CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
(Version 02 - in effect as of: 1 July 2004)

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Jalles Machado Bagasse Cogeneration Project (JMBCP).

A.2. Description of the project activity:

This project activity consists of increasing the efficiency in the bagasse (a renewable fuel source, residue from sugarcane processing) cogeneration facility at **Jalles Machado S.A.** (Jalles Machado) a Brazilian sugar mill. With the implementation of this project, the mill has been able to sell electricity to the national grid, avoiding the dispatch of same amount of energy produced by fossil-fuelled thermal plants to that grid. By that, the initiative avoids CO_2 emissions, also contributing to the regional and national sustainable development.

Focusing not only on supplying the grid with renewable energy, Jalles Machado decided to expand all its (JMBCP) benefits to the whole company, improving other activities. The irrigation system operating in the sugarcane fields is one activity that has still been based in common techniques such as the use of diesel-based irrigators. This CDM project activity will increase the internal supply of renewable electricity, thus allowing the fuel switch in irrigation fields (electrification) and tackling CO_2 emissions reductions.

Jalles Machado SA. (Jalles Machado) is a Brazilian private company founded in 1980, with headquarters located in Goianésia, a city in the state of Goiás' north region. In the 2002/2003 harvest season, it employed 2.031 people directly, being the major employer in its municipality area. In the same season, the company crushed 1,33 million tones of sugarcane, producing 39.000 m^3 of ethanol and 119.725 tons of sugar.

Contribution to Sustainable Development

Besides job creation that accounts for around 2.085 employees, Jalles Machado is also important due to the benefits it provides to its employees. Jalles Machado employees and its dependents are health insured – both medically and odontologically – and have access to its own pharmacy and food. Moreover, the company owns a school for primary education, with capacity for 150 students, called Fundação Luiz César. Jalles Machado also sponsors scholarships for employees in all school levels, including also English classes. Other social initiatives are maintenance of the local roads, the construction and maintenance of a club for employees' families' recreation and a program for participation in the company's results. The company was the first in the state of Goiás to earn a "friend of the children" certificate, issued in 1996 by the Brazilian toys manufacturers association (ABRINQ), a foundation for the children and teenagers' rights, and in 2001 was also awarded the Environmental Management Prize (Prêmio de Gestão Ambiental), from the state's environmental agency, for the measures taken foreseeing the preservation of the natural resources.

The industrial processes of Jalles Machado are also a matter of care for the company, and quality is on top of that care. The company has defined programs for eventual certification of all its processes in compliance with ISO norms as a mean to incorporate technology. The result was the company's ISO 9001:2000 certification, issued in December 1999 by Bureau Veritas Quality International and recertificated through a new auditing that took place in May 2003. Jalles Machado has also implemented an environmental management system, and therefore obtained in November 2004 an ISO 14000 series certificate – ISO 14001:1996, following the global trend on environmental responsibility through systematized procedures.

The JMBCP project activity participants are concerned that bagasse cogeneration is a sustainable source of energy that brings not only advantages for mitigating global warming, but also creates a sustainable competitive advantage for the agricultural production in the sugarcane industry in Brazil. Using the available natural resources in a more efficient way, the JMBCP project activity helps to enhance the development of a renewable energy source. Besides that, it is used to demonstrate the viability of electricity generation as a side-business source of revenue for the sugar industry. It is worthy to highlight that out of approximately 320 sugar mills in Brazil, the great majority produces energy for on-site use only, and not for grid supply, and in the state of Goiás, Jalles Machado is the first sugar mill to sell electric energy to the grid.

Jalles Machado also develops projects aimed at the local environment protection, designed to protect local animal species, reforestation of native vegetation alongside rivers. Jalles Machado is also holding the Rubber Tree Project, with a total of more than one million trees already planted and generating jobs in the region via latex extraction.

Additional contribution to the national sustainable development includes the fact that bagasse cogeneration also supports the country's economic development, as sugarcane-based industry provides approximately 1 million jobs and represents one of the major agribusiness products within the trade balance of the country. Furthermore, bagasse-based power project activities contribute to support the competitive model of the Brazilian electric sector.

A.3. Project participants:

Participants in JMBCP are:

- Jalles Machado S/A (Jalles Machado), the project developer, a Brazilian private entity;
- Econergy Brasil Ltda. (Econergy), a Brazilian private entity, responsible for PDD development and GHG emission reductions estimate;
- Corporación Andina de Fomento (CAF) Netherlands Clean Development Facility (NCDF). CAF is a trustee to the Dutch government to buy emission reductions from CDM Projects in the Latin America region.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Brazil

A.4.1.2. Region/State/Province etc.:

Goiás

A.4.1.3. City/Town/Community etc:

Goianésia

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

Jalles Machado is located in Goianésia, a town with 49.724 inhabitants in 2001 (SEPLAN[1]). Located north in the State of Goiás, about 167 kilometers (km) far from the state capital – Goiânia - as can be seen in the following Figure 1. The region holds an ample availability of manpower, communication and transport infrastructures, and can be accessed through BR-251, GO-080, GO-230 e GO-338 highways. The municipality basically counts on agriculture as its economic strength and Jalles Machado plays an important role in that area through job creation and social benefits provided to the local community.

Figure 1: Jalles Machado Sugar Mill site overview Geographical position of the city of Goianésia.

A.4.2. Category(ies) of project activity:

Sectorial Scope: 1-Energy industries (renewable - / non-renewable sources)

A.4.3. Technology to be employed by the project activity:

The predominant technology in all parts of the world today for generating megawatt (MW) levels of electricity from biomass is the steam-Rankine cycle, which consists of direct combustion of biomass in

[1] Goiás' Secretary of Planning and Development

a boiler to generate steam, which is then expanded through a turbine. Most steam cycle plants are located at industrial sites, where the waste heat from the steam turbine is recovered and used for meeting industrial process heat needs. Such combined heat and power (CHP), or cogeneration systems provide greater levels of energy services per unit of biomass consumed than systems that generate electric power only.
The steam-Rankine cycle involves heating pressurized water, with the resulting steam expanding to drive a turbine-generator, and then condensing back to water for partial or full recycling to the boiler. A heat exchanger is used in some cases to recover heat from flue gases to preheat combustion air, and a de-aerator must be used to remove dissolved oxygen from water before it enters the boiler.

Steam turbines are designed as either "backpressure" or "condensing" turbines. CHP applications typically employ backpressure turbines, wherein steam expands to a pressure that is still substantially above ambient pressure. It leaves the turbine still as a vapor and is sent to satisfy industrial heating needs, where it condenses back to water. It is then partially or fully returned to the boiler. Alternatively, if process steam demands can be met using only a portion of the available steam, a condensing-extraction steam turbine (CEST) might be used. This design includes the capability for some steam to be extracted at one or more points along the expansion path for meeting process needs (Figure 2). Steam that is not extracted continues to expand to sub-atmospheric pressures, thereby increasing the amount of electricity generated per unit of steam compared to the backpressure turbine. The non-extracted steam is converted back to liquid water in a condenser that utilizes environment air or a cold water source as the coolant[2].

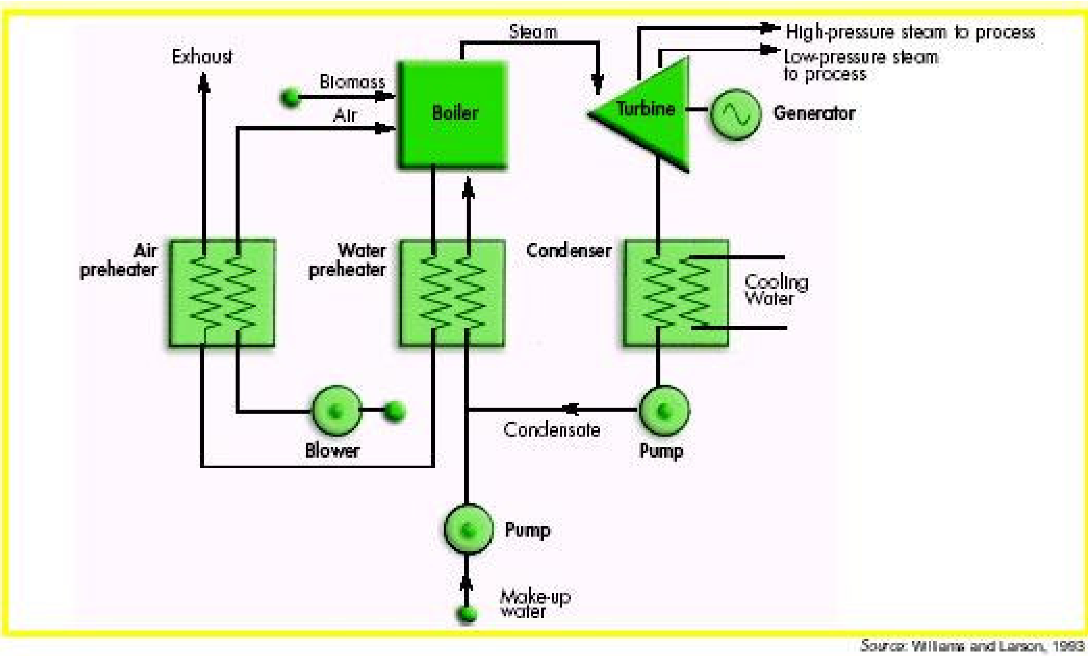

Figure 2: Schematic diagram of a biomass-fired steam-Rankine cycle for cogeneration using a condensing-extraction steam turbine

The steam-Rankine cycle uses different boiler designs, depending on the scale of the facility and the characteristics of the fuel being used. The initial pressure and temperature of the steam, together with the pressure to which it is expanded, determine the amount of electricity that can be generated per kilogram of steam. In general, the higher the peak pressure and temperature of the steam, the more efficient, sophisticated, and costly the cycle.

[2] Williams & Larson, 1993 and Kartha & Larson, 2000, p.101

Using steam-Rankine cycle as the basic technology of its cogeneration system, for achieving an increasing amount of surplus electricity to be generated, Jalles Machado began its efforts in three phases, which are:

Project Phases:

Before the Expansion Plan (2000), Jalles Machado counted on two 21 kgf/cm² pressure boilers that generated, each one, 100 tons of steam per hour and two back pressure turbo-generators (1 x 5 MW (G1) and 1 x 1,2 MW) , which during the 3 phases of the Expansion Plan are to be replaced by higher efficiency ones. Using its own financial resources and capital from the BNDES[3], Jalles Machado invested US$ 8,7 million[4] for expanding its total installed power generation capacity from 10 MW to 38 MW, counting on the Certified Emission Reductions (CERs) as a financial support to this project. The project is divided into 3 phases:

- **Phase 1 (2001):**

In this first phase a new TOSHIBA 5 MW backpressure turbo generator was installed adding more energy generation capacity to the plant – which consisted of two 21 kgf/cm² boilers that provided 100 ton of steam per hour at 450 ºC each and two backpressure turbo generators (1 x 5 MW and 1 x 1,2 MW). Therefore, the total installed capacity for this phase, as that one 1,2 MW backpressure turbo-generator was deactivated, is 10 MW. However, 2 MW was the installed capacity considered to supply the grid, which was sold to Enron[5]. The total amount of energy produced in this phase and sold to the local utility was 3.877 MWh.

- **Phase 2 (2002):**

By the year 2002, the JMBCP continued the investment from the year 2001, to reach a higher capacity and efficiency for exploiting biomass through the construction of a 42 kgf/cm² high-efficiency boiler which will produce 200 ton of steam per hour, in substitution of one of its 21 kgf/cm² boiler.

In this phase, the total amount of clean energy dispatched in order to supply the regional grid - avoiding the marginal plants to dispatch their energy - was 8.985 MWh. Companhia Paulista de Força e Luz (CPFL[6]) is the utility signing the Power Purchase Agreement (PPA) in this second phase.

- **Phase 3 (2003):**

For this phase, one 28 MW backpressure turbo generator was installed and another 42 kgf/cm² high-efficient boiler – producing 200 ton of steam per hour – is replacing the old 21 kgf/cm² boiler.

In the second quarter of 2005, Jalles Machado signed a contract with state-owned electricity company Eletrobras, in order to further expand its cogeneration capacity and take part in the PROINFA program, which is a program to buy electricity from renewables in Brazil. This further expansion is not part of this CDM project.

[3] BNDES, Brazilian National Bank for Socio-Economic Development
[4] Exchange rate in August, 2002: US$ 1.00/R$ 3.10
[5] In 2001, Enron was the utility buying energy from JMBCP.
[6] CPFL is a leading energy distributor.

The investment to increase efficiency is dependent also on the expansion of sugar production; therefore the financial support from CERs will be helpful to improve the mill competitiveness and so to enhance the sustainability of the rural areas in Brazil.

For this third phase it is intended to supply the grid with approximately 25.000 MWh of renewable energy during the harvest season of 2003, which is coincident to the low reservoir period on the hydropower plants in Brazil, dedicating initially 7,3 MW of its 38 MW already installed capacity, which will be gradually increased as more bagasse is generated.

The G1 and G2 turbo-generators are connected to a 34,5 kV transmission line and G3 is connected to a 69 kV transmission line, which have distinct electric meters[7]. The electric energy sale will be sold though a ten-year Power Purchase Agreement (PPA) with CPFL[8].

For the local utility company it is an advantage to buy energy produced by a sugar mill, as the base load for the utilities in Brazil is supported mainly through hydro generation, and the sugarcane crop season is during the dry period.

Emission Offset From Diesel Operations

Regarding irrigation, the use of diesel oil as fuel for the irrigator engines has always been considered the most common option when investments in irrigation were needed, given that for not so large areas and relative short operating time, the use of diesel-based irrigators is considerably inexpensive. However, when crops grow larger and the operating times for the irrigation must be also extended, the use of electric engines is feasible, considering that, thanks to the electricity produced by JMBCP, the electric engines will have a more competitive source of energy. Four different engine capacities are being employed: 100 HP, 150 HP, 200 HP and 250 HP electric-engines, depending on the place they are going to be located – what means different needs in terms of power needed to pump water in different heights or distances.

This kind of diesel-based irrigators, which is considered the "business-as-usual", has been widely used in this region due to its low cost of implementation and easy mobility. When compared to diesel oil, electricity presents lower costs for operating; however it requires the existence of an electricity transmission line that might *a priori* turn it into an unfeasible project, when considering that as a major constraint. But, investments in JMBCP opened doors for Jalles Machado to expand internal transmission lines to distribute energy for electric engines and, therefore, increasing their irrigation in such way that would not happen otherwise. As it was already assessed by Jalles Machado, the construction of the transmission lines reached more than R$ 10.000 (US$ 3.300) per installed kilometer.

Briefly, two steps were already taken towards an electric irrigation system for Jalles Machado:

1. In the year **2001**, instead of three diesel-fueled irrigators, three new 100HP electric engines for irrigation were bought. Also, a 10 Km transmission line was built, supplying electric energy to the engines and for the future ones.

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[7] G1 and G2 have their electric energy generation and dispatch data measured in a computer station and G3 in other one, although both send the electric energy dispatch data to the local distribution utility – CELG - via modem. This data is compiled by CELG that reports to Jalles Machado, which forwards this report for the Companhia Paulista de Força e Luz - CPFL – that is the buyer, in order it proceeds with payments, according to the signed PPA.

