**PROJECT DESIGN DOCUMENT FORM
FOR CDM PROJECT ACTIVITIES (F-CDM-PDD)
Version 04.1**

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	Candelaria Hydroelectric Project
Version number of the PDD	Version 07.1
Completion date of the PDD	20/09/2013
Project participant(s)	Hidroeléctrica Candelaria S.A.: Private
Host Party(ies)	Guatemala
Sectoral scope and selected methodology(ies)	**Sectoral Scope:** Type I-Renewable Energy Projects, Category D-Renewable Electricity Generation for a Grid **Methodology:** AMS-I.D. Grid Connected renewable electricity generation (version 8)
Estimated amount of annual average GHG emission reductions	18,922

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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The objective of the proposed project activity is to generate renewable electricity using hydroelectric resources and to sell the generated output to the national grid. The project has the capacity to reduce CO2 emissions by avoiding electricity generation by the fossil fuel-fired power plants connected to the grid.

The project activity involves the installation of a run-of-river hydropower plant with an installed capacity of 4.3 MW that will utilize the water of the Trece Aguas River. Currently, this watercourse is used for electricity generation in an existing 16 MW hydropower plant (Secacao) located upstream of Candelaria. The Secacao plant was developed in 1998 and is owned and operated by Candelaria's sponsors.

Project participants consider that sustainable development can be achieved due to important benefits generated by the project activity.

The country's total operable installed electric capacity in the year 2004 was 1,785.4 MW. It is estimated that Guatemala has the potential to generate electricity through hydroelectric plants at a capacity of at least 4,000 MW. However, during the last 10 years, due to political and legal instability and the lack of long-term planning and incentives, the country has installed mainly fossil fuel based power plants. This has led to a decline in the proportion of hydroelectric generation, from 92% in 1990 to less than 37% in 2004[1]. Hydroelectric plants and other renewable technologies would allow Guatemala, in the medium to long-term, to achieve the following benefits: (a) a higher standard of living for its population; (b) sufficient clean energy supply to balance out the negative environmental impact caused by fossil fuel consumption, (c) reduction in the current dependence on imported fossil fuels (and the corresponding dependence on foreign currency required to purchase it); (d) transfer of appropriate technology and associated benefits such as job creation and training.

Specifically, the project has the capacity to bring the following benefits:

Economic benefits: on a national scale, the project provides "clean" electricity to the power market, thus reducing fossil fuel import dependence.

Environmental benefits: hydroelectricity is a clean generation technology and a renewable energy source. In addition to CO_2 emissions reductions, Candelaria would also mitigate other pollutants, such as SO_2, NO_x, and particulates associated with power generation by displacing fossil fuels consumption. In addition, the project developers of Candelaria and the existing Secacao Hydroelectric Plant have begun implementing an afforestation and reforestation plan in the areas surrounding both projects, to date approximately 450 hectares have been planted. Moreover, on the long-term, because of its size and general characteristics (i.e., very rural area, local electricity needs), this project has a high probability of being replicated in other parts of Guatemala. This fact magnifies any global and local environmental benefits generated by the project.

Social benefits: the region where the project will be located has a serious need of electricity and work opportunities, as most inhabitants have no access to them. Petén, Guatemala's largest "department" (administrative district), is located north of Alta Verapaz, where the project will be located. The two departments lack appropriate electricity distribution networks, and large portions of the population have no access to electricity. The project has the ability to deliver some of its electricity to local inhabitants, improving their life quality. In addition, the afforestation project established by the Candelaria

[1] Source: "Administrador del Mercado Mayorista", http://www.amm.org.gt/.

developers has offered hundreds of workplaces for the communities surrounding the project site, and will continue to do so in the long-term.

Candelaria is anticipating to direct 10% of the funds generated through the sale of CERs to an organization to be established by the Candelaria developers aimed at investing in the local communities to support and strengthen mainly school education, health services and infrastructure needs. The long-term aim is to establish this organization in a manner to allow for fund raising and/or international or local aid assistance management, among others, in order to carry on its mission and extend its local impact.

Moreover, Candelaria will increase employment opportunities in the area.

A.2. Location of project activity
A.2.1. Host Party(ies)
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Guatemala

A.2.2. Region/State/Province etc.
>>
Alta Verapaz Department

A.2.3. City/Town/Community etc.
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Senahú (closest town)

A.2.4. Physical/Geographical location
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The project will be located in the north-central area of Guatemala, on the mountain range called "Sierra de Santa Cruz," on the northern side of the Polochic River Valley. The region is an agricultural area and contains large but decreasing areas of rainforest. Figure 1 shows a map identifying the general location of the project.

Figure 1: Guatemala, Alta Verapaz Department

A.3. Technologies and/or measures

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The project has the capacity to reduce CO2 emissions by avoiding electricity generation by the fossil fuel-fired power plants connected to the grid.

Total differential altitude (head) between the headpond and the turbine/generator of Candelaria is approximately 130 meters. The project involves the installation of a 4.456 MW Francis type turbine[2] and requires a 430 meter long tunnel a 770 meter long penstock. The water used, once having gone through both plants, will be returned to the original river basin downstream.

The plant will deliver electricity to the Guatemalan National Electric Grid and will be connected to it through a 69 kilovolt transmission line (that was built to connect the existing 16 MW plant). The plant could also deliver part of its output locally through an existing 13.8 kilovolt distribution line owned by a Utility serving this rural area, thus giving access to electricity to several local communities.

There is an existing 16 MW hydropower plant (Secacao) located upstream Candelaria, also using the water of the Trece Aguas river. The mentioned hydropower plant was developed from 1993 to 1998, began operations in 1998, and is owned and operated by Candelaria's sponsors, but is not part of the proposed project activity. Nor are any other CDM projects to be submitted by the project sponsor in the future on the same river and within the distance limitations of small-scale CDM project activities. Thus, the proposed Candelaria Hydroelectric Project is not part of a larger, debundled CDM activity.

A.4. Parties and project participants

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Guatemala (host)	Hidroeléctrica Candelaria, S.A.	No

A.5. Public funding of project activity

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No public funding, including official development assistance, is involved in financing this project activity.

SECTION B. Application of selected approved baseline and monitoring methodology

B.1. Reference of methodology

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AMS-I.D. Grid Connected renewable electricity generation (version 8).

B.2. Applicability of methodology

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[2] The installed capacity of the hydroelectric plant is determined and delimited by the capacity of the generator. As indicated by the manufacturer of the generator of Candelaria, the generator has an apparent power of 5,397 kVA and a power factor of 0.8. The maximum output capacity of the generator is the real power (in kW) and results from multiplying the apparent power (in kVA) by the power factor, as follows: 5,397 kVA × 0.8 = 4,318 kW = 4.3 MW.

Type: I – Renewable Energy Projects
Category: D – Renewable Electricity Generation for a Grid

The Candelaria Hydroelectric Project conforms with the project type and category proposed, since it is a project activity which comprises renewable energy generation from the installation of a new small hydropower plant (4.3 MW capacity) that will supply electricity to the national grid, displacing fossil fuel fired generating units. The installed capacity connected to the Guatemalan grid in December of 2004 was composed of 36.40% hydro, 8.0% steam turbines, 10.4% gas turbines, 33.2% internal combustion engines, 10.5% cogeneration, and 1.5% geothermal origin (see a detailed description in Table 4 below).

Hydroelectricity is among the cleanest power generation technologies; it is widely used around the world and has a proven track record. The Candelaria plant will install a Francis-type turbine of British manufacture. This turbine type is the best suited efficiency wise for the available water flow and head at this location. Quality, efficiency, service, warranty, spare parts, and time of delivery were the key ingredients that were used in the final evaluation and selection of equipment contracted.

The Candelaria project will import environmentally sound technologies to rural Guatemala. It will also train and employ local workers in the operation of these technologies. Because of its size (4.3 MW) and location (rural highlands) this project has a high probability of being copied in other parts of the country, thus multiplying the social and environmental benefits, contributing to environmentally safe technology transfer and capacity building.

B.3. Project boundary

The project boundary encompasses the physical, geographical site of the hydropower generation source, which is represented by the Trece Aguas river basin close to the power plant facility. Schematically, the next figure shows the project boundary considered in this project activity.

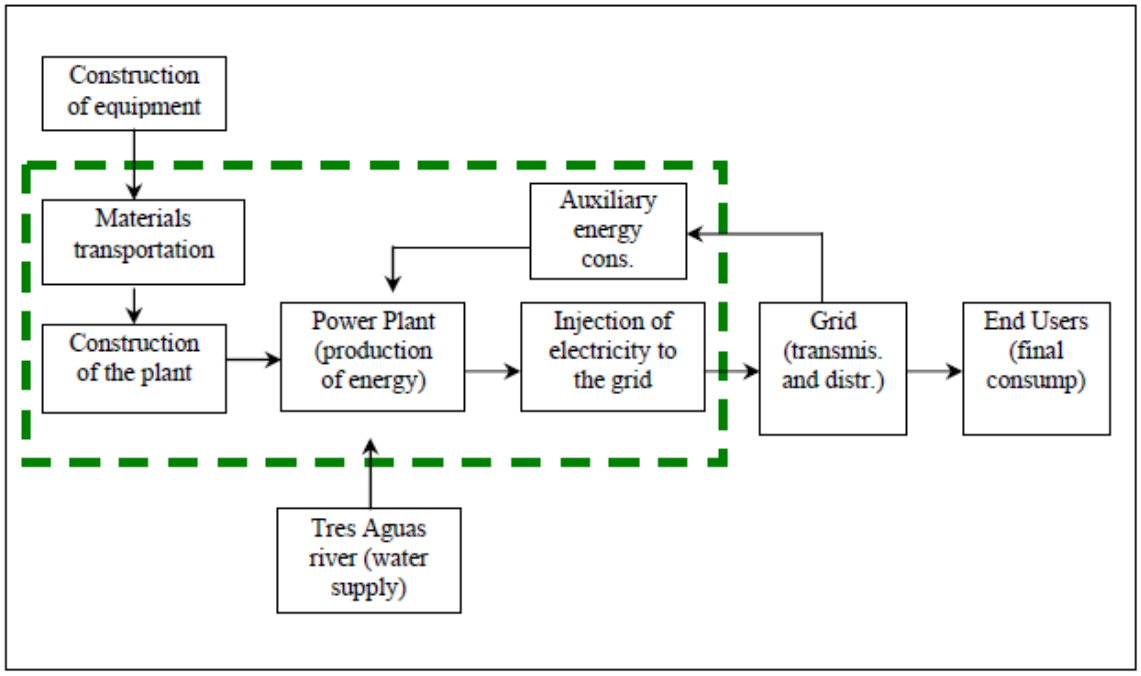

Figure 2: Flow chart of the Candelaria Project. Dashed line indicates project boundary.

