf{Equation 4}$$

Considering the equation above and data presented in the previous sections, emission reductions of Fundão-Santa Clara Energetic Complex Project from 01/05/2009 to 30/04/2010 are presented below:

Table 9: Emission Reductions over the monitored period.

***Fundão-Santa Clara* Energetic Complex Emission Reductions (tCO_{2e})**							
Year	**Month**	***Santa Clara* Complex**			***Fundão* Complex**		
		Baseline Emissions	**Project Emissions**	**Emission Reductions**	**Baseline Emissions**	**Project Emissions**	**Emission Reductions**
2009	May	1,100	381	719	1,546	0	1,546
	June	5,127	1,767	3,360	5,797	0	5,797
	July	23,541	8,114	15,426	23,057	0	23,057
	August	23,500	8,101	15,400	15,010	0	15,010
	September	20,388	7,027	13,360	11,344	0	11,344

	October	21,434	7,388	14,046	19,125	0	19,125
	November	9,937	3,425	6,512	20,417	0	20,417
	December	17,222	5,936	11,286	21,242	0	21,242
2010	January	22,462	7,742	14,719	21,930	0	21,930
	February	21,402	7,377	14,025	20,513	0	20,513
	March	18,266	6,296	11,970	18,167	0	18,167
	April	21,477	7,403	14,074	21,245	0	21,245
	Total	**205,855**	**70,959**	**134,896**	**199,394**	**0**	**199,394**

TOTAL	**Baseline Emissions**	**Project Emissions**	**Emission Reductions**
	405,249	**70,959**	**334,290**

Summarizing data discussed above, the total of the emission reductions achieved during the monitoring period are:

- Total baseline emissions: 405,249 tCO_2e
- Total project emissions: 70,959 tCO_2e
- Total leakage: 0 tCO_2e
- Total emission reductions: 334,290 tCO_2e

E.5. Comparison of actual emission reductions with estimates in the CDM-PDD

Below table presents a comparison between the actual values of emission reductions achieved during the monitoring period and the estimations as per the registered CDM-PDD.

Item	**Values applied in ex-ante calculation of the registered CDM-PDD**	**Actual values reached during the monitoring period**
Emission reductions (tCO_2e)	265,587	334,290

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

Considering the emission factor was determined during the validation of the proposed project activity (*ex-ante* option) and the emission factor used for calculate project emissions related to the reservoir is also a fixed value, the amount of emission reductions calculated during the monitored period may only differ from the values presented in the registered PDD due to a difference between the electricity generation by the plants.

The total electricity generation, as estimated in the registered CDM PDD, for an equivalent monitoring period (from May, 2009 until April, 2010) is 1,229,000 MWh. During the monitored period it was verified a total electricity generation equal to 1,552,091 MWh. This difference represents an increase of approximately 26% in the electricity generation. Due to this increase the emission reductions varied from 265,587 to 334,290 tCO_{2e}.

In hydropower projects differences are expected to occur since the average river flow is directly dependent of any rainy season variation from year to year. Therefore, it is reasonable to assume that the difference observed between the emission reductions calculated in the registered PDD and verified during the monitored period can be attributed to an increase in the river flow where the plants are located.

Nevertheless, despite of the observed increase in the electricity generation, the chart below shows that the electricity generation of the complex varies around the estimated value presented in the PDD, *i.e.*, based on the assured energy. According to the sum of the electricity generation since the project was registered (2008), 2009 and 2010, the average electricity generation is 1,272,436 MWh, *i.e.*, an increase of 3% related to electricity generation estimated in the PDD.

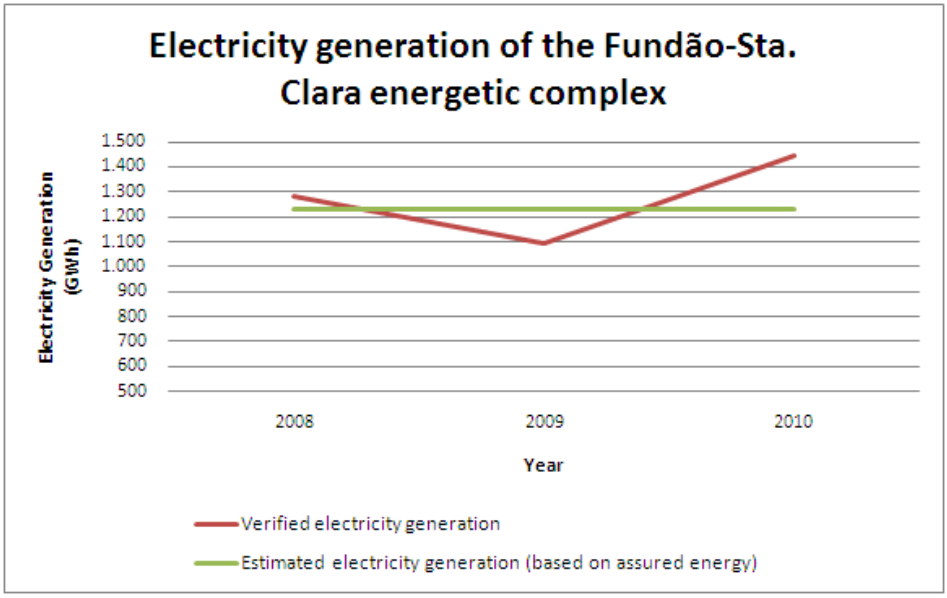

Figure 4: Estimated energy generation in the PDD (green line) and energy generation per year since the project was registered in 2008 (red line).

Finally, it is also worth mentioning that *Fundão* and *Santa Clara* power plants are classified as Type I Power Plants[9]. This means that their programming and dispatching is directly oriented by the Electric System National Operator[10] (from the Portuguese *Operador Nacional do Sistema Elétrico - ONS*). In this sense, the decision to run or not the plants is made by ONS considering the entire interconnected system. In other words, the increase in electricity generation is not determined by the project owner.

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[9] http://www.ons.org.br/integracao_sin/definicao_modalidade_de_operacao_de_usinas.aspx

[10] The ONS is an entity of private right, non-profitable, created on August, 26th 1998, responsible for coordinating and controlling the operation of generation and transmission facilities in the National interconnected Power System (NIPS) under supervision and regulation of the Electric Energy National Agency (from the Portuguese *Agência Nacional de Energia Elétrica - ANEEL*). This definition is available at <http://www.ons.org.br/institucional_linguas/o_que_e_o_ons.aspx?lang=en>.

History of the document

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01	EB 54, Annex 34 28 May 2010	Initial adoption.
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