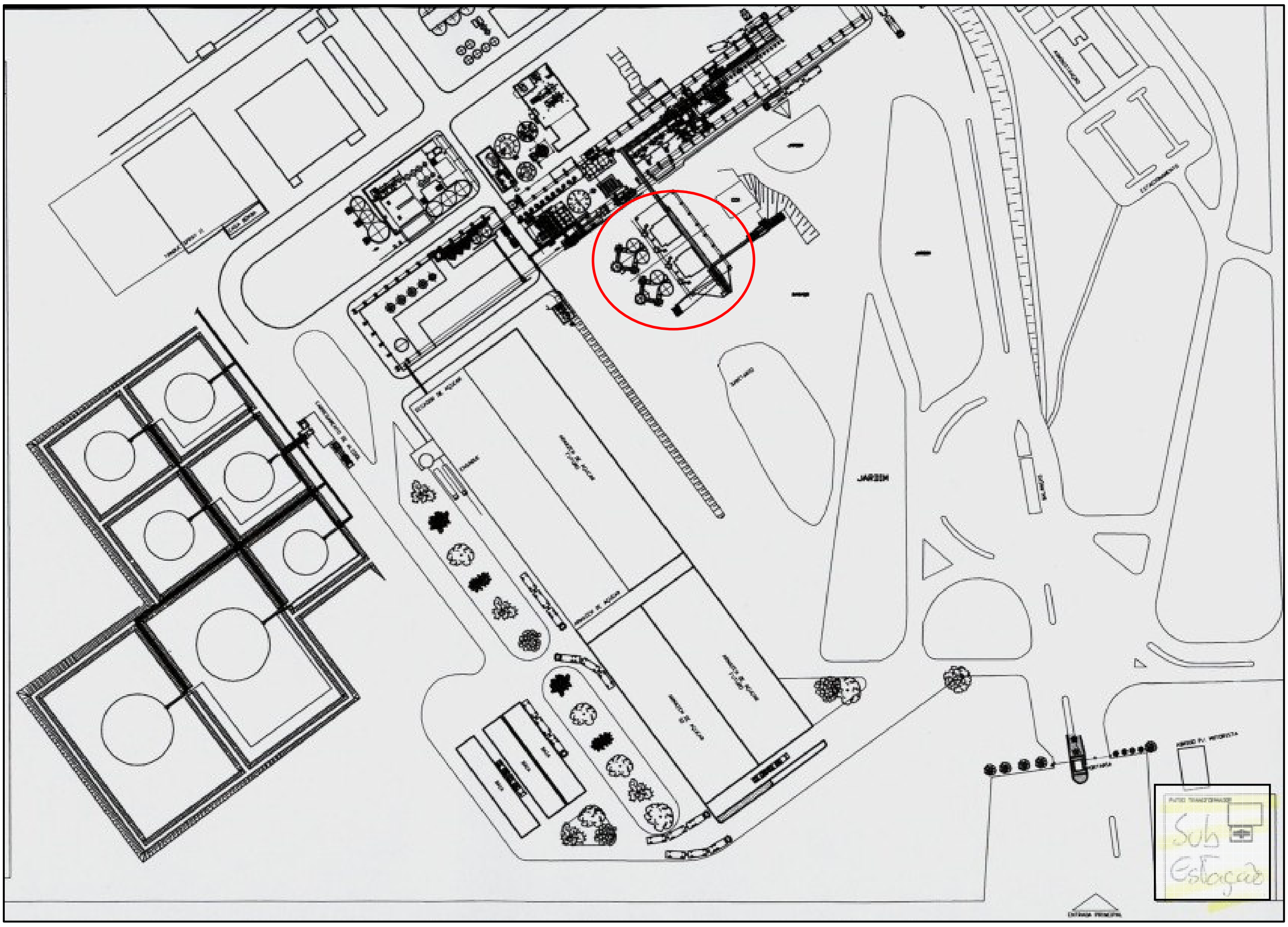
[8] CPFL is a leading energy distributor.

2. In the year **2002**, two new electric engines 250HP and one 150HP electric engines for irrigation were installed, instead of three diesel-based ones.

For the year **2004 and on**, new electric irrigators will be installed, as can be seen in Table 2, and a 15 Km transmission line is expected to be constructed.

Figure 3 to 6 below show the detailed location of JMBCP installed equipments and electric engines on Jalles Machado site.

Figure 3: Location of installed equipments for bagasse cogeneration at Jalles Machado site



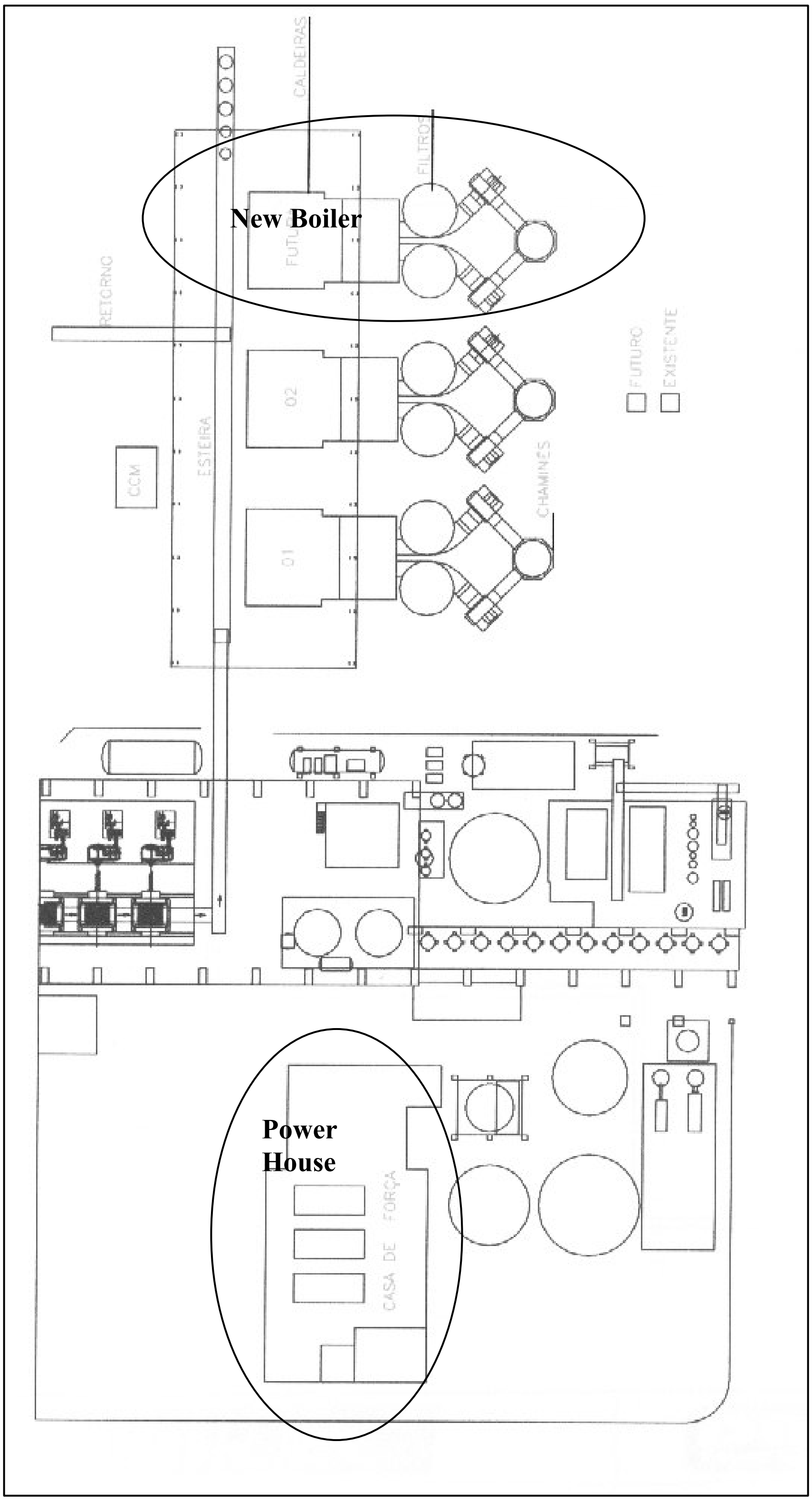


Figure 4: Location of installed equipments for bagasse cogeneration at Jalles Machado with new boiler

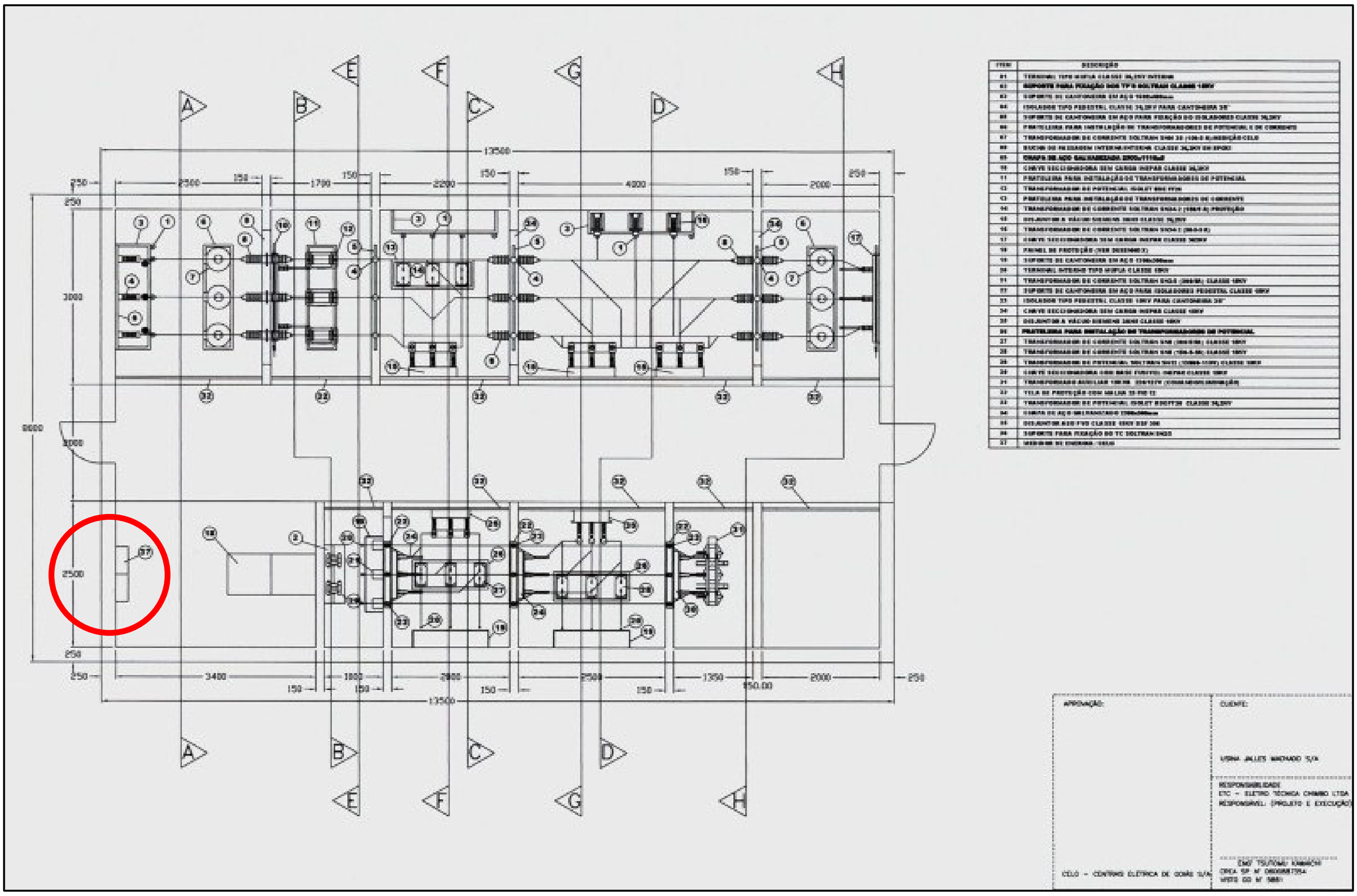


Figure 5: Details Location of energy meter

Figure 6: Example of one installed electric irrigation engine and new transmission line designed exclusively for irrigation activities.

Table 1 and Table 2 show project activity implementation schedule both for bagasse cogeneration project and electricity powered engines for irrigation.

Table 1: Jalles Machado Bagasse Cogeneration Project Technical Data

	Active / Activating				Stand by/ Deactivated
Before the Expansion Plan 2000	One 5 MW (G1) backpressure turbo generator	One 1,2 MW backpressure turbo generator			
	Two 21 kgf/cm^2 pressure boilers				
Phase 1 2001	One 5 MW (G2) backpressure turbo generator	One 5 MW (G1) backpressure turbo generator			One 1,2 MW backpressure turbo generator
		Two 21 kgf/cm^2 pressure boilers			
Phase 2 2002		One 5 MW (G2) backpressure turbo generator	One 5 MW (G1) backpressure turbo generator		One 1,2 MW backpressure turbo generator
	One 42 kgf/cm^2 pressure boiler		One 21 kgf/cm^2 pressure boilers		One 21 kgf/cm^2 pressure boiler
Phase 3 2003	One 28 (G3) MW backpressure turbo generator		One 5 MW (G2) backpressure turbo generator	One 5 MW (G1) backpressure turbo generator	One 1,2 MW backpressure turbo generator
	One 42 kgf/cm^2 pressure boiler	One 42 kgf/cm^2 pressure boiler			One 21 kgf/cm^2 pressure boiler One 21 kgf/cm^2 pressure boiler

Table 2: Jalles Machado Irrigation technical data

	Active / Activating							Irrigated Area
2000	25 diesel fueled irrigators							8073 ha
Phase 1 2001	3 electric irrigators 100 HP	25 diesel fueled irrigators						8909 ha
Phase 2 2002	1 electric irrigator 150HP	3 electric irrigators 100 HP	25 diesel fueled irrigators					10 198 ha
	2 electric irrigator 250HP							
Phase 3 2004	4 electric irrigator 100HP	1 electric irrigator 150HP	3 electric irrigators 100 HP	25 diesel fueled irrigators				10 200 ha (estimate)
		2 electric irrigator 250HP						
Phase 4 2005	5 electric irrigators 200 HP	4 electric irrigator 100HP	1 electric irrigator 150HP	3 electric irrigators 100 HP	25 diesel fueled irrigators			13 000 ha (estimate)
			2 electric irrigator 250HP					
Phase 5 2006	5 electric irrigators 200 HP	5 electric irrigators 200 HP	4 electric irrigator 100HP	1 electric irrigator 150HP	3 electric irrigators 100 HP	25 diesel fueled irrigators		16 000 ha (estimate)
				2 electric irrigator 250HP				
Phase 6 2007	5 electric irrigators 200 HP	5 electric irrigators 200 HP	5 electric irrigators 200 HP	4 electric irrigator 100HP	1 electric irrigator 150HP	3 electric irrigators 100 HP	25 diesel fueled irrigators	19 000 ha (estimate)
					2 electric irrigator 250HP			

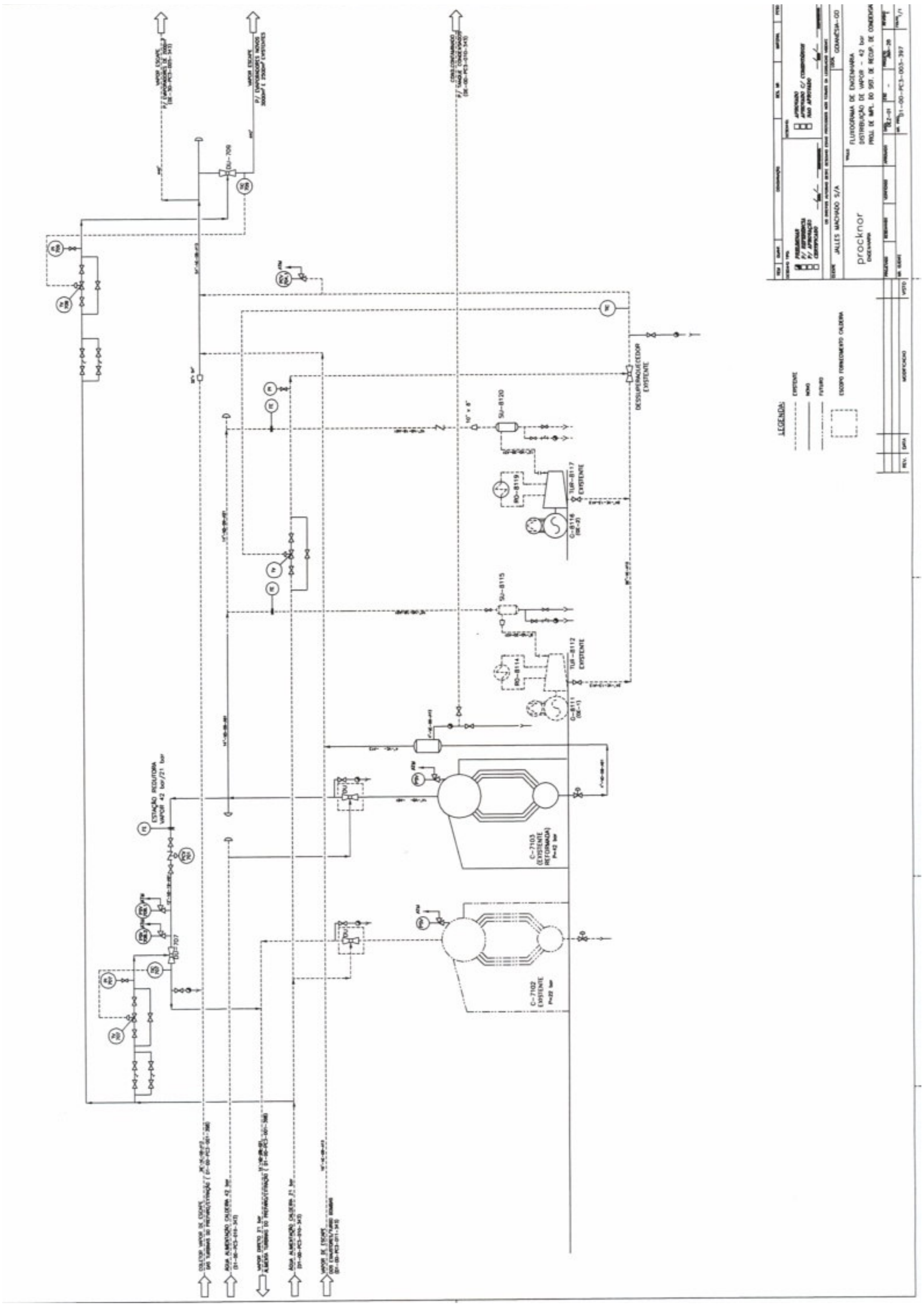


Figure 7: Energy Balance Diagram

Bagasse cogeneration requires a constant bagasse supply to the sugar mill's boilers. If there is an interruption in bagasse supply, for example due to an interruption in sugarcane supply to the mill, the boilers will not be able to produce the steam required by both the sugar production process and power-generation. In order to avoid power-generation interruptions, the cogeneration expansion plan in JMBCP includes investments in the sugar production process that reduce the steam consumption in the sugar and ethanol production processes. This efficiency improvement is necessary in order to drive as much steam as possible to the cogeneration project. Consequently, the greater the quantity of electricity production that is sought, the higher the investment cost per MWh produced.