Additionally, next table shows the sources of emissions and leakage considered:

Table 1: Source of emissions

Project emissions	• Emissions during the project construction (e.g. fuel consumption by trucks and machinery). • Emissions generated during the project's operation.
Baseline emissions	• Emissions at the interconnected national grid from existing or new thermal power plants that are avoided through the project activity.
Leakage	• Emissions during the manufacturing process of parts, supplies, and machinery required for building the project (i.e. cement, electromechanical equipment, etc.). • Emissions related to the transport of construction materials and equipment to the project site (one-step upstream). • Emissions related to grid losses due to transmissions and distribution of energy generated by the project (one-step downstream).

Project emissions

Project emission sources can be divided into activities prior to and during the operation of the project.

Since hydropower is a clean energy source there will be no GHG emissions that are directly related to hydropower generation. The exception is the construction phase needed to get the project up and running.

During construction there will be emissions, mostly through the burning of fossil fuels by trucks and construction machinery. While these emissions are within the project boundaries they will not be accounted, as they are very small. Moreover, according to the simplified modalities and procedures for CDM small-scale project activities, it is not required to include these emissions.

The use of energy for the operation of the power plant such as energy for cooling systems, lighting, ventilation, compressors, etc. will be supplied by the plant itself when operating.

Since hydropower is highly reliable, the plant is expected to be operating virtually all the time. Thus, the emissions related to plant grid-electricity consumption when the plant is not operating are very small and are neglected.

Leakage

Emissions during the manufacturing process of parts, supplies, and machinery required for building the project are outside the control of the project and thus these are excluded.

Leakage includes, in principle, one-step upstream and downstream emissions.

Although hydropower facilities do not produce emissions during the generation of electricity, there would be emissions related to grid losses due to the transmission and distribution of the energy generated by the project. All power plants connected to the grid will suffer from transmission and distribution losses. Indeed transmission and distribution losses are likely to be smaller from small power plants.

In addition, the transport of construction materials and equipment to the project site would also be accounted. However, these are beyond the project control and will not be accounted following the simplified modalities and procedures for CDM small-scale project activities.

Thus, only baseline emissions are considered in this project activity. Such emissions correspond to avoided electricity generation by the fossil fuel-fired power plants connected to the national grid.

Source		GHGs	Included?	Justification/Explanation
Baseline scenario	Source 1	CO_2		
		CH_4		
		N_2O		
		…		
	Source 2	CO_2		
		CH_4		
		N_2O		
		…		
	…	…		
		…		
		…		
Project scenario	Source 1	CO_2		
		CH_4		
		N_2O		
		…		
	Source 2	CO_2		
		CH_4		
		N_2O		
		…		
	…	…		
		…		
		…		

B.4. Establishment and description of baseline scenario

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The baseline scenario involves the electricity that would have otherwise been generated by the operation of the existing and new fossil fuel-fired power plants connected to the grid.

The project activity involves the installation of an hydropower plant with an installed capacity of 4.3 MW. This plant will deliver electricity to the Guatemalan National Electric Grid. Thus, the project has the capacity to reduce CO_2 emissions by avoiding electricity generation by the fossil fuel-fired power plants connected to the grid.

Background information on Guatemalan power sector

During the 1980's, the government of Guatemala, through the state-owned companies such as EEGSA (Empresa Eléctrica de Guatemala) and INDE (Instituto Nacional de Electrificación), controlled all generation, transmission, and distribution of electricity.

The state's largest hydroelectric plant, Chixoy (300 MW), came on line in 1983 while other large government-sponsored hydro projects were also under development. However, after the inauguration of Chixoy, all other investments in the power sector were abandoned and a power crisis took place in the

early 1990s. Blackouts were routine, and EEGSA as well as INDE became insolvent. By the end of the decade, there had been no new investment in the energy sector[3].

In an effort to control the power crisis, the Guatemalan government signed the first Power Purchase Agreement (PPA) with private companies that could install generating capacity quickly in the country. The first emergency-style operation was the 110 MW bunker fuel burning barges of Puerto Quetzal Power Company (partial Enron ownership) that began operating in 1993, followed by cogeneration plants installed by several Guatemalan sugar mills[4] and some small hydro projects, all private enterprises.

In 2000, Puerto Quetzal Power installed additional barge with capacity of 124 MW. In the same year, TECO (Tampa) began operating the 120-MW San José Power Station using low-grade South American coal.

A dramatic shift in the generation sources used in Guatemala's electricity grid over the past decade can be observed, mainly due to the fact that fossil fuel based plants are cheaper and faster to install when compared with hydropower plants.

From 1993 to 2002, thermal installed generation capacity grew nearly 400%. Along with increased fossil-fuel generating capacity, Guatemala added two geothermal-powered plants, the 5-MW Calderas in 1998, and the 24-MW Zunil 1 in 1999. During the same period, hydro installed electric generating capacity remained essentially static (see figure 2)[5].

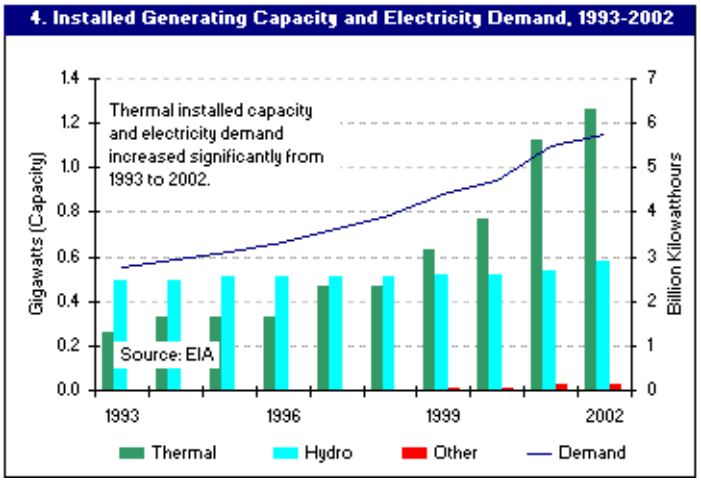

Figure 3: Installed generating capacity and electricity demand (1993-2002)

In 1996 the Guatemalan government deregulated the electricity sector by establishing a new General Electricity Law. EEGSA and INDE distribution companies were sold to the private sector following the electricity sector's reform.

[3] Source: Energy Information Administration- (EIA), *Country Analysis Brief*, US Dept. of Energy, 2004, http://www.eia.doe.gov/emeu/cabs/centam.html; IDC, 2001, *Guatemala's Electricity Sector*, National Association of Private Electricity Generators, PowerPoint Presentation.

[4] In Guatemala, cogenerators burn sugarcane bagasse mixed with bunker fuel from November through April, depending on the harvest.

[5] Source: Energy Information Administration, *Country Analysis Brief*, US Department of Energy, 2001 http://www.eia.doe.gov/emeu/cabs/centam.html.

The Ministry of Energy and Mines is in charge of developing, implementing, and overseeing the country's energy strategy and the sector's legislation. The General Electricity Law (Decree 93-96, 1996) establishes a free and open market for all electricity activities (generation, distribution, and transmission) and aims to avoid state and private sector monopolies. The National Electricity Commission regulates the Guatemalan power sector, oversees the Spot Market, enforces the law, defines transmission and distribution rates, arbitrates any controversies among agents, and issues technical and operational dispatch rules.

The Spot Market Administrator (AMM) nets out daily (short-term) transactions, thus establishing short-term energy prices (on an hourly basis), and coordinates all power plant generation including international connections. The Guatemalan Spot Market is a cost-based system, and all generation, whether it is renewable resource based or fossil fuel based, must compete under equal terms (this places renewable resource generation at a serious cost disadvantage, especially during debt repayment). All generating plants declare their operating and fuel costs, and the Market Administrator dispatches the system to cover total demand plus reserves at the lowest declared variable cost (US$/MWh). In this manner, geothermal and hydro power plants with no fuel costs are dispatched first, followed by the next least-cost plant and so forth. The most up-to-date spot market prices are available at http://www.amm.org.gt/. Figure 3 shows the monthly average spot prices in 2004. The annual average was 48.81 US$/MWh, with a maximum of 57.24 US$/MWh registered in September.