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

Cogeneration Facility

By dispatching renewable electricity to the grid, electricity that would otherwise be produced using fossil fuel is displaced. This electricity displacement will occur at the system's margin, i.e. this CDM project will displace electricity that is produced by marginal sources (mainly fossil fueled thermal plants), which have higher electricity dispatching costs and are solicited only over the hours that baseload sources (low-cost or must-run sources) cannot supply the grid (due to higher marginal dispatching costs or fuel storage – in case of hydro sources – constraints).

Bagasse is a fibrous biomass by-product from sugarcane processing, which accounts for about 25 percent on weight of fresh cane and approximately one third of the cane's energy content. In a typical Brazilian sugarcane mill, burning bagasse for generation of process heat and power production is a practice already established. It is estimated that over 700 MW of bagasse-based power capacity is currently installed in the state of São Paulo only[9]. The energy produced from these facilities is almost all consumed for their on purposes. Because of constraints that limit the access of independent power producers to the electric utilities market, there is no incentive for sugarcane mills to operate in a more efficient way. Low-pressure boilers, very little concern with optimal use and control of steam, crushers mechanically activated by steam, energy intensive distillation methods, are a few examples of inefficient methods applied to the sugar industry as normal routine.[10]

The Brazilian electric sector legislation currently recognizes the role of independent power producers, which has triggered interest in improving boiler efficiency and increasing electricity generation at mills, allowing the production of enough electricity not only to satisfy sugar mills' need but also a surplus amount for selling to the electricity market. Furthermore, the ever increasing electricity demand opens an opportunity for some bagasse cogeneration power plants in Brazil. Additionally, the feature of electricity generation from sugarcane coinciding with dry months of the year, when hydroelectric generation system - the most important electricity source in the country - is under stress, should provide considerable complementary energy and make bagasse cogeneration electricity attractive for any potential purchasers.

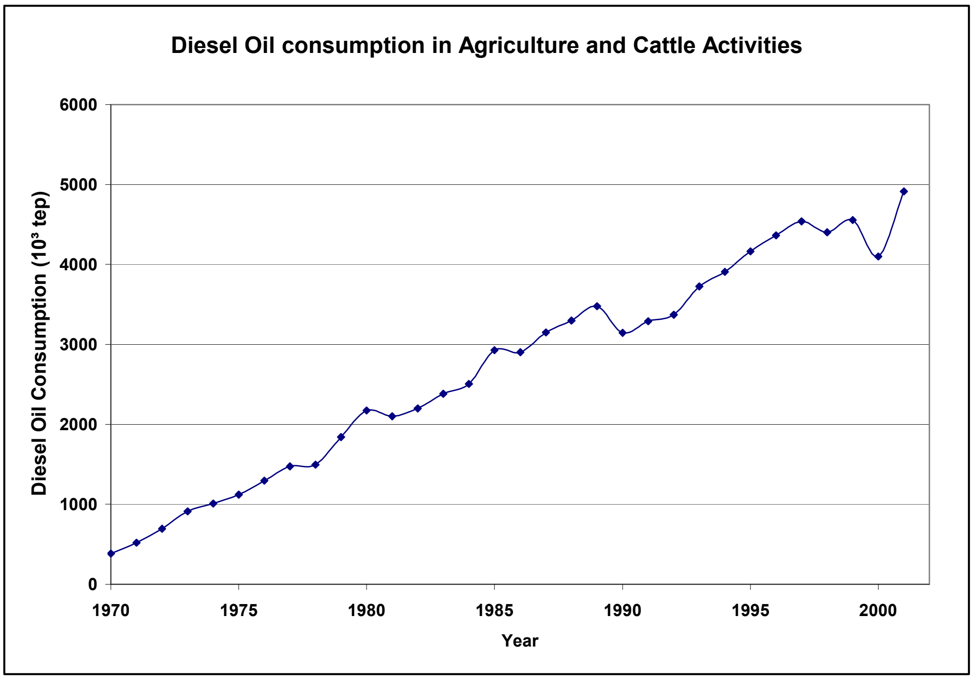
Nevertheless, some barriers pose a challenge for implementation of these kind of projects. In most cases, the sponsors' culture in the sugar industry is very much influenced by the commodities – sugar and ethanol – market. Therefore sponsors need an extra incentive to invest in electricity production due

[9] São Paulo Secretary of Energy, 2001.
[10] Nastari, 2000.

to the fact that it is a product that can never be stored in order to speculate with price. The Power Purchase Agreement requires different negotiation skills, which is not the core of the sugar industry. For instance, when signing a long-term electricity contract, the PPA, a given sugar mill has to be confident that it will produce sufficient biomass to supply its cogeneration project. Although it seems easy to predict, the volatility of sugarcane productivity may range from 75 to 120 ton of sugarcane per hectare annually depending on the rainfall. So, the revenue from GHG emission reductions and other benefits associated with CDM certification offer a worthy financial comfort for the sugar mills, like Jalles Machado, which is investing to expand its electric power generation capacity and to operate in a more rational way under the above mentioned new electric sector circumstances.

Electricity Powered Irrigation

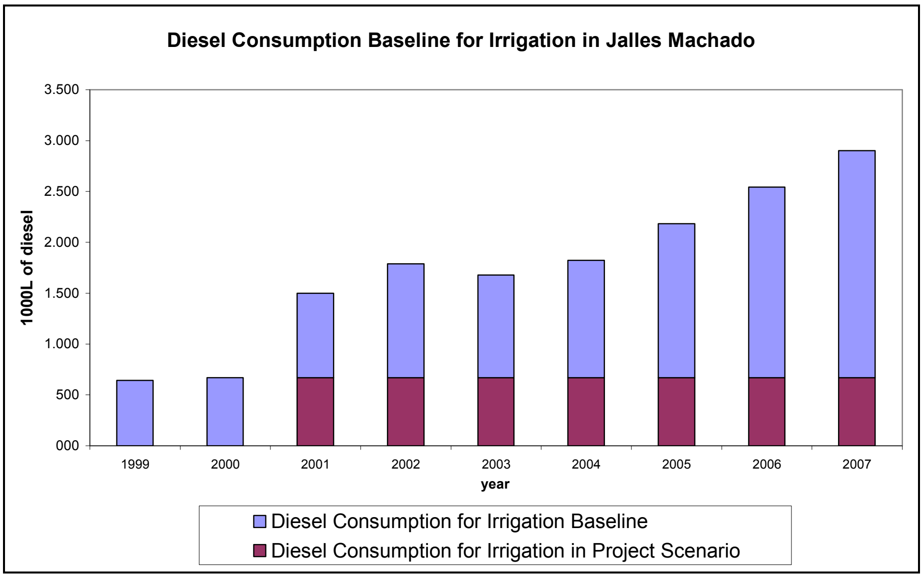
Regarding irrigation, the use of diesel-fueled irrigators is considered a "business as usual" activity, since, among other factors, diesel oil in Brazil is subsidized, representing lower costs for operation in small and medium scale cases where electrification of fields has always been an expensive project. Therefore, if Jalles Machado decided for continuing the use of diesel irrigators, as it would occur in the "business as usual" situation, there would be a contribution for higher GHG emissions due to diesel oil use in the agriculture sector. On the other hand, the use of electric engines represents an additionality when this increasingly diesel use trend scenario is taken into account as it can be seen in Figure 8.



Source: BEN 2002 – National Energy Balance, Brazilian Ministry of Mines and Energy

Figure 8: Diesel Oil Consumption in Agriculture and Cattle Activities

In Figure 9: **Diesel Oil Consumption Baseline**, it can be seen how the diesel oil consumption is to be reduced, and thus the CO_2 emissions, in Jalles Machado case (for detailed calculation, please refer to item E.4).



Note: 1999 and 2000 data were supplied by Jalles Machado

Figure 9: Diesel Oil Consumption Baseline

A4.4.1. Estimated amount of emission reductions over the chosen crediting period:

1st Crediting Period	Phase 1 2001	Phase 2 2002	Phase 3 2003	2004	2005	2006	2007	Total CERs
Total CO_2 emissions reductions, tCO_2e/year	1.402	3.462	7.236	11.602	12.581	16.725	19.048	72.056

This project activity is to reduce **72.056 tCO_2e** over 7 years.

CERs produced until 2004. Data for 2005 and on are estimates.

A.4.5. Public funding of the project activity:

According to the technical investments described below, BNDES, the National Bank for Economic and Social Development, is financing 63% of the R$60,4 million (US$ 19,5 million[11]) investment of the sugar mill bagasse cogeneration expansion project and production (from this value R$26,32 million is the investment share for cogeneration project), through the Special Agency for Industrial Finance (FINAME) approved in August 30th, 2002, as shown:

Item	Total Value Financed	% Financed	Period/Interest Rate
Cogeneration	R$ 26.318.028,00	80	10 years / 35% + TJLP[12]

[11] Exchange rate in August, 2002: US$ 1,00/R$ 3,10

[12] TJLP: *Taxa de Juros de Longo Prazo* (Long Term Interest Rate), created by Ministerial Order Nº 684 of December 31, 1994 and published in the Federal Official Gazette on November 3, 1994, is defined as the basic cost of financing granted by the BNDES. The TJLP rate is set periodically by the Brazilian Central Bank in accordance with the norms established by the National Monetary Council and can be found in any of the principal

Sugar and Alcohol	R$ 24.674.732,00	50	6 years / 4,5% + TJLP
Sugarcane	R$ 3.750.000,00	50	6 years / 4,5% + TJLP
Working Capital and Interests	R$ 5.704.000,00	-	-

SECTION B. Application of a baseline methodology

B.1. Title and reference of the approved baseline methodology applied to the project activity:

AM0015: Bagasse-based cogeneration connected to an electricity grid.

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

This methodology is applicable to JMBCP due to the fact that (i) the bagasse is produced and consumed in the same facility; (ii) the project would never be implemented by the public sector, as well as it would not be implemented in the absence of CDM, as shown in the additionality chapter bellow; (iii) there is no increase on the bagasse production due to the project activity itself/ and (iv) there will be no bagasse storage for more than one year.

B.2. Description of how the methodology is applied in the context of the project activity:

The project activity follows the steps provided by the methodology taking into account the (b) Simple Adjusted OM calculation for the STEP 1, since the would be no available data for applying to the preferred option – *(c) Dispatch Data Analysis OM.* For STEP 2, the option 1 was chosen. The following table presents the key information and data used to determine the baseline scenario.

Brazilian newspapers. It was defined in 9.25% per year for the first quarter of 2001. Nowadays (first quarter of 2003), it is 11.0% per year. For more information on TJLP, see BNDES, 2003b

ID number	Data type	Value	Unit	Data Source
1. EG_y	Electricity supplied to the grid by the Project.	Obtained throughout project activity lifetime.	MWh	Project owner
2. EF_y	CO_2 emission factor of the Grid.	0,249	tCO_2e/MWh	Calculated
3. $EF_{OM,y}$	CO_2 Operating Margin emission factor of the grid.	0,404	tCO_2e/MWh	This value was calculated using data information from ONS, the Brazilian electricity system manager.
4. $EF_{BM,y}$	CO_2 Build Margin emission factor of the grid.	0,094	tCO_2e/MWh	This value was calculated using data information from ONS, the Brazilian electricity system manager.
10. λ_y	Fraction of time during which low-cost/ must-run sources are on the margin.	λ_{2001} = 0,520 λ_{2002} = 0,505 λ_{2003} = 0,531	-	These values were calculated using data information from ONS, the Brazilian electricity system manager.

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity:

Application of the Tool for the demonstration and assessment of additionality of Jalles Machado.

Step 0. Preliminary screening based on the starting date of the project activity

(a) A copy of the first revision of a technical proposal for JMBCP construction, sent to Jalles Machado, date from November 24th, 2000 and the copy of a bill of sale (receipt), a government controlled document emitted by a seller whenever a product is sold, documenting the acquisition of the 5 MW backpressure turbo generator installed in 2001 (Phase 1 of JMBCP) dated of March 13th, 2001 is available.

(b) The environmental consciousness has been always taken into account in the story of Jalles Machado Sugar Mill. The founder – Mr. Jalles Machado – was a federal deputy in the beginning of the 20th century who has advocated the use of ethanol since that time as a way to supply the inner part of the country with an environmentally sound fuel. His soon – Mr. Octávio Lage de Siqueira – has disseminated his father management stile throughout the company. Therefore, the executives have implemented several environmental actions as described in this document. For the purpose of this project activity in the very beginning of its development, in November, 20th 2000, the consultancy company J.A. Rubiano Consultores prepared the project activity's Business Plan delivered to BBA Bank, in order this bank could apply as intermediary to the BNDES (National Development Bank) asking for debt funding. This Business Plan contemplated the qualification of this project activity as a CDM project. Therefore, this document is a very reliable evidence that the CDM was seriously considered in the decision to proceed with this project activity.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations.

Sub-step 1a: Define alternatives to the project activity

1. There were only two possibilities to implement this project activity: one was to continue the current situation of the sugar mill, focusing only on the production of sugar and alcohol and invest in enhancing the efficiency and increasing the scale of its core business. The other option was the project activity undertaken, which is the investment made to increase steam efficiency and production for electricity sales purposes by acquiring high-efficiency boilers and turbo-generators.

Sub-step 1b: Enforcement of applicable laws and regulations

2. As it can be seen in section F, this project activity complies with all environmental laws and also complies with other applicable laws and regulatory requirements. As the other alternative was to continue with the situation before the decision of implementing this CDM project activity, it is considered that it would comply with all applicable requirements.

3. Non applicable.

4. All alternatives are in compliance with all regulations.

Step 3. Barrier analysis

Sub-step 3a: Identify barriers that would prevent the implementation of type of the proposed project activity

1+2. According to COELHO (1999)[13], "large scale cogeneration program in sugar-alcohol sector has not yet occurred, due to several barriers, mainly economic, political and institutional", these barriers include:

I. Technological Barriers

Technological barriers represent a very important issue for increasing bagasse cogeneration in Brazil, as – despite the fact that Rankine-cycle is a well known technology - the cogeneration units operate with low-efficiency and are not competitive comparing to other generation options. Due to this, there is a delicate issue about technology and economic value for such technology. Although this technology is well developed, the economic value for its application is not present for projects on the scale similar to the sugar mills in Brazil. COELHO (1999) justifies that by highlighting that the unit costs ($/installed MW) are significantly influenced by the scale-effect. As the bagasse cogeneration unit should have a small scale due to the high cost for transportation of the fuel (bagasse), investments are high. Therefore, as lower cost of capital is required, the end result is a simplified installation and lower efficiency.

COELHO (1999) also states that the great majority of the sugar mills still rely on inefficient technology, such as on 22 bar pressure boilers, even in the state of São Paulo, the most industrialized in Brazil. Moreover, when there is a necessity to change equipments it is usual not to consider purchasing high-

[13] COELHO, Suani T. *Mecanismos para implementação da cogeração de eletricidade a partir de biomassa*: um modelo para o Estado de São Paulo. São Paulo: Programa interunidades de pós-graduação em energia, 1999.

efficiency boilers due to conservativeness, lack of knowledge or even lack of interest to generate surplus steam for electricity sales purposes.

Finally, SWISHER (1997)[14] considers it difficult to convince the local distributor that the energy to be acquired, generally generated during the harvest season, is sufficiently reliable to be accounted in the distributor's planning.

II. Institutional and Political Barriers

From the electric sector point of view, according to COELHO (1999), acquiring electricity other than hydroelectric would not be a priority, arguing that since bagasse based electricity is generated only during the harvest season, no reliable energy could be offered. However, the biggest advantage of bagasse based electricity is that it is produced during the period where hydroelectric plants face difficulties due to the low level of rainfall. As a result, COELHO (1999) suggests that there is a significant prejudice and conservativeness of the distributors when deciding whether to purchase bagasse based energy or not.

From the sugar mill point of view, save rare exceptions, COELHO (1999) says that the great majority of sugar mills do not consider investments in cogeneration (for electricity sale) as a priority. The sector, even in the new political context, does not seem to have motivation to invest in a process that it sees with mistrust and no guarantees that the product will have a secure market in the future. Moreover, it is a fact that "the sugar mills are essentially managed by families, which difficults the association with external financial agents", that would allow the sector to be more competitive and diversifying its investment.

Since 1997, according to SWISHER (1997), the announcement of a Cogeneration Decree has been awaited, and such decree was supposed to have a positive influence on corporate decision-making with respect to biomass project implementation. The original Cogeneration Decree proposal, which was never approved, called for mandatory purchase by the regional utilities - "*concessionárias*" - from cogenerating and self-generating facilities[15]. Instead of renewable energy, the government expansion plan for electric energy, approved in February 2000, is based on fossil fuel – Natural Gas. This expansion plan, called Thermoelectricity Priority Plan (PPT), became a reality right before the energy crisis. The Thermoelectricity Priority Plan beneficiaries, which were mainly natural gas thermal plants, through the Ministry of Mines and Energy (MME) Decree 3.371 from February 2000, counted on guaranteed, long term and attractive price conditions on Natural Gas supply and Energy sales, together with financing from the national development bank BNDES. And though the PPT plan is not likely to be fully implemented, the public-sector policies for renewable energy are not considered reliable enough by the executives of the private sector to support cogeneration expansion in the sugar mills. This assumption is clearly shown in the following list of rules and/or regulations in the energy sector that have been set in the last 10 years:

- **March 1993**: Law 8.631 sets a tariff regulation for electric energy;
- **February 1995**: Law 8.987 establishes public concession for energy;

[14] SWISHER, J. *Using area-specific cost analysis to identify low incremental-cost renewable energy options:* a case study of co-generation using bagasse in the State of São Paulo. Washington DC: Prepared for Global Environment Facility (GEF) Secretariat, 1997.
[15] Presidential Decree on the co-generation of electric energy, draft of 5 August 1997.

- **July 1995**: Law 9.074 regulates concession for electric energy sector;
- **December 1996**: Law 9.427 creates the National Energy Agency (ANEEL);
- **August 1997**: Law 9.478 sets the National Council for Energy Planning (CNPE);
- **October 1997**: Decree 2.335 regulates the ANEEL task;
- **December 1997**: Implements ANEEL;
- **May 1998**: Law 9.648 establishes the Spot Market for Electric Energy (MAE) and the Operator National System (ONS);
- **July 1998**: Decree 2.655 regulates MAE and ONS tasks;
- **February 2000**: Decree 3.371 regulates the Thermoelectricity Priority Plan (PPT);
- **April 2002**: Law 10.438 sets the Promotion Program for Electricity Generated from Renewable Sources (PROINFA), stating that contracts shall be signed within 24 months from its date and that there will be different economic values for the acquisition of 3.300MW of electricity capacity from renewable sources by the state owned Eletrobrás, for plants starting operations before December 30th, 2006;
- **August 2002**: MP 64 is a presidential act to change the constitution in order to allow the energy sector regulation, including the PROINFA;
- **December 2002**: Resolution 4.541 from ANEEL regulates the implementation of PROINFA, stating that economic values would be defined within 90 days;
- **March 2003**: Decree 4.644 postponed for 180 days, from its date, the economic value and operational guidelines announcement;
- **June 2003**: Decree 4.758 indefinitely postponed the date for the economic value and operational guidelines announcement and revoked the above mentioned Decree 4.644.
- **November 2003**: Law 10.762 of November 11th, 2003 revised Law 10.438 of 26 April 2002 institutes PROINFA.
- **March 2004:** Decree 5.025 regulates the Law 10.438 as of April 26th, 2002.

For the purpose of this CDM project analysis, at the time the project started, there were no institutional incentive like PROINFA to be considered. Therefore, the company's decision to sign a long-term PPA with the local distributor undoubtedly represented a significant risk that the mill was willing take, partially thanks to the expected CDM revenue.

III. Economic and Investment Barriers

From the point of view of the economic agents, the excessive level of guarantees required to finance the projects is a common barrier to achieving a financial feasibility stage, deeply discussed in SWISHER (1997).

Other barriers have more to do with the lack of adequate commercial contractual agreements from the energy buyers (i.e. bankable long-term contracts and payment guarantee mechanisms for non-creditworthy local public-sector and private customers) making it much more difficult to obtain long-term financing from a commercial bank and/or a development bank. Some other financing barriers occur simply due to prohibitively high transaction costs, which include the bureaucracy to secure the environmental license.

"There are several reasons for the Brazilian utilities' reluctance to offer higher prices for co-generated power. One important reason stems from their assumption that their costs are geographically uniform – i.e., that there is essentially a single value for their avoided cost in the industrial sector. If this cost value does not indicate that sufficient savings are available from buying co-generated power, and then there is little economic motivation, under either a public monopoly or a privatized competitive structure, for a utility to pay enough for co-generation to satisfy potential investors' financial criteria" [16] as stated by SWISHER (1997). In fact, the economic cost is the reason that Brazilian utilities do not buy cogeneration electricity energy, at least, while the energy sector regulation does not guarantee them the right to pass such cost through the end user tariff. The cost of cogeneration electricity ranges from US$ 35 to US$ 105 per MWh, according to the Expansion Plan 2001-2010 from Brazil Government, which is described as higher than the marginal cost for electricity expansion in the system – US$ 33/MWh[17].

COELHO (1999) also highlights as one of the major problems of selling surplus energy to the grid as being the economic value paid to the sugar mills which not enough to remunerate the capital invested in the expansion of a cogeneration project. Furthermore, "the fee for accessing the grid does not contribute to making feasible the sale of the surplus energy to the distributors".

Summarizing, SWISHER (1997) considers that the main difficulties are found in: (a) **small sizes of projects and installation costs**: as the fixed costs are high and usually installations do not tend to be large, there is a huge economic barrier towards implementation of these sort of projects, as returns will low comparing with such fixed costs, (b) **availability of long-term financing:** traditionally, infrastructure projects have had a wide access to long-term financing, situation that has changed after the electric sector privatization; (c) **lack of guarantees:** besides technical guarantees, investors require commercial guarantees generating a contradiction: the objective of privatization is to foster a market-based economy but banks still require governmental guarantees to ensure long-term investments in the private sector, (d) **lack of local funding**: lack of familiarity with project finance tools and due to the high interest rates in Brazil.

Moreover, it is important to note that the electricity commercialization business is responsible for a very small part of the total revenues of the mill – 3% for the fiscal year of 2004.

IV. Cultural Barrier

Due to the nature of the business in the sugar industry, the marketing approach is narrowly focused on commodity type of transaction. Therefore, the electricity transaction based on long-term contract (Power Purchase Agreement) represents a significant breakthrough in their business model. In this case, the

[16] *Joel Swisher personal communication with Rolls Royce Power Ventures project manage.* Mark Croke, August 26, 1997. Swisher J. 1997 pg. 76.
[17] "Como se pode observar, os custos unitários das fontes alternativas de energia ainda são altos comparados ao custo marginal de expansão do sistema, hoje calculado em US$33/MWh". IN: Brazil, Ministry of Mines and Energy, 2001, pg. 80.

electricity transaction has to represent a secure investment opportunity from both economical and social-environmental perspective for convincing the sugar mills to invest in.

There are also questions regarding the managerial capacity of the companies that comprise the Brazilian sugarcane industry. According to WALTER (1994)[18], they have in many cases demonstrated the will to undertake investments in new technologies, but without sufficient financial and entrepreneurial capacity to complete such projects.

Also, the investment on diesel cost savings in irrigation were also a considerable cultural barrier. As mentioned above, in order to increase sugar and alcohol production, increasing sugarcane harvested is critical. However, the city of Goianésia is located in a region where water is the constraint to secure satisfactory sugarcane productivity, due to low rainfall levels. Any irrigated area expansion relying on buying electric energy from the grid would be unfeasible. The voluntary expansion of the irrigation area of Jalles Machado can be better understood if the cultural aspect and economic context are also evaluated: a) The use of diesel oil based engines for irrigation is a widespread technique in sugar industry: <u>easy mobility</u> allows the user to irrigate different areas in the same day (please refer to Figure 8: Diesel Oil Consumption in Agriculture and Cattle Activities). This condition evidences the diesel oil use growth trend, what would not occur in the case of electric engines irrigators, that depend on the length of the transmission line to reach those areas, what represents a substantial investment, – and b) <u>low-cost for implementation</u>, since no other costs besides fossil fuel and engine maintenance is required. In the case an electric engines irrigation system, it is necessary to acquire electric energy at a low price to turn it into an affordable project. In the case of Jalles Machado, if the electric energy was to be acquired from the grid (CELG), it would cost R$ 169,00 per MWh for the mill, but the existence of the JMBCP allowed the company to internally sell energy at much lower price: R$ 25,00 per MWh.

Sub-step 3b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity).

3. As exposed above, the other alternative to this project activity was to maintain the current situation and focus strictly in its core business, which is the production of sugar and alcohol. Therefore, as the barriers mentioned above are directly related to entering into a new business (electricity sales), there is no impediment for sugar mills to maintain (or even invest in) its core business.

Step 4. Common practice analysis.

Sub-step 4a: Analyze other activities similar to the proposed project activity

1. The sugar sector, historically, always exploited its biomass (bagasse) in an inefficient manner by utilizing low-pressure boilers. Although they consume almost all of their bagasse for self-energy generation purposes, it is done in such a manner that no surplus electric energy is available for sale, and no sugar company has ventured in the electricity market until recent years.

A similar project activity was implemented by the leading company in this industry – Cia Açucareira Vale do Rosário. However, this is a single example in a universe of about 320 sugar mills. Currently, other similar project activities are under implementation, for instance Cia Energética Santa Elisa, Moema, Equipav, Nova América. Added together, similar projects in the sugar industry in Brazil account to approximately 10% of the sugar industry. The additional 90% are still burning their bagasse

[18] WALTER, A.C.S. *Viabilidade e perspectivas da co-geração e geração termelétrica no setor sucro-alcooleiro*, 1994. Thesis (Doctorate). UNICAMP, Campinas.

for on-site use only in the old-fashioned inefficient way. That clearly shows that just a small part of this sector is willing to invest in cogeneration projects. Moreover, majority of similar projects currently being implemented, are carried out as CDM project activities (so far, Econergy has reported at least 26 CDM bagasse cogeneration projects in Brazil).

Sub-step 4b: Discuss any similar options that are occurring

2. This project activity type is not considered as a widely spread activity in Brazil as only a small portion of the existing sugar mills in the country actually produce electricity for sale purposes.

Step 5. Impact of CDM registration

The impact of registration of this CDM project activity will contribute to overcoming all the barriers described in this Tool: technological, institutional and political, economic and investment and cultural. The registration will enhance the security of the investment itself and, will foster and support the project owners' breakthrough decision to expand their business activities. Along these lines, the project activity is already engaged in a deal to sell its expected CERs.

Notwithstanding, the benefits and incentives mentioned in the text of the Additionality Tool published by the CDM-EB, will also be experienced by the project activities such as: the project will achieve the aim of anthropogenic GHG reductions; financial benefit of the revenue obtained by selling CERs will bring more robustness to the project's financial situation; and its likelihood to attract new players and new technology (currently there are companies developing new type of boilers – extra-efficient – and the purchase of such equipment is to be fostered by CER sales revenue) and reducing the investor's risk.

Registration will also have an impact on other sugarcane industry players, who will see the feasibility of implementing renewable energy commercialization projects in their facilities with the CDM. Moreover, hard-currency inflows are highly desirable in a fragile and volatile economy as is the Brazilian one.

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

The definition of the project boundary related to the baseline methodology is applied to the project activity in the following way:

Baseline energy grid: for JMBCP, the South-Southeast and Midwest subsystem of the Brazilian grid is considered as a boundary, since it is the system to which Jalles Machado is connected and therefore receives all the bagasse-based produced electricity.

Bagasse cogeneration plant: the bagasse cogeneration plant considered as boundary comprises the whole site where the cogeneration facility is located including, therefore, the irrigation facilities.

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

1. Date of completing the final draft of this baseline section: 06/01/2005.

2. Name of person/entity determining the baseline:

ECONERGY BRASIL (Contact information in Annex 1), which is a project participant, is responsible for the technical services related to GHG emission reductions, and is therefore, on behalf of Jalles Machado, the developer of this document and all its contents.

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

23/04/2001

C.1.2. Expected operational lifetime of the project activity:

25y-0m.[19]

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

23/04/2001

C.2.1.2. Length of the first crediting period:

7y-0m.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Left blank on purpose.

C.2.2.2. Length:

Left blank on purpose.

SECTION D. Application of a monitoring methodology and plan

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

Approved monitoring methodology AM0015: “Bagasse-based cogeneration connected to an electricity grid”;

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

[19] Specialists from the Brazilian National Agency of Electric Power (ANEEL - *Agência Nacional de Energia Elétrica*) suggest using 25 years of lifetime for steam turbines, combustion turbines, combined cycle turbines and nuclear power plants, according to Bosi, 2000, p. 29.

The monitoring methodology was designed to be applied to the Vale do Rosario CDM Project. Due to the great similarity of the project, the same methodology was chosen in order to monitor the emissions reduction of this project activity.

The methodology considers monitoring emissions reductions generated from cogeneration projects with sugarcane bagasse. The energy produced by the project could be electricity exported to a grid-connected system and/or energy used to substitute fossil fuel off-grid connected. And that is exactly the case of JMBCP: the project exploits a by-product from the sugarcane milling process (bagasse) to produce and commercialize renewable electricity connected to a regional Brazilian grid. The methodology is therefore fully applicable to JMBCP, and justification for choosing it.

Furthermore, besides being a methodology to be used in conjunction with the approved baseline methodology AM0015 ("Bagasse-based cogeneration connected to an electricity grid"), the same applicability conditions are described and justified in item B1.1 of this document.

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
21. hour	θ	Operating hours of the electric irrigation engines	Hours (h)	*m*	Monthly	100%	Electronic and Paper	Value is used to estimate the fuel consumption of an avoided diesel engine. Data will be archived, according to internal procedures, in the spreadsheet file "JMBCP.xls", administered by Jalles Machado, and will be kept for two years after the end of the crediting period.