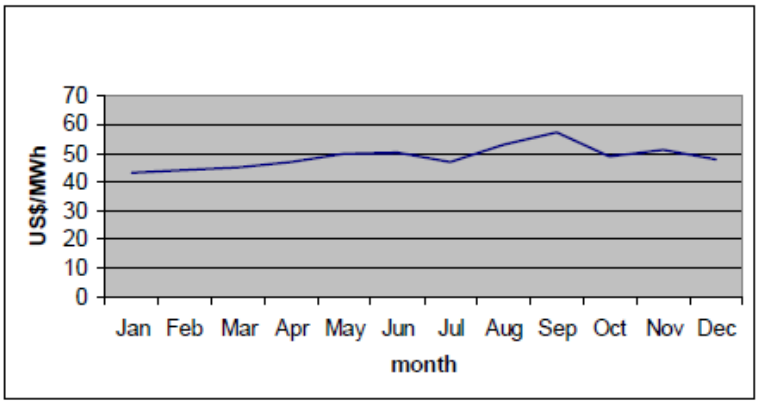

Figure 4: Monthly average spot price (2004)

Under Guatemala's current market structure, energy is sold either via power purchase agreements or through the spot market. Capacity, on the other hand, is only sold through short, medium or long-term contracts. Under the Guatemalan Electricity Law, distribution companies must guarantee that they have enough energy and capacity to cover their demand plus a reserve, thus they must contractually purchase energy and capacity from generators.

As informed in the AMM website report, (as of December 2004), the effective installed capacity of Guatemala was 1,785.4 (see next Table, below).

Table 2: Installed capacity connected to the National Grid[6]

Generating Plant	Installed Capacity	
	Installed (MW)	%
Hydro	650.3	36.4
Steam	143.0	8.0

[6] Source: Administrador del Mercado Mayorista, http://www.amm.org.gt/pdfs/informes/2004/InfEst2004_01.pdf.

Gas Turbines	184.9	10.4
Internal Combustion	593.0	33.2
Cogenerators	187.8	10.5
Geothermal	26.5	1.5
Total	**1,785.446**	**100**

B.5. Demonstration of additionality

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Additionality considerations

Following the simplified modalities and procedures for CDM small-scale project activities, evidence of barriers to investment is shown to justify the choice of option (a): "Investment Barrier."

Installation costs are lower and construction time is shorter for fossil-fuel technologies when compared to renewable energy alternatives. The table below compares costs of the various technologies operating in Guatemala[7].

Table 3: Cost comparison of various power generation technologies in Guatemala

Technology	Fuel	Installation (US$/kW)	Variable O&M (US$/kWh)	Fixed (US$/kW-mo)
Diesel engines	HFO	900	0.40	5
Gas turbine	Diesel	500	0.10	2.5
Steam turbines	Coal	1,2000	0.15	4
Hydroelectric	NA	1,800	0.05	3
Geothermal	NA	2,830	0.06	

Price expected for Candelaria's energy and capacity

Since Candelaria will be an extension of an existing hydroelectric plant, the Secacao Plant, the exact water availability is known. Since Secacao is a run-of-river plant, Candelaria will also be a run-of-river plant. Feasibility analysis for the Candelaria project has shown that, in order to be competitive in the market in the long-term, Candelaria should sell more electricity during peak hours at higher electricity prices. This is not possible since Candelaria is a run-of-river project, with no capacity for storing water.

The combined price to be received from the SPOT market and a capacity contract for Candelaria's energy and capacity is expected to be 0.0533 US$/kWh. Under this scenario Candelaria would be exposed to the energy price risk of the SPOT market as a "merchant plant." Although the project is being developed as a merchant plant under this scenario, the company will continuously evaluate possibilities of negotiating a contract for a fixed energy and capacity price to reduce the market price risk.

Construction of Candelaria began in January of 2005. As of early November of 2005, the tunnel, intake structure and transmission line of Candelaria were finalized. From November 2005 through May 2006 the steel penstock of US manufacture was imported, transported and installed, and the remaining tasks required for plant start-up were concluded, including the powerhouse and tailrace channel construction, and the import, transport and installation of electromechanical equipment. Finally, during June of 2006, plant testing and final commissioning was successfully accomplished. Candelaria officially began generating electricity for the SPOT market on July 1, 2006.

[7] Source: Asociación Nacional de Generadores, interviews, 2002.

Cash Flow Analysis

In 1986, in order to promote private investment in renewable energy projects, the Guatemalan government passed law 20-1986, the "Law for the Development of New and Renewable Energy Sources," which gave tax incentives to renewable energy projects and their investors and has been succeeded in promoting the development and construction of several plants. In 1999 this law was repealed and at present a new law (Decree 52-2003), regulated by Gov. Agreement 211-2005, is promoting renewable energy sources through fiscal incentives and import exemptions. Although this law provides a 10-year income tax and importation tax exemptions to renewable energy projects, which contributes positively to the projects' economics, the impact is relatively low since most projects have long term debt service periods that coincide with this exemption period thus reducing its financial contribution. Therefore this incentives law does only partially contribute to overcome the investment barrier.

Financial analysis for the Candelaria project was performed with the following assumptions:

- 10 year income tax break
- 0.0533 US$/kWh for capacity and energy (estimated as an average price considering a capacity price of US$ 7 per kW-month, and energy price of 0.048 US$/kWh)
- Discount rate of 12% per year.
- Expected life of the project: 30 years
- Debt: 10-year loan (2 year grace period) with an interest rate of 9%.

The analysis resulted in a negative net present value of US$ –377,669 and an internal rate of return of 11.00%, without carbon credits. Taking into account income from emission reductions (at US$ 6 per tonne CO_2) the NPV of the project increases to US$ 232,238 and the IRR increases to 12.61%. CDM contributions (with a 21-year crediting period) increase the internal rate of return of the project by 1.61%.

The project cost is estimated at US$ 6.3 million (US$ 6,243,000), close to US$ 1.6 million per installed MW. Hidroeléctrica Candelaria S.A. will provide equity of US$ 375,000 and a local commercial bank will provide a loan of US$ 5.9 million (5,868,000).

A competitive price for energy and capacity for the Guatemalan Electricity Market for the coming 10 years is 0.05 to 0.055 US$/kWh (see Figure 3). The price assumed for the Candelaria project is 0.0533 US$/kWh, even though the price to make the project "stand on its own" would have needed to be at least 0.06 US$/kWh.

However, the project sponsors decided to develop Candelaria for the following two reasons:

- The long-term attractiveness of a small and efficient hydropower plant at a location already owned, a supplemental cash flow to come from the existing Secacao Plant in order to resolve Candelaria's cash flow shortfalls in the early years, and importantly,
- the potential of generating supplemental income from Certified Emission Reductions (CERs).

Candelaria's required price is high relative to the expected future spot market prices mainly due to the fact that a small 4.3-MW plant has difficulties in reducing the investment per MW, as its size does not allow for scale economies to be achieved easily. Due to the market's inability to level costs of renewable energies with fossil-fuel burning plants, Candelaria is a marginal project and would not be carried out in the absence of CDM revenues. Income from emission reductions would help the project become more attractive to developers and lenders. Thus, the proposed project activity is clearly additional.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

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The selected methodology for CDM small-scale project activities contains four options that can be applied in the selected project category:

"The baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in $kgCO_2/kWh$) calculated in a transparent and conservative manner as:

(a) The average of the "approximate operating margin" and the "build margin", where:

(i) The "approximate operating margin" is the weighted average emissions (in $kgCO_2/kWh$) of all generating sources serving the system, excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation;

(ii) The "build margin" is the weighted average emissions (in kg CO_2equ/kWh) of recent capacity additions to the system, based on the most recent information available on plants already built for sample group m at the time of PDD submission. The sample group m consists of either the five power plants that have been built most recently, or the power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently. Project participants should use from these two options that sample group that comprises the larger annual generation. Power plant capacity additions registered as CDM project activities should be excluded from the sample group m. If 20% falls on part capacity of a plant, that plant is included in the calculation.

OR,

(b) The weighted average emissions (in $kgCO_2/kWh$) of the current generation mix."

(c) Approximate Operating Margin emission factor and the weighted average emission factor can be calculated using either of the two following data vintages for years(s) y:

- Option 1:
  A 3-year average, based on the most recent statistics available at the time of PDD submission.
- Option 2:
  The year in which project generation occurs, if emission factor is updated based on ex post monitoring.

(d) Build margin emission factor can be calculated using either of the following data vintages for years(s) y:

- Option 1:
  Most recent information available on plants already built at the time of PDD submission.
- Option 2:
  For the first crediting period, emission factor is updated based on ex-post monitoring. For subsequent crediting periods, emission factor should be calculated ex-ante, as described in option 1 above.

Option (a) is the one selected in this project. The Candelaria project will displace fossil-fuel generating sources serving the system, because these are the power plants at the margin. The Generation Expansion Plan for Guatemala shows that the future electricity generation is highly fossil-fuel oriented, except for big hydropower plants (installed capacity greater than 50 MW), which are not included since those plants always enter into the dispatch and are not displaced by the inclusion of the project activity in the generation system. This choice represents the more realistic of the two options.

The methodology used in this project activity is applied as follows:

1. The expected annual electricity production of Candelaria plant is found by multiplying the installed capacity (4.3 MW) by the plant capacity factor[8] (61%) by the number of hours per year (8,760).

Annual Plant Electricity Output = Plant Capacity x Plant Capacity Factor x Annual Hours			
(MWh/year)	(MW)	(%)	(hours/year)

The expected annual electricity production is 23 GWh.