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

In the case of this project activity, as mentioned in this document, there will be also a reduction of fossil fuel consumption inside the project boundaries, since the additional renewable energy produced by Jalles Machado allowed the implementation of an electric based irrigation. Therefore, these emissions reduction is given according to the baseline methodology by:

$$PE_y = \sum_i FF_{i,y} . COEF_Y$$

where:

- *PEy* Are the project emissions during the year *y* in tons of CO_2,
- *FFi,y* Is the quantity of fuel type i combusted due to the project activity during the year *y* in a volume or mass unit,

- *COEFi* Is the CO_2 emission factor of the fossil fuel type *i* fired in the boiler in the absence of the project activity in tons CO2 / mass or volume unit of the fuel.

However, for this project activity these variables will be considered as:

- $FF_{i,y} = \theta$ (hours of operation, which is the amount of fuel that is avoided by using a "i"-HP electric engine)
- *COEFi* = -0.1813 L/(HP.h) (how this number is obtained is shown in item E).

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :								
ID number *(Please use numbers to ease cross-referencing to table D.3)*	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 supplied to the grid by the Project.	Readings of the energy metering connected to the grid and Receipt of Sales.	MWh	*M*	Monthly	*100%*	Electronic and paper	Double check by receipt of sales. Will be archived according to internal procedures, until 2 years after the end of the crediting period.
2. EF_y	CO_2 emission factor of the Grid.	Calculated	tCO_2e/MWh	*C*	At the validation and yearly after registration	*0%*	Electronic and paper	Will be archived according to internal procedures, until 2 years after the end of the crediting period.

3. $EF_{OM,y}$	CO_2 Operating Margin emission factor of the grid.	Factor calculated from ONS, the Brazilian electricity system manager.	tCO_2e/MWh	*C*	At the validation and yearly after registration	*0%*	Electronic and paper	Will be archived according to internal procedures, until 2 years after the end of the crediting period.
4. $EF_{BM,y}$	CO_2 Build Margin emission factor of the grid.	Factor calculated from ONS, the Brazilian electricity system manager.	tCO_2e/MWh	*C*	At the validation and yearly after registration	*0%*	Electronic and paper	Will be archived according to internal procedures, until 2 years after the end of the crediting period.
10. λ_y	Fraction of time during which low-cost/ must-run sources are on the margin.	Factor calculated from ONS, the Brazilian electricity system manager.	index	*C*	At the validation and yearly after registration	*0%*	Electronic and paper	Will be archived according to internal procedures, until 2 years after the end of the crediting period.

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

$$EF_{OM,simple\_adjusted,y} = (1-\lambda_y)\frac{\sum_{i,j} F_{i,j,y}.COEF_{i,j}}{\sum_j GEN_{j,y}} + \lambda_y \frac{\sum_{i,k} F_{i,k,y}.COEF_{i,k}}{\sum_k GEN_{k,y}} \quad (tCO_2e/GWh)$$

$$EF_{electricity} = w_{OM}\, EF_{OM} + w_{BM}\, EF_{BM} \quad (tCO_2e/GWh)$$

$F_{i,j(or\ m),y}$ Is the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *j* in year(s) *y*
j,m Refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports from the grid
$COEF_{i,j(or\ m)\ y}$ Is the CO2 emission coefficient of fuel *i* (tCO2 / mass or volume unit of the fuel), taking intoaccount the carbon content of the fuels used by relevant power sources j (or m) and the percent oxidation of the fuel in year(s) y, a
$GEN_{j(or\ m),y}$ Is the electricity (MWh) delivered to the grid by source *j (or m)*
$BE_{electricity,y}$ Are the baseline emissions due to displacement of electricity during the year y in tons of CO_2

$BE_{electricity,y} = EF_{electricity} \cdot EG_y$	w_{OM}, w_{BM} Are the weights given to the operating margin (OM) and the build margin (BM) in the emission factor calculation. EG_y Is the net quantity of electricity generated in the bagasse-based cogeneration plant due to the project activity during the year y in MWh, and $EF_{electricity,y}$ Is the CO_2 baseline emission factor for the electricity.

D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table D.3)*	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

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

Left blank on purpose.

D.2.3. Treatment of leakage in the monitoring plan

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

Left blank on purpose.

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

Jalles Machado did not use to sell bagasse, therefore no leakage will be considered for this project activity.

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

$ER_y = BE_{thermal,\ y} + BE_{electricity,\ y} - PE_y - L_y$ $BE_{thermal,\ y} = 0$ $PE_y = -\ 4{,}95.10^{-4}\ tCO_2/HP.h\ .\ \theta$ $L_y = 0$ $BE_{electricity,\ y} = EF_{electricity}\ .\ EG_y$	ER_y: are the emissions reductions of the project activity during the year y in tons of CO_2 $BE_{electricity,y}$: Are the baseline emissions due to displacement of electricity during the year y in tons of CO_2 $BE_{thermal,y}$: Are the baseline emissions due to displacement of thermal energy during the year y in tons of CO_2 PE_y: Are the project emissions during the year y in tons of CO_2.

	L_y: Are the leakage emissions during the year y in tons of CO_2.

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored

Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
1	*Low*	These data will be directly used for calculation of emission reductions. Sales record and other records are used to ensure the consistency.
2	*Low*	Data does not need to be monitored
3	*Low*	Data does not need to be monitored
4	*Low*	Data does not need to be monitored
10	*Low*	Data does not need to be monitored

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

The structure for monitoring this project activity will basically consist of registering the amount of energy sold to the grid (EG_y) and the amount of hours that each engine will operate. There are two operations that the project operators must perform in order to ensure data consistency.

1. The monthly readings of the meter equipment of irrigators must be recorded in an electronic spreadsheet. (for θ only);
2. Energy sales receipt must be archived and registered in a electronic spreadsheet. (for EG_y only).

Moreover, according to the law, the metering equipment shall be periodically calibrated to comply with the regulations for independent power producers connected to the regional grid.

The operational and management structure implemented to monitor emission reductions is the same as the one in place for monitoring electricity generation and sale. Operators, working in 3-shifts, will operate the electronic system that registers the sold electricity data. Their role will be to guarantee the data are being generated and correctly stored. Considering the invoice paid by the electricity distributor, will be kept and used as to account for the amount of electricity fed into the grid. The accountancy department will be in charge of storing such data.

Considering the actual amount of electricity sold, will be remote-read by the electricity distributor through phone signals. The invoice sent by Jalles Machado on such readings and paid by the distributor will also be archived by an administrative person, working in the accounting department of the mill.

D.5 Name of person/entity determining the monitoring methodology:

ECONERGY BRASIL (Contact information in Annex 1), which is a project participant, is responsible for the technical services related to GHG emission reductions, and is therefore, on behalf of Jalles Machado, the developer of this document, and all its contents.

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

This project activity does not burn any additional quantity of fossil fuel due to the project implementation, instead it actually decreases the amount of diesel oil burned due to the electrification of irrigation allowed by the production of renewable energy. Jalles Machado will diminish its internal emissions as follows:

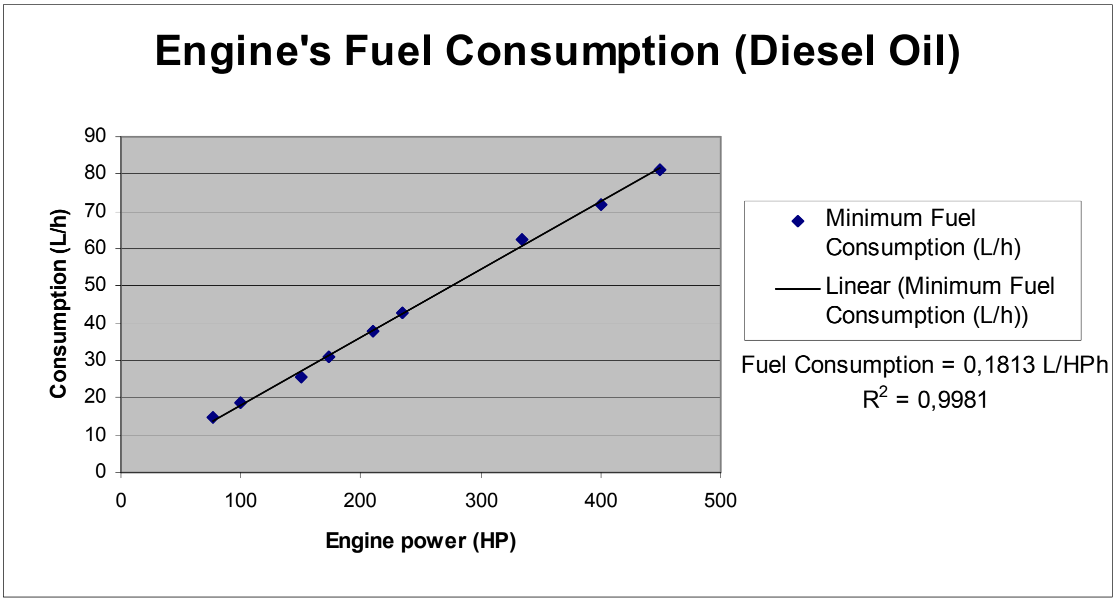
For estimating the emissions reductions caused by the use o electric engines is also necessary to establish baseline parameters of diesel oil consumption in diesel-fueled engines that would be used to irrigate in business-as-usual scenario. It is important bring highlight that this sort of data is not always available and/or calculated, since it depends on tests undergone by the manufacturer and often they have restriction in sharing this kind of information.

Companies such as MWM and CUMMINS[20] are top engine manufacturers/assemblers in Brazil. However only CUMMINS was supportive to data requests, providing project's developer with technical data on fuel consumption, allowing project's developer to infer on how fuel consumption is related to engine power capacity.

Nevertheless, a conservative approach was used in the calculations since fuel consumption may vary according to the conditions that the engine is exposed to: RPM, load, etc. Being that, assuring data conservativeness and credibility, the minimum consumption obtained by the manufacturer on his tests and showed on the fuel consumption curve is considered.

CUMMINS' reports (example Figure 10 and Figure 11) were then compiled and the following graph was built:

[20] Cummins Inc., is a corporation of complementary business units that designs, manufactures, distributes service electric power generation systems, engines, and related technologies, including fuel systems, controls, air handling, filtration, and emissions solutions. Headquartered in Columbus, Indiana (USA), Cummins serves its customers through more than 500 company-owned and independent distributor locations in 131 countries and territories.



Source: CUMMINS – Industrial Performance Curve Reports

Figure 10: Diesel Oil Consumption for CUMMINS Engines

CUMMINS ENGINE COMPANY, INC Columbus, Indiana 47201 INDUSTRIAL PERFORMANCE CURVE	Basic Engine Model: 4BT3.9-P		Curve Number: C-4645	
	Engine Family: D38	CPL Code: 0730	Date: 12Aug91	By: RMM

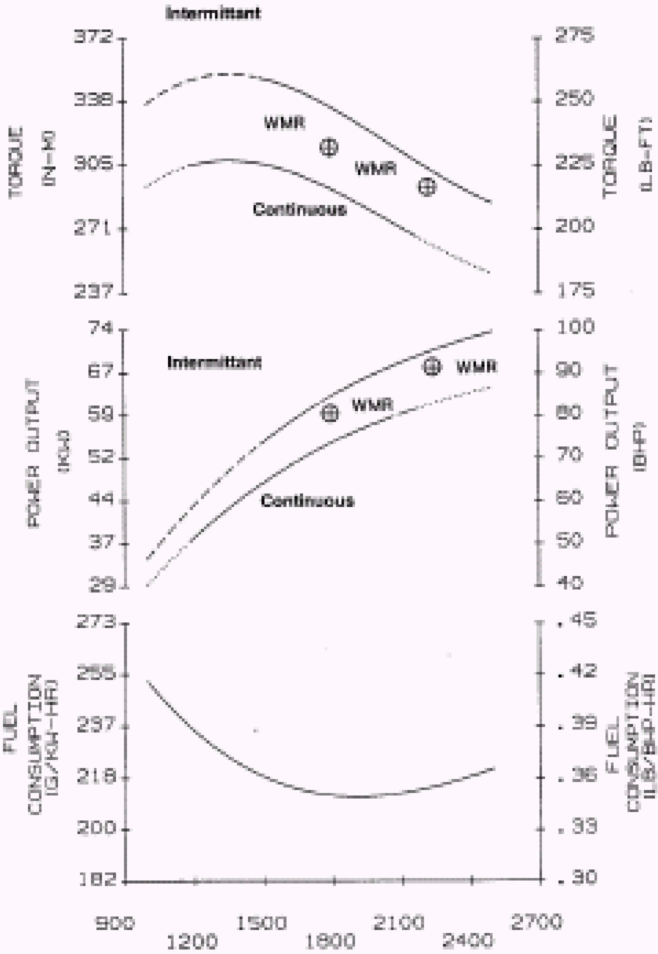
Displacement: 239.3 $in.^3$ (3.92 litre) Aspiration: Turbocharged

Bore: 4.02 in. (102 mm) Stroke: 4.72 in. (120 mm) No. of Cylinders: 4

Emission Control: Fuel System:

BHP (kW) @ RPM
100 (75) @ 2500

All data is based on the engine operating with fuel system, water pump, lubricating oil pump, and 10 in H_2O (250 am) inlet air restriction and with 2.0 in Hg (50 mm) exhaust restriction; not included are alternator, fan, optional equipment and driven components.



TORQUE

RPM	lb.-ft.	N•m
1000	250	339
1200	257	348
1500	260	353
1600	259	351
1800	249	338
2000	234	317
2200	225	305
2500	210	285
Water Management Rating 4BT3.9		
2200	217	294
1800	233	316

POWER OUTPUT

RPM	BHP	kW
1000	47	35
1200	58	43
1500	74	55
1600	79	59
1800	85	63
2000	90	67
2200	94	70
2500	100	75
Water Management Rating 4BT3.9		
2200	91	68
1800	80	60

FUEL CONSUMPTION

RPM	lb/BHP-HR	g/kW-hr
1000	.415	252
1200	.390	237
1500	.359	218
1600	.356	217
1800	.349	212
2000	.350	213
2200	.355	216
2500	.365	222
Water Management Rating 4BT3.9		
2200	.365	216
1800	.349	212

Curves shown above represent gross engine performance capabilities obtained and corrected in accordance with SAE J1995 conditions of 29.61 in Hg (100 kPa) barometric pressure [300 ft. (90 m) altitude], 77°F (25°C) inlet air temperature, and 0.30in Hg (1 kPa) water vapor pressure with No.2 diesel fuel. The engine may be operated without changing the fuel setting up to 10,000 ft. (3 000 m) altitude and 100°F (38°C). For sustained operation at high altitudes, the fuel rate of the engine should be adjusted to limit performance by 4% per 1,000 ft. (300 m) above 7,400 ft. (2 250 m) and 2% per 10°F above 100°F (2% per 11°C above 38°C).

TECHNICAL DATA DEPT. CERTIFIED WITHIN 5% CHIEF ENGINEER

Figure 11: CUMMINS Industrial Performance Curve Example

Thus, the emissions change caused by JMBCP is calculated by using equation (2) as follows:

$$PE_y = \sum_i FF_{i,y}.COEF_Y$$

where:

- *PEy* Are the project emissions during the year *y* in tons of CO_2,
- *FFi,y* Is the quantity of fuel type i combusted due to the project activity during the year *y* in a volume or mass unit,
- *COEFi* Is the CO_2 emission factor of the fossil fuel type *i* fired in the boiler in the absence of the project activity in tons CO_2 / mass or volume unit of the fuel.

However, for this project activity these variables will be considered as:

- $FF_{i,y} = \theta$ (hours of operation, which is the amount of fuel that is avoided by using a "i"-HP electric engine)
- *COEFi* = -0,1813 L/(HP.h) (how this number is obtained is shown in item E).

According to "IPCC (1996) Guidelines for National Greeehouse Gas Inventories" and "BEN" (Brazilian National Energetic Balance), an emission factor for diesel-oil can be calculated: 0,00273 tCO_2/L.
Thus, the emission change can be simply calculated as follows:

$$\mathbf{PE_y = \theta \,.\, (-0{,}1813) \,.\, (0{,}00273) = -\,4{,}95.10^{-4}\ tCO_2/HP.h \,.\, \theta}$$

The electric energy supplying the electric engines for irrigation is produced by JMBCP. Therefore, as it is explained, no net GHG emissions associated to the electric energy generating source will be considered.

E.2. Estimated leakage:

This project activity did not sell bagasse prior to its implementation.