2. Electricity generation of the power plants serving the national system (excluding hydro, geothermal, wind, nuclear, low-cost biomass, and solar generation) and recent capacity additions to the system are obtained from the Wholesale Market Administrator (AMM: http://www.amm.org.gt/).
3. Calorific values, emission factors, and fraction of carbon oxidised for fuel combustion are taken from Revised IPCC Guidelines for National GHG Inventories, Volume 3: GHG Inventory Reference Manual, 1996.
4. Fossil fuel consumption data were provided by the Guatemala Ministry of Energy and Mining ("Ministerio de Energía y Minas" - MEM), the National Energy Information System (Sistema de Información Energética Nacional" - SIEN), and the Centre for Promotion and Information of Renewable Energy (Centro de Información y Promoción de Energías Renovables), http://www.mem.gob.gt/.
5. Annual emissions of carbon dioxide are calculated by multiplying electricity generation fuel consumptions times the corresponding emission factors (by fuel and technology), for each type of fuel reported.

In the application of this methodology, it is assumed that there is a trend for thermal power plant construction (excluding big hydropower plants).

In addition, the Central American Interconnected Grid (SIEPAC)[9] is not taken into account in this particular scenario because how the Central American markets interact under SIEPAC is not clear. The Monitoring Plan for the Candelaria project will include revisions of the baseline when SIEPAC's impact on the baseline is better understood.

According to the methodology, the key data used to determine the baseline scenario is given in the following table.

[8] The plant capacity factor is given by the capacity factor of the already existing Secacao plant, since both plants will share the water flux. The value is obtained from historical generation and simulations performed by Hidroeléctrica Secacao S.A.

[9] In order to increase the reliability of its power supplies, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica and Panama have all agreed on SIEPAC (Sistema de Interconexión Eléctrica de los Países de América Central), which would interconnect all the Central American grids. Initially, the project consisted of two parts: the first was the consolidation of the Central American Power market (Mercado Eléctrico Regional), and the second was a US$ 340 million, 230 kV power transmission line that would interconnect the countries by 2005. The project has received approval of US$ 240 million from the IDB (Interamerican Development Bank) and the Spanish government (IDB SIEPAC 2001 report). According to industry leaders, the original plan of SIEPAC will not take place as planned because the countries have not agreed on common market mechanisms (Asociación Nacional de Generadores, 2002).

Table 4: Key Data

Parameters	Data sources
Electricity generation of the power plants serving the national system	Wholesale Market Administrator
Capacity Additions to the system	Wholesale Market Administrator
Emission factors of fuels	IPCC Guidelines for National GHG Inventories
Fossil fuel consumption of the power plants serving the national system	Guatemala Ministry of Energy and Mining National Energy Information System Centre for Promotion and Information of Renewable Energy
Variables	**Data sources**
Annual electricity production of Candelaria plant	Hidroeléctrica Candelaria, S.A.

B.6.2. Data and parameters fixed ex ante

(Copy this table for each piece of data and parameter.)

Data / Parameter	⟨E⟩baseline
Unit	tonnes CO2/MWh
Description	Combined margin emission factor
Source of data	Official data provided by the Ministry of Energy and Mines (MEM) and Wholesale Electricity Market Administrator (AMM)
Value(s) applied	0.824
Choice of data or Measurement methods and procedures	*The average of the "approximate operating margin" and the "build margin"is* selected from the methodology.
Purpose of data	Calculation of baseline emissions
Additional comment	

B.6.3. Ex ante calculation of emission reductions

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Emissions of the set of power plants supplying electricity to the interconnected grid considered for calculating both the operating margin as well as the build margin are given by:

$$E \text{ (tonnes } CO_2\text{/year)} = \sum_j E_j \text{ (tonnes } CO_2\text{/year)}, \quad (1)$$

where E_j = CO_2 emissions per year of fuel *j* burnt for electricity generation, calculated as:

$$E_j \text{ (tonnes } CO_2\text{/year)} = FC_j \text{ (tonnes/year)} \times LHV_j \text{ (TJ/tonnes)} \times EF_j \text{ (tonnes C/TJ)} \times OF_j \times CF \text{ (tonnes } CO_2\text{/ton C)}, \quad (2)$$

where FC_j = consumption of fuel *j*;
LHV_j = lower heating value of fuel *j*
EF_j = emission factor of fuel *j*;
OF_j = oxidation factor of fuel *j*;
CF = unit conversion factor: 44/12 ($C \rightarrow CO_2$).

Weighted average emission $\langle E \rangle$, representing the emission intensity, is given by:

$$\langle E \rangle \text{ (tonnes } CO_2\text{/MWh)} = E \text{ (tonnes } CO_2\text{/year)} / PG \text{ (MWh/year)}, \quad (3)$$

where E is given by Equation (1), and the power generation of the plants connected to the grid PG is calculated as PG (MWh/year) = $\Sigma_j PG_j$ (MWh/year), where *j* stands for all power plants supplying electricity to the grid, excluding low-cost and must-run resources.

Equation (3) is applicable to both the operating margin and the build margin cases. The only difference lies on the set of power plants considered in each case.

The emission intensity coefficient, $\langle E \rangle_{baseline}$, is thus obtained as:

$$\langle E \rangle_{baseline} \text{ (tonnes } CO_2\text{/MWh)} = \{\langle E \rangle_{operating\ margin} \text{ (tonnes } CO_2\text{/MWh)} + \langle E \rangle_{build\ margin} \text{ (tonnes } CO_2\text{/MWh)}\}/2 \quad (4)$$

Finally, baseline emissions are given by:

$$E_{baseline} \text{ (tonnes } CO_2\text{/year)} = \langle E \rangle_{baseline} \text{ (tonnes } CO_2\text{/MWh)} \times CG \text{ (MWh/year)}, \quad (5)$$

where CG stands for Candelaria's electricity generation.

Values obtained when applying formulae above:

Considering the Candelaria installed capacity (4.3 MW) and its expected capacity factor (CF = 61%), the expected annual electricity generation by the Candelaria project is 23,000 MWh/year.

Build margin estimation

Official data provided by the Ministry of Energy and Mines (MEM) and Wholesale Electricity Market Administrator (AMM) was used to calculate Guatemala's electricity grid emission factor. Data provided consisted in the annual fuel consumptions for electricity generation by type of fuel, and electricity generation by type of technology. Due to the lack of data of fuel consumptions by each power generation unit, average plant efficiencies were applied, taken from the registered PDD "Las Vacas Hydroelectric Project". MEM only provided fuel consumption data up to year 2003. In consequence, and in order to be consistent with the values of real fuel consumption used to estimate the OM, the BM was calculated using annual fuel consumption data for the year 2003.

It is important to note that for the BM estimation, the following hydroelectric power plants registered as CDM projects were excluded from the analysis:

- Las Vacas
- San Isidro
- Matanzas

Following the guidelines of the selected methodology for small scale projects, it is necessary to choose between either the five power plants that have been built most recently, or the power plant capacity additions in the electricity system that comprise 20% of the system generation and that have been built most recently.

Table 5: 2003 generation and selection of BM power plants

Item	Generation (GWh)
1)2003 total generation	6,694.6
2) Generation of the five power plants that have been built most recently excluding CDM projects	631.3
3) Generation of plants that comprise 20% of the system generation and that have been built most recently	1,338.9
4) Generation selected to estimate BM (*)	1,523.3

(*): For additional information, please see next table.

Considering the data presented in the table above and the guidelines of the selected methodology, the BM was estimated with the generation that comprise 20% of the system generation and that have been built most recently, represented in item 4 of table 7. In this case, the generation slightly exceeds the 20 % because it falls on part capacity of San José power plant, so it was fully included in the estimation.

According to the information shown in next table, the build margin estimated is:

$\langle E \rangle_{\text{build margin}} = 0.880$ tonne CO_2/MWh.

Table 6: Build margin (2003)[10]

Plant Identification	Technology	Fuel Type	Installation Date	Generation (MWh/yr)	Average Plant Efficiency (%)	Fuel Con-sumption (TJ/yr)	Emission Factor (tonC/TJ)	Fraction Carbon Oxidized	Conversion Factor (C-->CO2)	Emissions (ton CO2 / yr)
El Canadá	Hydro	Renewable	2003	13,020	100%		0	0	3.67	0
Electrogeneración	IC Motor	Bunker Fuel	2003	3,890	33%	42	21.1	0.99	3.67	3,250
Amatex	IC Motor	Bunker Fuel	2003	20,250	33%	221	21.1	0.99	3.67	16,920
Arizona	IC Motor	Bunker Fuel	2003	561,400	33%	6,124	21.1	0.99	3.67	469,083
Calderas	Geothermal	Renewable	2002	32,690	100%		0	0	3.67	0
San José	Steam Turbine	Coal	2000	892,060	35%	9,175	25.8	0.98	3.67	850,640

[10] Source: Administrador del Mercado Mayorista, Web page: http://www.amm.org.gt, Ministerio de Energía y Minas, Web page: http://www.mem.gob.gt/, personal communication and UNFCCC website.

Operating margin estimation

In order to estimate the operating margin for the Guatemalan grid, and considering that, as shown in table 4 of this PDD, the low cost/must run installed capacity only represents the 37.9% (36.4 % hydro and 1.5% geothermal) of the total installed capacity, the simple OM method was selected and applied.

As mentioned in the methodology, "The simple OM emission factor is calculated as the generation weighted average emissions per electricity unit of all generating sources serving the system, not including low-operating cost and must-run power plants". The estimation was performed with data provided for the years 2001, 2002 and 2003.

According to data shown in Tables 9 and 10, the operating margin estimated is:

$\langle E \rangle_{\text{operating margin}} = 0.767$ tonnes CO_2/MWh.

These calculations are based on real fuel consumption data provided by governmental agencies, and not based on assumptions on fuel efficiencies of the different thermal power plants.

Table 7: Operating margin[11]

Fuel Emissions (tonnes CO_2/year)	**2001**	**2002**	**2003**
Diesel	143,873	172,120	131,226
Bunker	1,584,234	1,986,483	1,657,871
Coal	979,797	1,072,712	1,007,076
Total	**2,707,904**	**3,231,315**	**2,796,173**

Table 8: Operating Margin

Technology Generation (MWh/year)	**2001**	**2002**	**2003**
I.C. Motor	1,780,710	2,215,130	2,605,170
Steam Turbine	1,426,600	1,588,870	1,499,320
Gas Turbine	106,940	147,060	85,000
Total	**3,314,250**	**3,951,060**	**4,189,490**

Calculation details are shown in the Appendix 4.

Baseline estimation

From these results, the combined margin emission factor is:

$\langle E \rangle_{\text{baseline}} = (\langle E \rangle_{\text{build margin}} + \langle E \rangle_{\text{operating margin}})/2 =$ **0.824 tonnes CO_2/MWh.**

This value will be considered fixed throughout the first crediting period, and revised for subsequent crediting periods.

[11] Source: Administrador del Mercado Mayorista, Web page: http://www.amm.org.gt, Ministerio de Energía y Minas, Web page: http://www.mem.gob.gt/, and personal communication.

The Candelaria power plant has an installed capacity of 4.3 MW, and an expected capacity factor of 0.61, so that annual generation is expected to be:

CG = 4.3 MW x 0.61 x 8760 hours / year = 22,977 MWh per year.

Thus, baseline emissions estimated prior to project implementation are:

$E_{baseline}$ **= 0.824 x 22,977 = 18,922 tonnes CO_2/year**.

As a consequence, the project has the capacity to reduce GHG emissions by 132,456 tonnes CO_2e over the first 7-year crediting period.

The results obtained applying the formulae above are shown in the next section.

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
2007	18,922	0	0	18,922
2008	18,922	0	0	18,922
2009	18,922	0	0	18,922
2010	18,922	0	0	18,922
2011	18,922	0	0	18,922
2012	18,922	0	0	18,922
2013	18,922	0	0	18,922
Total	132,456	0	0	132,456
Total number of crediting years				
Annual average over the crediting period	18,922	18,922	18,922	18,922

In subsequent crediting periods, the electricity generation is expected to be the same, but emissions reductions would be different, depending on updated calculations of build and operating margin.

B.7. Monitoring plan

The selected methodology is AMS-I.D. Grid Connected renewable electricity generation (version 8).

Monitoring has been chosen as it is suggested in the last proposal on "Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories".

Data collection is compatible with the baseline methodology described in Section B.6.1.

B.7.1. Data and parameters to be monitored

(Copy this table for each piece of data and parameter.)

Data / Parameter	CG
Unit	MWh
Description	Electricity generation of the Candelaria hydroelectric plant
Source of data	Hidroeléctrica Candelaria, S.A.
Value(s) applied	
Measurement methods and procedures	Measured
Monitoring frequency	Daily
QA/QC procedures	Uncertainty level of data: Low Electric meter will be calibrated considering the frequency (once a year) and procedures established by the manufacturer, and also considering the Guatemalan electricity market regulations. The calibration would be carried out by an external calibration laboratory.
Purpose of data	
Additional comment	Data will be archived and is to be kept for 10 years.

B.7.2. Sampling plan

>>

N/A

B.7.3. Other elements of monitoring plan

>>

As stated in the above monitoring methodology, the Candelaria hydroelectric power plant data will be closely monitored, metered and recorded. The daily generation data will be added to a specific spreadsheet, especially designed to monitor the emission reductions due to implementation of the proposed CDM project activity.

Hidroeléctrica Candelaria S.A. belongs to the same owner of Secacao hydroelectric power plant. For this reason, the management structure has wide experience in Guatemala's electricity market, as well as in the operation of electricity generation power plants. Considering this fact, it is clear that the training of the operational structure for further implementation of the monitoring plan, following all the guidelines provided in the monitoring methodology, will not represent any kind of barrier.

The management and operation of Candelaria hydroelectric power plant will be the responsibility of Hidroeléctrica Candelaria S.A.

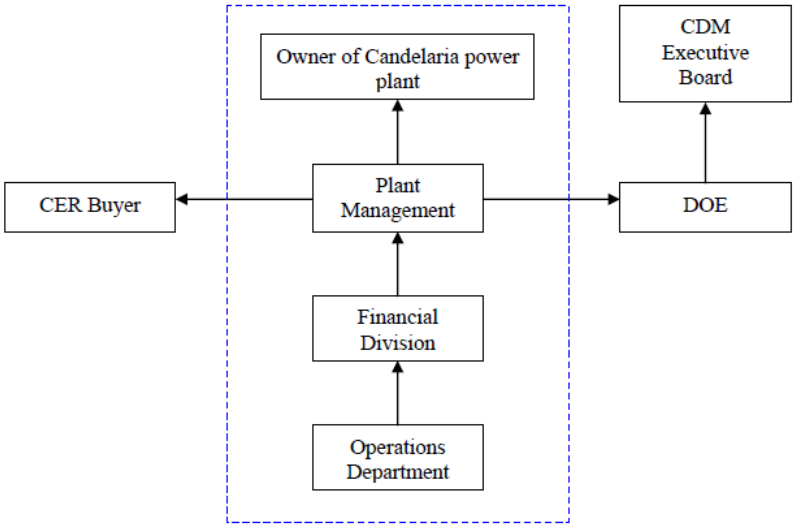
The Financial Division of Candelaria will be responsible for carrying out the Monitoring Plan. This division manages electricity billing and as a matter of normal operation records the amount of electricity generated each month and also compares it with the back-up electricity meters that are in place at the point of delivery to the grid.

The Operations Department will be in charge of controlling the operating conditions of the power plant.

Emission reductions will be loaded in spreadsheets and archived for two years following the end of the crediting period.

The emission reductions will be annually verified by an independent entity, a Designated Operational Entity (DOE). A regular (annual) reporting of the emission reductions generated by the project will be emitted to the CER buyer, coincidently with the DOE verification.

An illustrative scheme of the operational and management structure that will monitor the proposed CDM project activity is as follows:



Note: the dashed line shows the Hidroeléctrica Candelaria S.A. operational and management structure boundaries.

The relation between Candelaria's operational and management structure and other actors of the proposed CDM project activity is described as follows:

- The plant operations department will be in charge of the supervision of the Programmable Logic Control (PLC) system that will be implemented to operate the hydroelectric power plant. Supported by the PLC system, it will report the daily electricity generation to the Financial Division.
- The Financial Division will provide a member of the plant staff structure that will also be in charge of processing the data generated by the PLC system. The Financial Division will receive the daily electricity generated by the Candelaria hydroelectric power plant from the Operations Department. This data will by entered into a spreadsheet especially designed for the monitoring plan. The spreadsheet will automatically calculate the annual emission reductions.
- Any time that the Plant Management wants or needs to follow the implementation of the CDM project activity, the Plant Management will ask for a report to the Financial Division. Every year, the Plant Management will send a report, which will basically be the monitoring plan spreadsheet sent to the CER buyer, as well as to the corresponding DOE.
- The DOE will then send the corresponding verification report to the CDM Executive Board in order to evaluate it and make able the issuance of the CERs.
- The owner of Candelaria hydroelectric power plant will receive annually, from the Plant Management, the same report sent to the CER buyer and the corresponding DOE.

Considering the arguments and the schematic illustration above, a compliance with the monitoring methodology and the monitoring plan will be completely guaranteed.

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>>
The construction began in January 2005 and power generation began on July 1, 2006.

C.1.2. Expected operational lifetime of project activity

>>
30 years.

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>>
Renewable crediting period.

C.2.2. Start date of crediting period

>>
01/1/2007

C.2.3. Length of crediting period

>>
7 years.

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>
Plant Design Blueprints, Environmental Impact Study,[12] Water Quality Study, Geological Study, Topographical Study have been completed.

D.2. Environmental impact assessment

>>
No significant negative impacts are reported in these studies.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>>
Candelaria Hydroelectric Project conducted two stakeholders' consultation processes in order to obtain comments from all the stakeholders.

The first stakeholder consultation of the Candelaria Hydroelectric Project was through a survey.

The following set of questions was sent to stakeholders, during June 2003:

[12] EIA: "Estudio de Evaluación del Impacto Ambiental Significativo del Proyecto Hidroeléctrica Secacao –16 MW–, de Hidroeléctrica Secacao S.A., Municipio Senahú, Departamento de Alta Verapaz, Guatemala," by Miguel Ángel Carballo Hernández (Asesoría en Geología, Petróleo y Medio Ambiente), April 1995. The Guatemalan authorities approved the study. Hidroeléctrica Secacao is linked with the Candelaria Project since both power plants share the same water flow and generation pattern, and are operated by the same company.

1. Do you think Candelaria hydroelectric Project will contribute to the Sustainable Development of Guatemala?
2. Do you believe that the socio-economic situation of the region will improve due to the implementation of Candelaria Hydroelectric Project?
3. Is the implementation of project able to improve the environmental situation in the region?
4. How does the development of the project affect you (positively or negatively) or on your environment?
5. Would you recommend private companies or authorities to develop projects of this nature?
6. Any additional comments you would like to make.