Thus, $\mathbf{L_y = 0}$

E.3. The sum of E.1 and E.2 representing the project activity emissions:

$$\mathbf{L_y + PE_y = -4{,}95.10^{-4}\ tCO_2/HP.h \,.\, \theta}$$

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

The baseline methodology considers the determination of the emissions factor for the grid to which the project activity is connected as the core data to be determined in the baseline scenario. In Brazil, there are two main grids, South-Southeast-Midwest and North-Northeast, therefore the South-Southeast-Midwest Grid is the relevant one for this project.

The method that will be chosen to calculate the Operating Margin (OM) for the electricity baseline emission factor is the option (b) *Simple Adjusted OM,* since the preferable choice (c) *Dispatch Data Analysis OM* would face the barrier of data availability in Brazil.

In order to calculate the Operating Margin, daily dispatch data from the Brazilian electricity system manager (ONS) needed to be gathered. ONS does not regularly provide such information, which implied in getting it through communicating directly with the entity.

The provided information comprised years 2001, 2002 and 2003, and is the most recent information available at this stage (At the end of 2004 ONS supplied raw dispatch data for the whole interconnected grid in the form of daily reports[21] from Jan. 1, 2001 to Dec. 31, 2003, the most recent information available at this stage).

Simple Adjusted Operating Margin Emission Factor Calculation

According to the methodology, the project is to determine the Simple Adjusted OM Emission Factor ($EF_{OM, simple adjusted, y}$) . Therefore, the following equation is to be solved:

$$EF_{OM,simple\_adjusted,y} = (1-\lambda_y)\frac{\sum_{i,j} F_{i,j,y}.COEF_{i,j}}{\sum_j GEN_{j,y}} + \lambda_y \frac{\sum_{i,k} F_{i,k,y}.COEF_{i,k}}{\sum_k GEN_{k,y}} \text{ (tCO}_2\text{e/GWh)}$$

It is assumed here that all the low-cost/must-run plants produce zero net emissions.

$$\frac{\sum_{i,k} F_{i,k,y}.COEF_{i,k}}{\sum_k GEN_{k,y}} = 0 \text{ (tCO}_2\text{e/GWh)}$$

Please refer to the methodology text or the explanations on the variables mentioned above.

The ONS data as well as the spreadsheet data with the calculation of emission factors have been provided to the validator (DOE). In the spreadsheet, the dispatch data is treated as to allow calculation of the emission factor for the most three recent years with available information, which are 2001, 2002 and 2003.

The Lambda factors were calculated in accordance with methodology requests. More detailed information is provided in Annex 3. The table below presents such factors.

Year	Lambda
2001	0,5204
2002	0,5053
2003	0,5312

Electricity generation for each year needs also to be taken into account. This information is provided in the table below.

---

[21] *Acompanhamento Diário da Operação do Sistema Interligado Nacional*. ONS-CNOS, Centro Nacional de Operação do Sistema. Daily reports on the whole interconnected electricity system from Jan. 1, 2001 to Dec. 31, 2003.

Year	Electricity Load (MWh)
2001	263.706.242
2002	275.402.896
2003	288.493.929

Using therefore appropriate information for $F_{i,j,y}$ and $COEF_{i,j}$, OM emission factors for each year can be determined, as follows.

$$EF_{OM,simple\_adjusted,2001} = (1-\lambda_{2001})\frac{\sum_{i,j} F_{i,j,2001}.COEF_{i,j}}{\sum_{j} GEN_{j,2001}} \therefore EF_{OM,simple\_adjusted,2001} = 0{,}3524 \text{ tCO}_2\text{/MWh}$$

$$EF_{OM,simple\_adjusted,2002} = (1-\lambda_{2002})\frac{\sum_{i,j} F_{i,j,2002}.COEF_{i,j}}{\sum_{j} GEN_{j,2002}} \therefore EF_{OM,simple\_adjusted,2002} = 0{,}4207 \text{ tCO}_2\text{/MWh}$$

$$EF_{OM,simple\_adjusted,2003} = (1-\lambda_{2003})\frac{\sum_{i,j} F_{i,j,2003}.COEF_{i,j}}{\sum_{j} GEN_{j,2003}} \therefore EF_{OM,simple\_adjusted,2003} = 0{,}4396 \text{ tCO}_2\text{/MWh}$$

Finally, to determine the baseline *ex-ante*, the mean average among the three years is calculated, finally determining the $EF_{OM,simple\_adjusted}$.

$$EF_{OM,simple\_adjusted\ 2001\_2003} = 0{,}404 \text{ tCO}_2\text{/MWh}$$

According to the methodology used, a Build Margin emission factor also needs to be determined.

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y}.COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$

Electricity generation in this case means 20% of total generation in the most recent year (2003), as the 5 most recent plants built generate less than such 20%. Calculating such factor one reaches:

$$EF_{BM,2003} = 0{,}094 \text{ tCO}_2\text{/MWh}$$

Finally, the electricity baseline emission factor is calculated through a weighted-average formula, considering both the OM and the BM, being the weights 50% and 50% by default. That gives:

$$EF_{electricity,2001-2003} = 0{,}5 * 0{,}404 + 0{,}5 * 0{,}094 = 0{,}249 \text{ tCO}_2\text{/MWh}$$

It is important to note that adequate considerations on the above weights are currently under study by the Meth Panel, and there is a possibility that such weighing changes in the methodology applied here.

The baseline emissions would be 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 ($EF_{electricity,2001\text{-}2003}$) with the electricity generation of the project activity.

$BE_{electricity,y} = EF_{electricity,2001\text{-}2003} \ . \ EG_y$

Therefore, for the first crediting period, the baseline emissions will be calculated as follows:

$\mathbf{BE_{electricity,y} = 0{,}249\ tCO_2/MWh\ .\ EG_y}$ (in tCO_2e)

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

The emissions reduction of this project activity is

$\mathbf{ER = BE_{electricity,y} - (L_y + PE_y)} = 0{,}249\ tCO_2/MWh\ .\ EG_y - (\mathbf{- 4{,}95.10^{-4}\ tCO_2/HP.h.\ \theta}) =$

$= \mathbf{0{,}249\ tCO_2/MWh\ .\ EG_y + 4{,}95.10^{-4}\ tCO_2/HP.h\ .\ \theta}$

E.6. Table providing values obtained when applying formulae above:

Jalles Machado Biomass Cogeneration Project

line		Item	(Phase 1) 2001	(Phase 2) 2002	(Phase 3) 2003	2004	2005	2006	2007	Total CERs
1	Grid-Connected Emission Reduction	Installed Capacity, MW	10	10	38	38	38	38	38	
2		Internal Consumption (MW)	5	5	7,74	7,74	7,74	9	9	
3		Standby (MW)	2,6	0,9	21,7	17,6	17,6	11,4	9,6	
4		Capacity Factor	0,85	0,85	0,85	0,85	0,85	0,85	0,85	
5		Installed capacity available for sale (MW)	**2**	**3,5**	**7,3**	**10,8**	**10,8**	**15**	**16,5**	
6		Total estimated days of cogeneration (days)	173	147	145	160	160	150	150	
7		Hours of operation (h/year)	4.159	3.533	3.488	3.837	3.837	3.600	3.600	
8		Electric energy to be sold to CPFL, MWh/year	3.877	8.985	25.326	41.288	41.288	54.000	59.400	
9		Baseline emission factor tCO2e/MWh	0,249	0,249	0,249	0,249	0,249	0,249	0,249	
10		**Total CO_2 emissions reductions, tCO2e/year**	965	2.237	6.306	10.281	10.281	13.446	14.791	**58.307**
11	Off-grid emission change	Electric engines (100 hp)	3	3	3	7	7	7	7	Installation plan for electric pumping engines
12		Electric engines (150 hp)	0	1	1	1	1	1	1	
13		Electric engines (200 hp)	0	0	0	0	5	10	15	
14		Electric engines (250 hp)	0	2	2	2	2	2	2	
15		Total operating time (h) per year (all 100 hp engines)	8928	10046	6000	14000	14000	14000	14000	New Electric Engines (historically, engines operate ~2000 h/year)
16		Total operating time (h) per year (all 150 hp engines)	0	2250	2000	2000	2000	2000	2000	
17		Total operating time (h) per year (all 200 hp engines)	0	0	0	0	10000	20000	30000	
18		Total operating time (h) per year (all 250 hp engines)	0	4643	4000	4000	4000	4000	4000	
		Minimum fuel consumption (L/HP*h)	0,1813	0,1813	0,1813	0,1813	0,1813	0,1813	0,1813	Equivalent fuel consumption of a standard diesel fueled engine
19		Consumption 100hp - Standard (L/h)	18,13	18,13	18,13	18,13	18,13	18,13	18,13	
20		Consumption 150hp - Standard (L/h)	27,195	27,195	27,195	27,195	27,195	27,195	27,195	
21		Consumption 200hp - Standard (L/h)	36,26	36,26	36,26	36,26	36,26	36,26	36,26	
22		Consumption 250hp - Standard (L/h)	45,33	45,33	45,33	45,33	45,33	45,33	45,33	
23		Fraction of Carbon Oxidized	0,99	0,99	0,99	0,99	0,99	0,99	0,99	IPCC data
24		Diesel Emission Factor (ton CO2/L)	0,00273	0,00273	0,00273	0,00273	0,00273	0,00273	0,00273	
25		**Total Off-Grid emissions change (tCO2e/year)**	437	1.225	930	1.321	2.300	3.279	4.257	**13.749**
26		**Total emissions reduction (tCO2e)**	**1.402**	**3.462**	**7.236**	**11.602**	**12.581**	**16.725**	**19.048**	**72.056**

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

The activity of electricity generation in Brazil is open to private enterprises via authorization issues by the National Agency of Electric Power, (ANEEL), or via concession auctions sponsored by the agency, depending on the energy source and particular circumstances. In the case of construction and operation of stations for generation of energy from alternative sources (solar, wind power, biomass, etc), as well as of thermoelectric and small hydro power stations, ANEEL requires simple authorization. Jalles Machado has an ANEEL authorization for operating as "Independent Power Producer" (PIE - *Produtor Independente de Energia Elétrica*), which is "a firm or consortium of firms that may receive a concession or authorization to produce and retail all or part of the power, to its own account and at its own risk", as defined by the Federal Decree Nº 2003 of January 10, 1996. The PIE is subject to its own operating and commercial rules, provided that they comply with specifications prescribed in the prevailing law, concession contract or authorization act.

Award of authorization by ANEEL, however, does not substitute or otherwise alter the requirement for the company to fully comply with other relevant legislation, in particular environmental requirements. The possible environmental impacts of JMBCP project activity are to be analysed by the State Secretary of Environment (SMA - *Secretaria de Estado do Meio Ambiente, dos Recursos Hídricos e da Habitação*) through a report called "Simplified Environmental Report" (RAS - *Relatório Ambiental Simplificado*) elaborated by the company and sent to the state environmental agency (*Agência Goiana de Meio Ambiente - AGMA*).

Regarding the out-of-boundary impacts, the JMBCP project activity will not affect the expansion of the national electricity grid supply due to its small size in power generation capacity. Since Jalles Machado has always cared also about other environmental issues, including preservation of local environment, in a constant improvement of preservation areas, adequate treatment of effluents and other residues, and is therefore in compliance with any applicable environmental regulation in Brazil, no other environmental impact assessment or documentation should be necessary for JMBCP project activity.

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

According to Brazilian laws, the possible environmental impacts are to be analysed by the State Secretary of Environment (SMA) through AGMA. Jalles Machado has applied for and been granted the installation license and the operation license for the project. However, Jalles Machado must comply with some demands from the environmental agency in order to proceed with the installation and operation of the project, being significant for the project:

- Pollution control equipments must be maintained and operated accordingly to their specifications, so their efficiency is kept in order.

- Particulate emissions, noise and vibration levels must be kept within the parameters established by the Environmental Law.

- Noise and pollutant emissions readings must be sent to AGMA each semester, including pollutant dispersion assessment.

- The Local Environmental Agency must be contacted in case of Environmental accidents and incidents

- The performance of the project activity shall not deteriorate the environment nor harm people outside the plant.

- Areas of Permanent Preservation must be kept preserved, and no soil waterproofing is allowed.

- The License renovation must be required at least 120 days before it expiration date.

- Adequate disposal of solid waste must be practiced.

SECTION G. Stakeholders' comments

G.1. Brief description how comments by local stakeholders have been invited and compiled:

Jalles Machado published in two newspapers the requirement of renewal of its Operating Licence: in 12th of September 2002 edition of the local one "Diário da Manhã" – from the state of Goiás – and in the 13th of September, 2002 edition of the D.O. / GO (state of Goiás official newspaper).

Also, as a requirement of the Brazilian Interministral Commission on Global Climate Change, the Brazilian DNA, Jalles Machado has invited several organizations and institutions to comment the CDM project being developed. Letters[22] were sent to the following recipients:

- Prefeitura do Município de Goianésia – GO / *Municipal Administration of Goianésia – GO;*

- Câmara dos Vereadores de Goianésia – GO / *Municipal Legislation Chamber of Goianésia – GO;*

- Fórum de Goianésia / *Goianésia Fórum;*

- Fórum Brasileiro de ONGs / *Brazilian NGO Fórum;*

- Agência Ambiental de Goiás / *Environmental Agency of Goiás;*

- Sindicato Rural de Goianésia / *Rural Syndicate of Goianésia;*

- CDEAL – Centro de Desenvolvimento de Empresários e Administradores Líderes / *Businessmen and Leader Managers Development Center*

G.2. Summary of the comments received:

Due to the invitations for comments sent by Jalles Machado, according to item G.1 above, as a request of the Brazilian DNA, 3 (three) comments were received out of the 7 (seven) invitations sent, as described below:

Comment 1. **Letter received from Prefeitura Municipal de Goianésia – GO / *Municipal Administration of Goianésia – GO;***

[22] The copy of these invitations, as well as the answers, are available in hold by Project participants.

Comment 2. **Letter received from Sindicato Rural de Goianésia** / ***Rural Syndicate of Goianésia;***

Comment 3. **Letter received from Câmara dos Vereadores de Goianésia – GO** / ***Municipal Legislation Chamber of Goianésia –GO.***

No suggestion or questioning was made in those letters, however, the contribution with relevant economic, social and pioneering aspects of the project were commented and recognized by the institutions, as well as the importance of renewable energy generation and the benefits for the Brazilian industry that CERs commercialisation could bring.

G.3. Report on how due account was taken of any comments received:

For the comments received, the project participants understood that the consultation process could be closed without further considerations.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no Annex I public funding involved in JMBCP project activity.

Annex 3

BASELINE INFORMATION

The Brazilian electricity system has been historically divided into two subsystems: the North-Northeast (N-NE) and the South-Southeast-Midwest (S-SE-CO). This is due mainly to the historical evolution of the physical system, which was naturally developed nearby the biggest consuming centers of the country.

The natural evolution of both systems is increasingly showing that integration is to happen in the future. In 1998, the Brazilian government was announcing the first leg of the interconnection line between S-SE-CO and N-NE. With investments of around US$700 million, the connection had the main purpose, in the government's view, at least, to help solve energy imbalances in the country: the S-SE-CO region could supply the N-NE in case it was necessary and vice-versa.

Nevertheless, even after the interconnection had been established, technical papers still divided the Brazilian system in two (Bosi, 2000)[23]:

"… where the Brazilian Electricity System is divided into three separate subsystems:
- (i) The South/Southeast/Midwest Interconnected System;
- (ii) The North/Northeast Interconnected System; and
- (iii) The Isolated Systems (which represent 300 locations that are electrically isolated from the interconnected systems)"

Moreover, Bosi (2000) gives a strong argumentation in favor of having so-called *multi-project baselines*:

"For large countries with different circumstances within their borders and different power grids based in these different regions, multi-project baselines in the electricity sector may need to be disaggregated below the country-level in order to provide a credible representation of 'what would have happened otherwise'".

Finally, one has to take into account that even though the systems today are connected, the energy flow between N-NE and S-SE-CO is heavily limited by the transmission lines capacity. Therefore, only a fraction of the total energy generated in both subsystems is sent one way or another. It is natural that this fraction may change its direction and magnitude (up to the transmission line's capacity) depending on the hydrological patterns, climate and other uncontrolled factors. But it is not supposed to represent a significant amount of each subsystem's electricity demand. It has also to be considered that only in 2004 the interconnection between SE and NE was concluded, i.e., if project proponents are to be coherent

[23] Bosi, M. *An Initial View on Methodologies for Emission Baselines: Electricity Generation Case Study*. International Energy Agency. Paris, 2000.

with the generation database they have available as of the time of the PDD submission for validation, a situation where the electricity flow between the subsystems was even more restricted is to be considered.