The questionnaire was sent to the following persons:

Name	Position	Company/Institution
Ing. Rudy Haroldo Nájera Sagastume	General Director	General Direction of Energy – Ministry of Energy and Mines (Dirección General de Energía – Ministerio de Energía y Minas)
Ing. Jorge Juárez Pedroza	General Manager	National Institute of Electrification (Instituto Nacional de Electrificación)
Ing. Luis E. García Pinot	President	National Comitee of Electric Energy (Comisión Nacional de Energía Eléctrica)
Lic. Carlos Roberto Morales Monzón	General Director	General Direction of Environmental Management and Natural Resources (Dirección General de Gestión Ambiental y Recursos Naturales – Ministerio de Ambiente y Recursos Naturales)
Mr. Roberto Barrera		AMM (Administrados del Mercado Mayorista)

The second stakeholder consultation intended to collect comments from local communities.

On July 21, 2006 Hidroelectrica Candelaria S. A. presented the project at a meeting where stakeholders from the local communities were invited.

In this event, 38 representatives (stakeholders) of four nearby communities participated, as documented in the attendance sheet. Ing. Raúl Castañeda from the local DNA Office -Oficina Nacional de Desarrollo Limpio del Ministerio de Ambiente y Recursos Naturales- also participated in the event as an observer.

The following table lists the stakeholder attendees:

Table 9: Second Stakeholders Consultation

Name	Position	Company/Institution
Domingo Coy Cuz	Teacher	La Montanesa
Enrique Coal	Teacher	La Montanesa
Hermenegildo Xol Tul	Teacher	Santa Lucía
Elmer Chiqui Turcios	Teacher	Santa Lucía
Manuel Cucul Mo	Teacher	San Carlos
Juan Cucul Tox	Secretary	Santa Lucía
Mario Cac Coc	Secretary	San Carlos
Lorenzo Cac	Treasure	San Carlos
David Che	Member I	San Carlos
Cesario Bac Chub	Auxiliary Mayor	San Carlos

Alfonso Cholon	Member III	San Carlos
Juan Rax	President	Santa Lucia Secacao
David Tox	Vicepresident	Santa Lucia Secacao
Santiago Coc	Treasure	Santa Lucia Secacao
Vicente Cucul	Member I	Santa Lucia Secacao
Mateo Caal	Auxiliary Mayor	Santa Lucia Secacao
Santiago Maquin	Member II	Santa Lucia Secacao
Jose Choc	President	La Motañesa
Felipe Ich	Vicepresident	La Motañesa
Emilio Chic Jalal	Secretary	La Motañesa
Pedro Ich Choc	Treasure	La Motañesa
Francisco Choc	Member I	La Motañesa
Alejandro Chub Col	Auxiliar Mayor	La Motañesa
Juan Daniel Caal	Member II	La Motañesa
Ramiro Choc Choc	Vicepresident	San Carlos
Martin Choc	President	San Carlos
Santiago Choc	Member II	San Carlos
Felipe Tzi Mo	Teacher	Santa Lucia
Javier Choc	Legal Representative	Las Margaritas Semococh
Francisco Chub Choc	Secretary	Las Margaritas Semococh
Augusto Chub	Vicepresident	Las Margaritas Semococh
Adrian Sub	Treasure	Las Margaritas Semococh
Jose Ba Coal	Sub-treasure	Las Margaritas Semococh
Alberto Choc	Member I	Las Margaritas Semococh
Carlos Villela	Advisor	Las Margaritas Semococh
Rodrigo J. Tormo A.	Manager	Hidroelectrica Candelaria
Ricardo A. Vasquez	Operations Manager	Hidroelectrica Candelaria
Hugo R. Alvarado Chavez	Notary Public	Hidroelectrica Candelaria
Raul Castañeda	Observer	National Clean Development Department

The presentation was coordinated by Ing. Ricardo Vasquez, Operation Manager of Hidroeléctrica Candelaria S. A. The event included a presentation by Mr. Rodrigo Tormo, General Manager of Hidroeléctrica Candelaria and a tour visit to project installations. Mr. Mario Cruz Pop participated as a translator (many participants only speak a Mayan dialect) and Lic. Hugo Ricardo Alvarado (Public Notary) documented a transcript of the meeting.

After the meeting and the visit were concluded, local stakeholders had the opportunity to express their comments through a questionnaire. The questionnaire and a summary of the comments received are added in the following section of this PDD.

E.2. Summary of comments received

>>

The following table shows a synthesis of the comments received during the first stakeholder consultation process:

Table 10: Stakeholders comments received during the First Stakeholder Consultation

Question	Ing. Rudy Haroldo Najera Sagastume	Ing. Jorge Juárez Pedroza	Ing. Luis E. García Pinot	Lic. Carlos Roberto Morales Monzón	Mr. Roberto Barrera
1	Yes. The project will contribute to reduce the electricity tariff dependency on international petroleum price and to reduce pollutant emissions due to fossil fuel combustion.	Yes. The project characteristics are compatible with the guidelines for sustainable development, e.g. private participation, internal development, clean energy utilization, and national energy sources development.	Yes. The project, using renewable resources to generate electricity, reduces the country vulnerability to changes in international fossil fuel price and contributes to tariff stabilization. It also contributes to balance the type of electricity generation in Guatemala.	Candelaria Project would contribute to the regional development. However, we cannot give an opinion since we do not know EIA results for Candelaria project.	Yes. Definitely.
2	Project implementation will impact positively in rural development and the reduction of poverty, producing new jobs, agro industrial development and attracting investment.	Yes, the local community will be favoured by the electricity supply, but also in new jobs generation and improvement of the local electricity market.	Yes. The project contributes to create new jobs during the construction phase and introduces capacity and specialization in local people. During the project operation new technical and specialized jobs will be created.	The economic situation of the local inhabitants would improve considerably. The social situation could improve life quality for local people. This situation should be proven in the Candelaria EIA. Nevertheless, the opinion of the inhabitants who live close to the SECACAO hydro central (which is upstream from the Candelaria Project), Mr. Von Quednow Cruz`s leagal appeal to the EIA in reference to regularization of the SECACAO reservoir, and the results of the social monitoring of environmental components through 30 surveys; should be considered as well.	Yes. There is an important percent of Guatemala inhabitants without electricity supply. Investment in power generation contributes to economic development since it represents production opportunities.

3	Yes. The environment will be favoured with construction of hydroelectric projects instead of conventional power plants, provided mitigation measures are included in the environmental impact assessment.	Yes, but very low. If we consider that more hydroelectric electricity will be used instead of another source consuming fossil fuels, local impact will be reduced.	Yes. The project sponsor will protect the river and its environment: fauna, flora, archaeology, etc., and today are careless. This improvement has positive effects at a regional and national level. In this point it is important to ensure that the environmental impact assessment recommendation will be enforced, taking into consideration the minimum water level that is ecologic.	In general, if renewable electricity supply increases, lower electricity consumption is expected from other electricity sources. But without the project EIA we cannot confirm that part of the electricity generated by the project will meet the energy demand of the local community. Candelaria EIA should consider the situation of project lifetime, and mitigation measures in the construction, operation and closure.	Yes. In 2002 the 64 % of the electricity generation was based on fossil fuel consumption (bunker fuel oil and coal) and this generates environmental pollution.
4	Project implementation is positive since the National Interconnected System will improve the offer of the power generation, making the electricity tariff more stable.	A better clime and atmosphere. The national economy will be improved since exports will be reduced. There will be new job opportunities. Enjoying a better environment through forest conservation.	Projects based in renewable electricity generation are very important for the National Committee of Electric Energy, since the electricity supply is increased, which is essential to the country development, reducing the country vulnerability and contributing to the electricity price stabilization.	I cannot give an opinion because I have not seen the EIA.	Hydroelectric projects are beneficial because they improve the electric inertia of the Interconnected System. I receive the benefits of the no environmental contamination.
5	Yes.	Yes, if more hydroelectric energy is used positive effects will occur in the environment, new jobs opportunities will appear and its contribution to increase social life quality and national and regional demand.	Yes. The National Committee of Electric Energy not only recommends this kind of projects but also has submitted to the National Congress a project of law named "Incentives for the Development of Renewable Energy Projects".	Yes, if project EIA can demonstrate that the construction and operation are compatible with the environment and mitigation measures are taken.	Yes. A balance of the generation system is needed. Most plants installed are thermal plants so the electricity price is dependent on the international price of fossil fuels and this is not an advantage for the country.

6	National policies are intended to encourage renewable resources development, which allow promoting investment in the renewable energy sector and benefit environmental quality in the energy sector. In this way the Ministry of Energy and Mines has created the Centre for Information and Promotion of Renewable Energy and has developed a project of law named "Incentives for the Development of Renewable Energy Projects".	It is recommended the study of a third project located in the same river downstream due to the topographic conditions could permit the construction. Commercialization that benefits local communities should be legally and economically studied.	Project EIA should consider local community opinion in detail. SECACAO local inhabitant requirements should be solved because Candelaria is located downstream SECACAO. Project Sponsor could register the project as CDM to increase cash-flow benefits.	The development of electricity generation facilities using renewable sources has social and economic benefits for the country.

The comments received from local stakeholders during the consultation process on July 21, 2006 are mainly very positive. Local stakeholders expressed that Candelaria Hydroelectric Project will bring benefits to their communities, generating new jobs and increasing electricity generation from a nonpolluting source. Provided the project activity is implemented, clean electricity will reach their houses and fossil fuels consumption will be reduced.

Local stakeholders also stated that Candelaria Hydroelectric Project will not only generate clean electricity but also will improve the labour and health conditions of the area through reforestation, providing better environmental conditions for the local communities.

The transcription of the comments received is included in the next table:

Table 11: Stakeholders comments received during the Second Stakeholder Consultation

Question	Based on the available information and your knowledge regarding Environment, Climate Change, Clean Development Mechanism (CDM) and Global Carbon Market related issues, briefly express your opinion about the Candelaria Hydroelectric Project.	Would you recommend private companies, governmental authorities or other organizations to develop projects of this kind: electricity generation from renewable resources as contribution to the mitigation of climate change?	Do you believe that Candelaria Hydroelectric Project will contribute to the environmental (sustainable development), social and economic development of the region and of Guatemala?	Express any additional comments
Hermenegildo Xal Tiul	Hidroeléctrica Candelaria is not contaminating our environment, as it is searching for techniques for reducing contamination.	Yes, because it does not generate contamination, by using renewable resources.	These projects are significantly important, since they provide a percentage of daily incomes.	Job opportunities for the young people in our community.
Mario Cac Coc	Hidroeléctrica Candelaria represents a huge benefit for all, as it allows us to breathe clean air and does not contaminate the environment at all.	Of course, I recommend this project to the private companies so that stop damaging our lives.	Yes, it benefits us by providing us electric energy, employment and protection of the flora and fauna of our country.	I believe that more projects should be implemented and more employment should be generated for the community.
Martin Choc	I believe is very good, because it does not contaminate and the water returns to its natural state.	I recommend the execution of projects involving renewable resources.	Now that the project is being developed, I believe that it will benefit us with a greater development.	It protects and preserves nature so that the rivers do not dry.
Lorenzo Cac	The project is excellent, as it helps to avoid an increase in the Earth's temperature.	Yes, the implementation of this type of projects helps to avoid contamination.	Yes, I believe it is a help regarding the financial development of the community.	Hidroeléctrica Candelaria is protecting our environment, unlike other companies that contaminate.
Manuel Cucul Mo	The project is not contaminating, everything is clean, and reforestation is being carried out in order to recover our natural wealth.	Yes, because it does not contaminate the environment at all.	Without the projects there are no incomes or employment. The implementation of the project in our country is worth it.	That employment opportunity should be provided to the community.
Alfonso Cholom	It is a very good work and helps us to preserve the environment.	I recommend them not to do it as it really affects nature.	Of course, because it can involve a better development for our community.	No
Cesario Bac Chub	Hidroeléctrica Candelaria does not contaminate because it involves a generation with no contamination.	This project is good for us, the construction of the Candelaria project must continue.	The projects involve improvements for the economy and social development of our community.	As Hidroeléctrica Candelaria is protecting the environment we expect more projects of this type to be developed.

Question	Based on the available information and your knowledge regarding Environment, Climate Change, Clean Development Mechanism (CDM) and Global Carbon Market related issues, briefly express your opinion about the Candelaria Hydroelectric Project.	Would you recommend private companies, governmental authorities or other organizations to develop projects of this kind: electricity generation from renewable resources as contribution to the mitigation of climate change?	Do you believe that Candelaria Hydroelectric Project will contribute to the environmental (sustainable development), social and economic development of the region and of Guatemala?	Express any additional comments
David Che	I believe that the hydroelectric plant is working better with no type of contamination, everything is ok.	Yes, it is very good because this service is needed in our communities.	Yes, we need the employment sources that this company could generate.	Hidroeléctrica Candelaria works wells without contaminating. Besides, it is helping to the reforestation of the environment.
Ramiro Choc Choc	For us, Hidroeléctrica Candelaria does not involve any contamination and helps to improve the environment.	What we want is to continue with the same equipment of Candelaria, unlike of those that produce gases that contaminate.	A project like Hidroeléctrica Candelaria is very important, as they provide a percentage of daily incomes.	Job opportunities for our community.
Santiago Choc	With the Hidroeléctrica Candelaria project there will not be diseases, it will bring development to our community.	Yes, because it does not contaminate the environment by using the same hydraulic technology.	It is contributing to the development of our community.	We would like to ask more projects like this in order to generate jobs.
Emilio Chub	It is very important because it protects the environment.	I agree because we want this project to benefit our community.	The reforestation of our community is necessary in order to protect water.	We would like the project to reach our community.
Pedro Ich	For us it is very important because it helps us with the environmental contamination problem.	It is very important for our community because it protects water.	I agree because it will help our community.	It is a help for us.
José Choc	It is very beneficial for the community, involving the planting of more trees so as to have enough natural resources.	To improve the condition of not contaminating the environment, to have a project like Candelaria	Yes, I agree.	We need the energy for our community.
Juan Daniel Caal	It is very important to know the rural situation.	Yes, I agree.	We would need this energy to reach the community.	I would like to thank everybody ad I hope you can continue working in this project.
Francisco Choc	It is very important how the project functions because it does not contaminate the environment.	Yes.	It is very useful for the community	We need to have energy in order to improve our situation.

Question	Based on the available information and your knowledge regarding Environment, Climate Change, Clean Development Mechanism (CDM) and Global Carbon Market related issues, briefly express your opinion about the Candelaria Hydroelectric Project.	Would you recommend private companies, governmental authorities or other organizations to develop projects of this kind: electricity generation from renewable resources as contribution to the mitigation of climate change?	Do you believe that Candelaria Hydroelectric Project will contribute to the environmental (sustainable development), social and economic development of the region and of Guatemala?	Express any additional comments
Alejandro Chub	The project does not contaminate the environment; it benefits and helps us satisfy our needs.	I recommend the authorities of the project to keep on working.	Yes, I agree, and I hope the activities will continue in order to achieve a clean environment.	I would like our community to receive the energy produced.
Domingo Coy	It involves a benefit that will allow improving our situation and not contaminating the environment.	Yes, it is very important to not contaminate the environment.	It is a general benefit, because it benefits the whole community and satisfies its needs.	It is a pleasure to attend this lecture because it provides a lot of information.
Tiul Cal	For me, Hidroeléctrica Candelaria is very beneficial for the rural community.	It is very important because it covers the needs of the community.	I consider that Hidroeléctrica Secacao will help us with the reforestation in our community.	As teachers we need to be helped in the educative process, so as to have a better education.
Felipe Ich	This project will be a significant help for our community.	I recommend the project to help us in the reforestation of our environment.	I would like this project to be developed in our community.	I think the project will provide a help for us in the energy and drinkable water sector.
Santiago Coc	I liked the Candelaria Hydroelectric Project because it is very clean.	I would like the authorities to develop more projects like Candelaria.	Yes, it generates jobs	Hidroeléctrica Secacao should continue generating a clean development.
Felix Tzi Mó	It is a project that economically contributes to the local and national community, as it avoids contamination.	In my opinion, it is advisable for other entities or companies to promote projects like the Candelaria project.	Of course, this project is a contribution to the social and environmental development.	It is necessary to promote the generation of electric energy of Candelaria in rural areas and thus the use of fuels will be avoided.
Juan Rax	Yes, I think it is convenient to carry out this kind of projects.	Yes, I recommend other companies to develop a project like this.	I consider that Hidroeléctrica Candelaria is contributing to the development of the country.	It is good for our development that the company keeps on generating electricity.

Question	Based on the available information and your knowledge regarding Environment, Climate Change, Clean Development Mechanism (CDM) and Global Carbon Market related issues, briefly express your opinion about the Candelaria Hydroelectric Project.	Would you recommend private companies, governmental authorities or other organizations to develop projects of this kind: electricity generation from renewable resources as contribution to the mitigation of climate change?	Do you believe that Candelaria Hydroelectric Project will contribute to the environmental (sustainable development), social and economic development of the region and of Guatemala?	Express any additional comments
David Tox	I think that the electricity generation in Hidroeléctrica Candelaria is very good, because of the proper use of natural resources.	Yes, I recommend it because it does not involve the cutting down of trees or burning of fossil remains.	Of course. Hidroeléctrica Camdelaria is contributing to the development of the country.	Besides the hydroelectric project, the area is also being afforested and this sets an example for other companies.
Mateo Caal	Hidroeléctrica Candelaria is a clean development project for it does not contaminate.	Yes because it constitutes a form of clean development without contamination.	Yes, it generates jobs	Hidroeléctrica Candelaria promotes the development of our community.
Santiago Maquín	Hidroeléctrica Secacaco does not damage our environment.	Yes, because it does no contaminate the environment.	Yes, it generates jobs	No
Abner Chiquin	Hidroeléctrica Candelaria is beneficial for our development and does not damage the community because it does not contaminate.	Yes, because the generation of electricity from renewable resource does not generate contamination.	Yes, it generates jobs	Hidroeléctrica Candelaria helps the development of our region.
Juan Cucul	I like Hidroeléctrica Candelaria, because it involves clean development and benefit our environment as it does not generate contamination; I hope it will continue that way.	Yes, I recommend the companies to develop projects like this.	Yes, it generates jobs	Hidroeléctrica Candelaria implies development for our region.
Vicente Cucul	Hidroeléctrica Candelaria does not destroy our environment	Yes, because it does not contaminate the environment	Yes, because it generates employment and social development.	We would like to ask more projects like this in order to generate jobs.
Juan Carlos Villela	I totally agree with the project implementation - The use of clean energy must be stimulated in order to avoid environmental contamination	Yes, I would recommend it, as it encourages the creation of laws for limiting the use of any type of contaminants.	Yes, I consider that the project involves a direct and indirect benefit for all.	I congratulate Hidroeléctrica Candelaria for participating in the development of Guatemala and for all the direct and indirect benefits it will generate.