The Brazilian electricity system nowadays comprises of around 91,3 GW of installed capacity, in a total of 1.420 electricity generation enterprises. From those, nearly 70% are hydropower plants, around 10% are natural gas-fired power plants, 5,3% are diesel and fuel oil plants, 3,1% are biomass sources (sugarcane bagasse, black liquor, wood, rice straw and biogas), 2% are nuclear plants, 1,4% are coal plants, and there are also 8,1 GW of installed capacity in neighboring countries (Argentina, Uruguay, Venezuela and Paraguay) that may dispatch electricity to the Brazilian grid. (http://www.aneel.gov.br/aplicacoes/capacidadebrasil/OperacaoCapacidadeBrasil.asp). This latter capacity is in fact comprised by mainly 6,3 GW of the Paraguayan part of *Itaipu Binacional*, a hydropower plant operated by both Brazil and Paraguay, but whose energy almost entirely is sent to the Brazilian grid.

Approved methodologies AM0015 and ACM0002 ask project proponents to account for "all generating sources serving the system". In that way, when applying one of these methodologies, project proponents in Brazil should search for, and research, all power plants serving the Brazilian system.

In fact, information on such generating sources is not publicly available in Brazil. The national dispatch center, ONS – *Operador Nacional do Sistema* – argues that dispatching information is strategic to the power agents and therefore cannot be made available. On the other hand, ANEEL, the electricity agency, provides information on power capacity and other legal matters on the electricity sector, but no dispatch information can be got through this entity.

In that regard, project proponents looked for a plausible solution in order to be able to calculate the emission factor in Brazil in the most accurate way. Since real dispatch data is necessary after all, the ONS was contacted, in order to let participants know until which degree of detail information could be provided. After several months of talks, plants' daily dispatch information was made available for years 2001, 2002 and 2003.

Project proponents, discussing the feasibility of using such data, concluded it was the most proper information to be considered when determining the emission factor for the Brazilian grid. According to ANEEL, in fact, ONS centralized dispatched plants accounted for 75.547 MW of installed capacity by 31/12/2004, out of the total 98.848,5 MW installed in Brazil by the same date (http://www.aneel.gov.br/arquivos/PDF/Resumo_Gráficos_mai_2005.pdf), which includes capacity available in neighboring countries to export to Brazil and emergency plants, that are dispatched only during times of electricity constraints in the system. Such capacity in fact is constituted by plants with 30 MW installed capacity or above, connected to the system through 138kV power lines, or at higher voltages. Therefore, even though the emission factor calculation is carried out without considering all generating sources serving the system, about 76,4% of the installed capacity serving Brazil is taken into account, which is a fair amount if one looks at the difficulty in getting dispatch information in Brazil. Moreover, the remaining 23,6% are plants that do not have their dispatch coordinated by ONS, since: either they operate based on power purchase agreements which are not under control of the dispatch authority; or they are located in non-interconnected systems to which ONS has no access. In that way, this portion is not likely to be affected by the CDM projects, and this is another reason for not taking them into account when determining the emission factor.

In an attempt to include all generating sources, project developers considered the option to research for available, but non-official data, to supply the existing gap. The solution found was the International

Energy Agency database built when carrying out the study "Road-Testing Baselines For Greenhouse Gas Mitigation Projects in the Electric Power Sector", published in October 2002. Merging ONS data with the IEA data in a spreadsheet, project proponents have been able to consider all generating sources connected to the relevant grids in order to determine the emission factor. The emission factor calculated was found more conservative when considering ONS data only, as the table below shows the build margin in both cases.

IEA/ONS Merged Data Build Margin (tCO_2/MWh)	ONS Data Build Margin (tCO_2/MWh)
0,205	0,0937

Therefore, considering all the rationale explained, project developers decided for the database considering ONS information only, as it was capable of properly addressing the issue of determining the emission factor and doing it in the most conservative way.

The fossil fueled plants efficiencies were also taken from the IEA paper. This was done considering the lack of more detailed information on such efficiencies from public, reliable and credible sources.

From the mentioned reference:

> *The fossil fuel conversion efficiency (%) for the thermal power plants was calculated based on the installed capacity of each plant and the electricity actually produced. For most of the fossil fuel power plants under construction, a constant value of 30% was used as an estimate for their fossil fuel conversion efficiencies. This assumption was based on data available in the literature and based on the observation of the actual situation of those kinds of plants currently in operation in Brazil. The only 2 natural gas plants in combined cycle (totaling 648 MW) were assumed to have a higher efficiency rate, i.e. 45%.*

Therefore only data for plants under construction in 2002 (with operation start in 2002 and 2003) was estimated. All others efficiencies were calculated. To the best of our knowledge there was no retrofit/modernization of the older fossil-fuelled power plants in the analyzed period (2001 to 2003). For that reason project participants find the application of such numbers to be not only reasonable but the best available option.

The aggregated hourly dispatch data got from ONS was used to determine the lambda factor for each of the years with data available (2001, 2002 and 2003). The Low-cost/Must-run generation was determined as the total generation minus fossil-fuelled thermal plants generation, this one determined through daily dispatch data provided by ONS. All this information has been provided to the validators, and extensively discussed with them, in order to make all points crystal clear.

On the following pages, a summary of the analysis is provided. First, the table with the 122 plants dispatched by the ONS is provided. Then, a table with the summarized conclusions of the analysis, with the emission factor calculation displayed. Finally, the load duration curves for the S-SE-MW system are presented.

ONS Dispatched Plants

	Subsystem*	Fuel source**	Power plant	Operation start [2, 4, 5]	Installed capacity (MW) [1]	Fossil fuel conversion efficiency (%) [2]	Carbon emission factor (tC/TJ) [3]	Fraction carbon oxidized [3]	Emission factor (tCO2/MWh)
1	S-SE-CO	H	Jauru	Sep-2003	121.5	1	0.0	0.0%	0.000
2	S-SE-CO	H	Gauporé	Sep-2003	120.0	1	0.0	0.0%	0.000
3	S-SE-CO	G	Três Lagoas	Aug-2003	306.0	0.3	15.3	99.5%	0.670
4	S-SE-CO	H	Funil (MG)	Jan-2003	180.0	1	0.0	0.0%	0.000
5	S-SE-CO	H	Itiquira I	Sep-2002	156.1	1	0.0	0.0%	0.000
6	S-SE-CO	G	Araucária	Sep-2002	484.5	0.3	15.3	99.5%	0.670
7	S-SE-CO	G	Canoas	Sep-2002	160.6	0.3	15.3	99.5%	0.670
8	S-SE-CO	H	Piraju	Sep-2002	81.0	1	0.0	0.0%	0.000
9	S-SE-CO	G	Nova Piratininga	Jun-2002	384.9	0.3	15.3	99.5%	0.670
10	S-SE-CO	O	PCT CGTEE	Jun-2002	5.0	0.3	20.7	99.0%	0.902
11	S-SE-CO	H	Rosal	Jun-2002	55.0	1	0.0	0.0%	0.000
12	S-SE-CO	G	Ibirité	May-2002	226.0	0.3	15.3	99.5%	0.670
13	S-SE-CO	H	Cana Brava	May-2002	465.9	1	0.0	0.0%	0.000
14	S-SE-CO	H	Sta. Clara	Jan-2002	60.0	1	0.0	0.0%	0.000
15	S-SE-CO	H	Machadinho	Jan-2002	1,140.0	1	0.0	0.0%	0.000
16	S-SE-CO	G	Juiz de Fora	Nov-2001	87.0	0.28	15.3	99.5%	0.718
17	S-SE-CO	G	Macaé Merchant	Nov-2001	922.6	0.24	15.3	99.5%	0.837
18	S-SE-CO	H	Lajeado (ANEEL res. 402/2001)	Nov-2001	902.5	1	0.0	0.0%	0.000
19	S-SE-CO	G	Eletrobolt	Oct-2001	379.0	0.24	15.3	99.5%	0.837
20	S-SE-CO	H	Porto Estrela	Sep-2001	112.0	1	0.0	0.0%	0.000
21	S-SE-CO	G	Cuiaba (Mario Covas)	Aug-2001	529.2	0.3	15.3	99.5%	0.670
22	S-SE-CO	G	W. Arjona	Jan-2001	194.0	0.25	15.3	99.5%	0.804
23	S-SE-CO	G	Uruguaiana	Jan-2000	639.9	0.45	15.3	99.5%	0.447
24	S-SE-CO	H	S. Caxias	Jan-1999	1,240.0	1	0.0	0.0%	0.000
25	S-SE-CO	H	Canoas I	Jan-1999	82.5	1	0.0	0.0%	0.000
26	S-SE-CO	H	Canoas II	Jan-1999	72.0	1	0.0	0.0%	0.000
27	S-SE-CO	H	Igarapava	Jan-1999	210.0	1	0.0	0.0%	0.000
28	S-SE-CO	H	Porto Primavera	Jan-1999	1,540.0	1	0.0	0.0%	0.000
29	S-SE-CO	D	Cuiaba (Mario Covas)	Oct-1998	529.2	0.27	20.2	99.0%	0.978
30	S-SE-CO	H	Sobragi	Sep-1998	60.0	1	0.0	0.0%	0.000
31	S-SE-CO	H	PCH EMAE	Jan-1998	26.0	1	0.0	0.0%	0.000
32	S-SE-CO	H	PCH CEEE	Jan-1998	25.0	1	0.0	0.0%	0.000
33	S-SE-CO	H	PCH ENERSUL	Jan-1998	43.0	1	0.0	0.0%	0.000
34	S-SE-CO	H	PCH CEB	Jan-1998	15.0	1	0.0	0.0%	0.000
35	S-SE-CO	H	PCH ESCELSA	Jan-1998	62.0	1	0.0	0.0%	0.000
36	S-SE-CO	H	PCH CELESC	Jan-1998	50.0	1	0.0	0.0%	0.000
37	S-SE-CO	H	PCH CEMAT	Jan-1998	145.0	1	0.0	0.0%	0.000
38	S-SE-CO	H	PCH CELG	Jan-1998	15.0	1	0.0	0.0%	0.000
39	S-SE-CO	H	PCH CERJ	Jan-1998	59.0	1	0.0	0.0%	0.000
40	S-SE-CO	H	PCH COPEL	Jan-1998	70.0	1	0.0	0.0%	0.000
41	S-SE-CO	H	PCH CEMIG	Jan-1998	84.0	1	0.0	0.0%	0.000
42	S-SE-CO	H	PCH CPFL	Jan-1998	55.0	1	0.0	0.0%	0.000
43	S-SE-CO	H	S. Mesa	Jan-1998	1,275.0	1	0.0	0.0%	0.000
44	S-SE-CO	H	PCH EPAULO	Jan-1998	26.0	1	0.0	0.0%	0.000
45	S-SE-CO	H	Guilmam Amorim	Jan-1997	140.0	1	0.0	0.0%	0.000
46	S-SE-CO	H	Corumbá	Jan-1997	375.0	1	0.0	0.0%	0.000
47	S-SE-CO	H	Miranda	Jan-1997	408.0	1	0.0	0.0%	0.000
48	S-SE-CO	H	Noav Ponte	Jan-1994	510.0	1	0.0	0.0%	0.000
49	S-SE-CO	H	Segredo (Gov. Ney Braga)	Jan-1992	1,260.0	1	0.0	0.0%	0.000
50	S-SE-CO	H	Taquaruçu	Jan-1989	554.0	1	0.0	0.0%	0.000
51	S-SE-CO	H	Manso	Jan-1988	210.0	1	0.0	0.0%	0.000
52	S-SE-CO	H	D. Francisca	Jan-1987	125.0	1	0.0	0.0%	0.000
53	S-SE-CO	H	Itá	Jan-1987	1,450.0	1	0.0	0.0%	0.000
54	S-SE-CO	H	Rosana	Jan-1987	369.2	1	0.0	0.0%	0.000
55	S-SE-CO	N	Angra	Jan-1985	1,874.0	1	0.0	0.0%	0.000
56	S-SE-CO	H	T. Irmãos	Jan-1985	807.5	1	0.0	0.0%	0.000
57	S-SE-CO	H	Itaipu 60 Hz	Jan-1983	6,300.0	1	0.0	0.0%	0.000
58	S-SE-CO	H	Itaipu 50 Hz	Jan-1983	5,375.0	1	0.0	0.0%	0.000
59	S-SE-CO	H	Emborcação	Jan-1982	1,192.0	1	0.0	0.0%	0.000
60	S-SE-CO	H	Nova Avanhandava	Jan-1982	347.4	1	0.0	0.0%	0.000
61	S-SE-CO	H	Gov. Bento Munhoz - GBM	Jan-1980	1,676.0	1	0.0	0.0%	0.000
62	S-SE-CO	H	S.Santiago	Jan-1980	1,420.0	1	0.0	0.0%	0.000
63	S-SE-CO	H	Itumbiara	Jan-1980	2,280.0	1	0.0	0.0%	0.000
64	S-SE-CO	O	Igarapé	Jan-1978	131.0	0.3	20.7	99.0%	0.902
65	S-SE-CO	H	Itauba	Jan-1978	512.4	1	0.0	0.0%	0.000
66	S-SE-CO	H	A. Vermelha (Jose E. Moraes)	Jan-1978	1,396.2	1	0.0	0.0%	0.000
67	S-SE-CO	H	S.Simão	Jan-1978	1,710.0	1	0.0	0.0%	0.000
68	S-SE-CO	H	Capivara	Jan-1977	640.0	1	0.0	0.0%	0.000
69	S-SE-CO	H	S.Osório	Jan-1975	1,078.0	1	0.0	0.0%	0.000
70	S-SE-CO	H	Marimbondo	Jan-1975	1,440.0	1	0.0	0.0%	0.000
71	S-SE-CO	H	Promissão	Jan-1975	264.0	1	0.0	0.0%	0.000
72	S-SE-CO	C	Pres. Medici	Jan-1974	446.0	0.26	26.0	98.0%	1.294
73	S-SE-CO	H	Volta Grande	Jan-1974	380.0	1	0.0	0.0%	0.000
74	S-SE-CO	H	Porto Colombia	Jun-1973	320.0	1	0.0	0.0%	0.000
75	S-SE-CO	H	Passo Fundo	Jan-1973	220.0	1	0.0	0.0%	0.000
76	S-SE-CO	H	Passo Real	Jan-1973	158.0	1	0.0	0.0%	0.000
77	S-SE-CO	H	Ilha Solteira	Jan-1973	3,444.0	1	0.0	0.0%	0.000
78	S-SE-CO	H	Mascarenhas	Jan-1973	131.0	1	0.0	0.0%	0.000
79	S-SE-CO	H	Gov. Parigot de Souza - GPS	Jan-1971	252.0	1	0.0	0.0%	0.000
80	S-SE-CO	H	Chavantes	Jan-1971	414.0	1	0.0	0.0%	0.000
81	S-SE-CO	H	Jaguara	Jan-1971	424.0	1	0.0	0.0%	0.000
82	S-SE-CO	H	Sá Carvalho	Apr-1970	78.0	1	0.0	0.0%	0.000
83	S-SE-CO	H	Estreito (Luiz Carlos Barreto)	Jan-1969	1,050.0	1	0.0	0.0%	0.000
84	S-SE-CO	H	Ibitinga	Jan-1969	131.5	1	0.0	0.0%	0.000
85	S-SE-CO	H	Jupiá	Jan-1969	1,551.2	1	0.0	0.0%	0.000
86	S-SE-CO	O	Alegrete	Jan-1968	66.0	0.26	20.7	99.0%	1.040
87	S-SE-CO	G	Campos (Roberto Silveira)	Jan-1968	30.0	0.24	15.3	99.5%	0.837
88	S-SE-CO	G	Santa Cruz (RJ)	Jan-1968	766.0	0.31	15.3	99.5%	0.648
89	S-SE-CO	H	Paraibuna	Jan-1968	85.0	1	0.0	0.0%	0.000
90	S-SE-CO	H	Limoeiro (Armando Salles de Oliviera)	Jan-1967	32.0	1	0.0	0.0%	0.000
91	S-SE-CO	H	Caconde	Jan-1966	80.4	1	0.0	0.0%	0.000
92	S-SE-CO	C	J.Lacerda C	Jan-1965	363.0	0.25	26.0	98.0%	1.345
93	S-SE-CO	C	J.Lacerda B	Jan-1965	262.0	0.21	26.0	98.0%	1.602
94	S-SE-CO	C	J.Lacerda A	Jan-1965	232.0	0.18	26.0	98.0%	1.869
95	S-SE-CO	H	Bariri (Alvaro de Souza Lima)	Jan-1965	143.1	1	0.0	0.0%	0.000
96	S-SE-CO	H	Funil (RJ)	Jan-1965	216.0	1	0.0	0.0%	0.000
97	S-SE-CO	C	Figueira	Jan-1963	20.0	0.3	26.0	98.0%	1.121
98	S-SE-CO	H	Furnas	Jan-1963	1,216.0	1	0.0	0.0%	0.000
99	S-SE-CO	H	Barra Bonita	Jan-1963	140.8	1	0.0	0.0%	0.000
100	S-SE-CO	C	Charqueadas	Jan-1962	72.0	0.23	26.0	98.0%	1.462
101	S-SE-CO	H	Jurumirim (Armando A. Laydner)	Jan-1962	97.7	1	0.0	0.0%	0.000
102	S-SE-CO	H	Jacui	Jan-1962	180.0	1	0.0	0.0%	0.000
103	S-SE-CO	H	Pereira Passos	Jan-1962	99.1	1	0.0	0.0%	0.000
104	S-SE-CO	H	Tres Marias	Jan-1962	396.0	1	0.0	0.0%	0.000
105	S-SE-CO	H	Euclides da Cunha	Jan-1960	108.8	1	0.0	0.0%	0.000
106	S-SE-CO	H	Camargos	Jan-1960	46.0	1	0.0	0.0%	0.000
107	S-SE-CO	H	Santa Branca	Jan-1960	56.1	1	0.0	0.0%	0.000
108	S-SE-CO	H	Cachoeira Dourada	Jan-1959	658.0	1	0.0	0.0%	0.000
109	S-SE-CO	H	Salto Grande (Lucas N. Garcez)	Jan-1958	70.0	1	0.0	0.0%	0.000
110	S-SE-CO	H	Salto Grande (MG)	Jan-1956	102.0	1	0.0	0.0%	0.000
111	S-SE-CO	H	Mascarenhas de Moraes (Peixoto)	Jan-1956	478.0	1	0.0	0.0%	0.000
112	S-SE-CO	H	Itutinga	Jan-1955	52.0	1	0.0	0.0%	0.000
113	S-SE-CO	C	S. Jerônimo	Jan-1954	20.0	0.26	26.0	98.0%	1.294
114	S-SE-CO	O	Carioba	Jan-1954	36.2	0.3	20.7	99.0%	0.902
115	S-SE-CO	O	Piratininga	Jan-1954	472.0	0.3	20.7	99.0%	0.902
116	S-SE-CO	H	Canastra	Jan-1953	42.5	1	0.0	0.0%	0.000
117	S-SE-CO	H	Nilo Peçanha	Jan-1953	378.4	1	0.0	0.0%	0.000
118	S-SE-CO	H	Fontes Nova	Jan-1940	130.3	1	0.0	0.0%	0.000
119	S-SE-CO	H	Henry Borden Sub.	Jan-1926	420.0	1	0.0	0.0%	0.000
120	S-SE-CO	H	Henry Borden Ext.	Jan-1926	469.0	1	0.0	0.0%	0.000
121	S-SE-CO	H	I. Pombos	Jan-1924	189.7	1	0.0	0.0%	0.000
122	S-SE-CO	H	Jaguari	Jan-1917	11.8	1	0.0	0.0%	0.000
				Total (MW) =	**64,478.6**				

* Subsystem: S - south, SE-CO - Southeast-Midwest

** Fuel source (C, bituminous coal; D, diesel oil; G, natural gas; H, hydro; N, nuclear; O, residual fuel oil).

[1] Agência Nacional de Energia Elétrica. *Banco de Informações da Geração* (http://www.aneel.gov.br/, data collected in november 2004)

[2] Bosi, M., A. Laurence, P. Maldonado, R. Schaeffer, A.F. Simoes, H. Winkler and J.M. Lukamba. *Road testing baselines for GHG mitigation projects in the electric power sector.* OECD/IEA information paper, October 2002.

[3] Intergovernmental Panel on Climate Change. *Revised 1996 Guidelines for National Greenhouse Gas Inventories.*

[4] Operador Nacional do Sistema Elétrico. Centro Nacional de Operação do Sistema. *Acompanhamento Diário da Operação do SIN* (daily reports from Jan. 1, 2001 to Dec. 31, 2003).

[5] Agência Nacional de Energia Elétrica. Superintendência de Fiscalização dos Serviços de Geração. *Resumo Geral dos Novos Empreendimentos de Geração* (http://www.aneel.gov.br/, data collected in november 2004).

Summary table

Baseline (including imports)	Emission factors for the Brazilian South-Southeast-Midwest interconnected grid			
	EF_{OM} [tCO2/MWh]	Load [MWh]	LCMR [MWh]	Imports [MWh]
2001	0,7350	263.706.242	244.665.786	5.493.162
2002	0,8504	275.402.896	258.720.232	1.607.395
2003	0,9378	288.493.929	274.649.425	459.586
	Total (2001-2003) =	827.603.067	778.035.443	7.560.143
	$EF_{OM, simple-adjusted}$ [tCO2/MWh]	$EF_{BM,2003}$	from ONS-Lambda SSECO 2001-2003.xls	
	0,4043	0,0937	λ_{2001}	
	Default weights		0,5204	
	w_{OM} = 0,5		λ_{2002}	
	w_{BM} = 0,5		0,5053	
	EF [tCO2/MWh]		λ_{2003}	
	0,2490		0,5312	

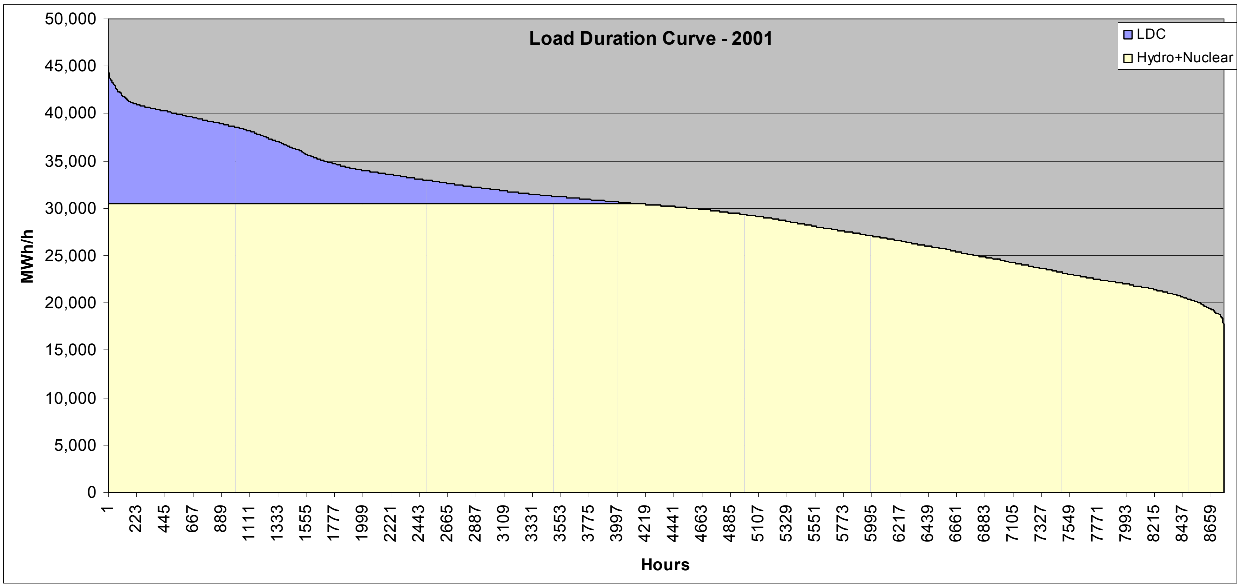

Figure 12: Load duration curve for the S-SE-MW system, 2001

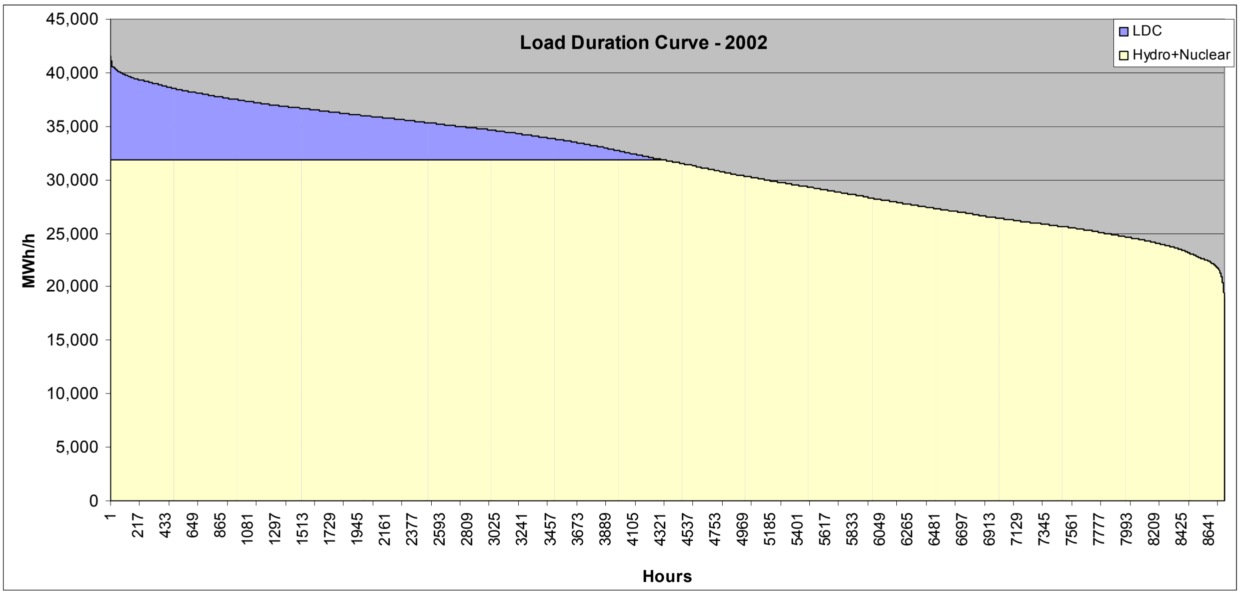

Figure 13: Load duration curve for the S-SE-MW system, 2002

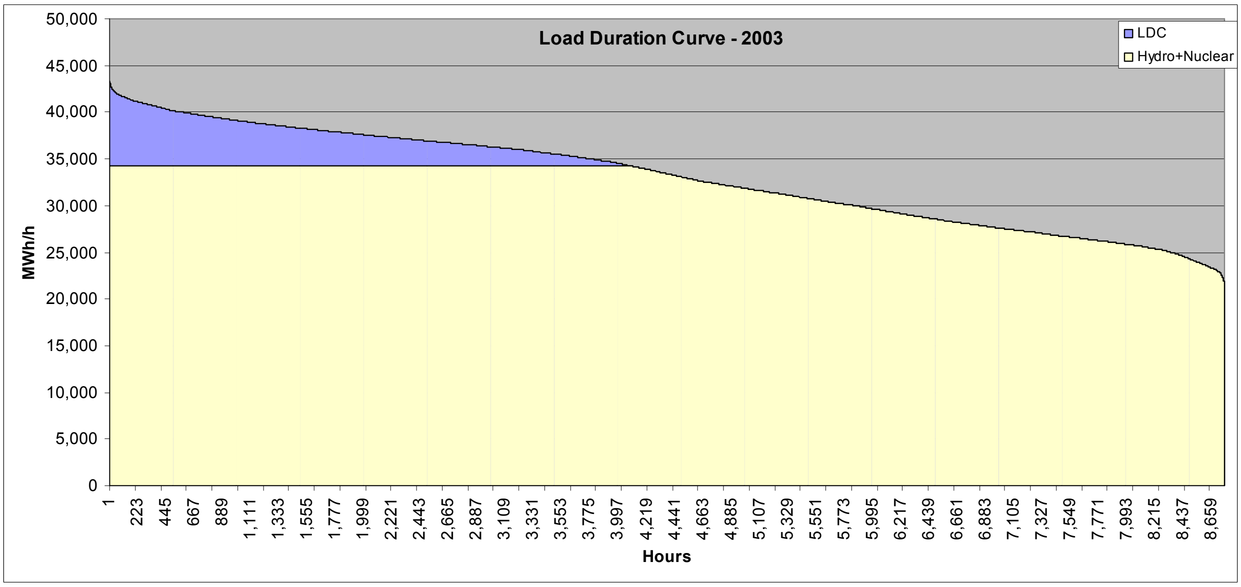

Figure 14: Load duration curve for the S-SE-MW system, 2003

Annex 4

MONITORING PLAN

Quantifying the energy sold is a fundamental responsibility of CELG, the local distributor to whose grid Jalles Machado is connected. They are responsible for the reads of the electricity meter and issuance of a report on the amount of electricity supplied to the grid on a monthly basis to CPFL, the electricity distributor that buys the energy from Jalles Machado. Energy from both transmission lines (line 1 – G1 and G2 connected to a 34,5kV transmission line; and line 2 – G3 connected to a 69 kV transmission line) are read by the computers and sent via modem directly to CELG computers which, by the end of the month, reports to Jalles Machado the total amount of energy sold.

Quantifying the total amount of operating hours of electric irrigation engines installed is a responsibility of Jalles Machado. The ISO 9001:2000 certified registry system of the company guarantees that the sugarcane cultivation management follows the needed quality assurance and control required by this CDM project. Also, an ISO 9001:2000 procedure was created to establish a routine for conducting the readings. A trained operator – also responsible for chronometers maintenance – takes notes from chronometers installed in each of the electric engines and input into the certified system. The equipment for timing the operating hours of irrigators can be seen in Figure and 13. Since chronometers are not necessarily calibrated, Jalles Machado keeps back up units for eventual miss function.

Figure 15: Electric Pumping Station and Control Panel

Figure 16: Control Panel with Chronometer indicated

According to the section D of this document, the variables that will be monitored in this project activity are the quantity of energy exported to the grid and the number of operating hours for the irrigation engines, from year 2001 up to the end of the last crediting period. Since no leakage nor any off-grid emissions change were identified in this project activity, there will be no need to monitor the variables for these cases. The monitoring will occur as follows:

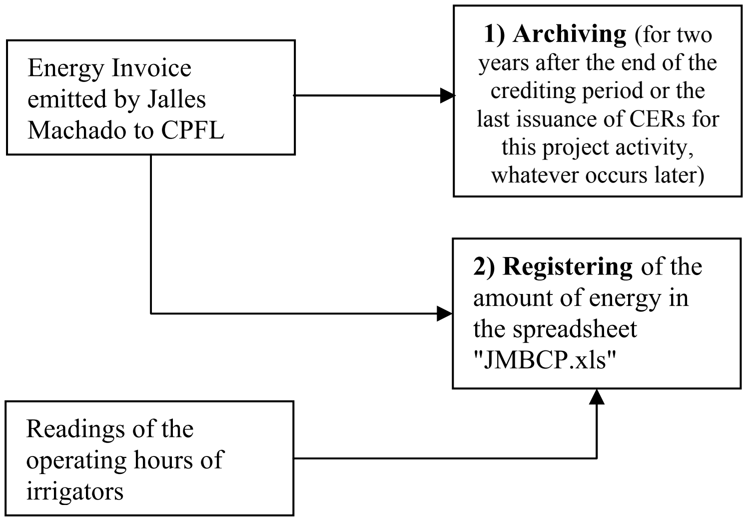

Figure 17: Monitoring procedures for JMBCP

The quantity of energy exported to the grid will be monitored through the energy invoice emitted by Jalles Machado to CPFL, the energy distributor. The archiving will occur up to two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later. The amount of energy will be registered in the spreadsheet "JMBCP.xls", which shall be the instrument for the further Verification.