Question	Based on the available information and your knowledge regarding Environment, Climate Change, Clean Development Mechanism (CDM) and Global Carbon Market related issues, briefly express your opinion about the Candelaria Hydroelectric Project.	Would you recommend private companies, governmental authorities or other organizations to develop projects of this kind: electricity generation from renewable resources as contribution to the mitigation of climate change?	Do you believe that Candelaria Hydroelectric Project will contribute to the environmental (sustainable development), social and economic development of the region and of Guatemala?	Express any additional comments
José Bacaal	The projects that generate fumes is what there was before and it was bad, but this project is clean and protects the environment. I hope there are more projects like this.	Yes, I recommend it	Yes, I'm happy and I know that it will soon help the community.	I just want to thank for the invitation and for the project
Augusto Chub	The project is very good, since everything that generates fumes contaminates and it has to be removed. The project must continue.	Yes, I recommend it	Yes, I'm happy that the project is being developed and that it will involve more development for the community, you are doing a good job, keep on doing it.	I thank Hidroeléctrica Candelaria for giving us the opportunity to know the project that so much benefit will bring to the community.
Adrian Sub	The project is very good and it is an excellent thing for the environment.	Yes, I recommend it	Yes, the project brings hope of a better future, as it will involve the generation of energy, employment and improvement of health for the community.	Thanks!
Alberto Choc	I like the project because it protects the environment. Continue with the project so that contamination ends.	Yes, I recommend it	Yes, the entire project is good and it will benefit the community and the children living in it.	I thank for the invitation as it helped me to know the project and I'm sure it will help the development of the community.
Francisco Chub	I liked the explanation regarding the greenhouse effect and I hope more projects similar to this are developed.	Yes, I recommend it	Yes, because we want to see improvements, such as light, development and the social benefits that the project involves.	I thank you for the work you are doing.
Javier Choc	I'm glad to know that the project is good, continue with the project.	Yes, I recommend it.	Yes	Yes, and I believe it will involve benefits regarding development, light, education and health.

E.3. Report on consideration of comments received

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The Candelaria project sponsors began the implementation of the mitigation measures mentioned in the Environmental Impact Study (EIA) of the project activity. The status of these activities is summarized below.

Reforestation and Afforestation Projects

Hidroeléctrica Candelaria began implementing reforestation and afforestation projects in 2003, by starting with a development of 246 hectares. Later on, in 2005, another project involving 160 hectares was carried out. For 2007 the project sponsors have planned the reforestation/afforestation of another 180 hectares. Between 2008 and 2013 they plan projects covering an estimated area of another 700 hectares.

About 250 employees are hired for the sowing/planting process involved in the projects, which lasts between two and three months depending on the size of the project. In addition, throughout the entire year, between 50 and 60 additional workers are hired for the maintenance of the existing plantations. This number will increase as more projects are developed.

All workers come from the local communities and, during all this time, they have had the opportunity of being trained for the type of work they perform. An agronomical engineer is responsible for the management and maintenance of the plantations.

In addition to the manager, Hidroeléctrica Candelaria has hired the services of a highly experienced and renowned forestry advisor with vast experience in the forestry field, who visits the projects once a month (for two days) in order to make recommendations and train workers.

All of these activities yield significant benefits to the communities, not only by providing them with employment, but also through what they learn and put into practice in their own plantations, allowing them to achieve higher productivity in their personal crop plantation yields.

Mitigation Measures

At the moment of presenting this PDD most of the mitigation measures mentioned in the EIA have been executed and a few are in the process of being implemented. The following is a list of these mitigation tasks (measures):

1- Land Movement
   a) To create live, visual barriers with native species around them, if necessary (implemented).
   b) To disperse earthy materials in order to avoid the formation of accumulations or deposits of water (implemented).
   c) To deposit the non-biodegradable materials in the areas designed and authorized for such purpose (implemented).
   d) To neutralize the action of toxic substances (implemented).
   e) To develop an efficient contingency plan, this would involve the training of personnel (in process of implementation).
   f) To maintain drainages, oil traps (in workshops) and structures in good conditions (implemented).
   g) Prompt collection and disposal of liquid wastes (implemented).
2- Waste and Residue Management, common actions, pre-operation phase
   a) Complete cleaning of the work areas before their abandonment (implemented).

b) Elaboration of the compost for the rehabilitation of the areas by sources of organic waste (implemented).
c) Disposal of oily cloths by means of their incineration and burial of their ashes (implemented).

3- Access Reconditioning and Prolongation

a) Prohibition of vegetation burning (implemented).
b) Implementation of breeding grounds, with local species for future reforestations (implemented).
c) To continue with the reforestation of intervened areas (partially implemented, works are still being executed).

4- Conduction works, pressure pipe (penstock)

a) To fill the ditch with material extracted from it (implemented).
b) To restore and stabilize the buried penstock line to its original form, and to surround and protect it by reforesting with brush type species to avoid erosion (implemented).
c) Efficient contingency plan for emergency control (in process of implementation).
d) To keep signposting over the structure (in process of implementation).
e) To remove scraps, wastes and residues from the site (implemented).
f) To fill holes and/or excavations (implemented).

5- Construction of Power House, Substation and Transmission Line

a) To rehabilitate the area (implemented).
b) To cover septic tanks with compacted soil (implemented)
c) To remove all the foreign objects found in the site by the end of the construction phase (implemented)
d) To properly stabilize the slopes (implemented)

6- Generation equipment functioning (operation phase)

a) To optimize the use of labor force, to avoid a later inducement to unemployment (implemented).
b) To train the personnel with regard to safety norms, operational training, community relationships, etc. (implemented).
c) Complete cleaning of the work areas before their abandonment (implemented).
d) To restore areas that may be contaminated or degraded (implemented).
e) To rehabilitate the area (implemented).
f) To cover septic tanks with compacted soil (implemented).

Candelaria hydroelectric plant began generating electricity as of July 1st, 2006. In August 2006, the environmental monitoring plan was first implemented; this would be carried out every 6 months and the results would be presented to the Environment and Natural Resources Ministry (Ministerio de Ambiente y Recursos Naturales - MARN) for its review and approval.

SECTION F. Approval and authorization

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Appendix 1: Contact information of project participants

Organization name	Hidroeléctrica Candelaria S.A.
Street/P.O. Box	16 Calle 0-26 Zona 14
Building	
City	Guatemala City
State/Region	Central America (Latin American / Caribbean Region)
Postcode	01014
Country	Guatemala
Telephone	(502) 2337-3255
Fax	(502) 2368-3330
E-mail	rjacobs@hidrosecacao.com
Website	
Contact person	
Title	Executive Director
Salutation	
Last name	Jacobs
Middle name	Walter
First name	Rudolf
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	rjacobs@hidrosecacao.com

Organization name	Hidroeléctrica Candelaria S.A.
Street/P.O. Box	16 Calle 0-26 Zona 14
Building	
City	Guatemala City
State/Region	Central America (Latin American / Caribbean Region)
Postcode	01014
Country	Guatemala
Telephone	(502) 2337-3255
Fax	(502) 2368-3330
E-mail	rtormo@hidrosecacao.com
Website	
Contact person	
Title	General Manager
Salutation	
Last name	Tormo
Middle name	José
First name	Rodrigo
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	rtormo@hidrosecacao.com

Appendix 2: Affirmation regarding public funding

No funds from public national or international sources were used in any aspect of the proposed project. The project would be funded by equity from the project sponsor and a loan from a commercial bank.

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Appendix 3: Applicability of selected methodology

N/A

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Appendix 4: Further background information on ex ante calculation of emission reductions

Candelaria Combined Margin

EF_Average_01-02-03

Fuel Consumption

Fuel	2001	2002	2003
Diesel (ton/yr)	45,283	54,173	41,302
Bunker (ton/yr)	514,650	645,324	538,572
Coal (ton/yr)	356,086	389,854	366,000

CO_2 Emissions

Fuel	2001	2002	2003
Diesel (tCO_2/yr)	143,873	172,120	131,226
Bunker (tCO2/yr)	1,584,234	1,986,483	1,657,871
Coal (tCO2/yr)	979,797	1,072,712	1,007,076
Total	**2,707,904**	**3,231,315**	**2,796,173**

Electricity Generation by technology

Technology	2001	2002	2003
I.C. Motor (MWh/yr)	1,780,710	2,215,130	2,605,170
Steam Turbine (MWh/yr)	1,426,600	1,588,870	1,499,320
Gas Turbine (MWh/yr)	106,940	147,060	85,000
Total	**3,314,250**	**3,951,060**	**4,189,490**

Operating Margin

$EF_{\_OM\_2001}$ (tCO_2/MWh)	0.817
$EF_{\_OM\_2002}$ (tCO_2/MWh)	0.818
$EF_{\_OM\_2003}$ (tCO_2/MWh)	0.667
$EF_{\_OM\_Average}$ (tCO_2/MWh)	0.767

Candelaria Combined Margin 7sep06

Emision Factor_2001

Emission Reductions - Candelaria Hydroelectric Project

Conversion Factors

1 Gallon	3.785	litre		
1kJ	1.00E-09	TJ		
1MWh	0.0036	TJ		
1 ton C	3.67	Ton CO2		
1GWh	1,000	MWh		
Diesel Density	0.88	kg/l o ton/m3		
Diesel Lower Heating Value	43.33	TJ/kton MJ/kg	0.0381 TJ/m3	IPCC guidelines
Bunker Density	0.95	kg/l o ton/m3		
Bunker Low Heating Value	40.19	TJ/kton	0.0380 TJ/m3	IPCC guidelines
Coal Low Heating Value	29.68	TJ/kton	IPCC guidelines	

Consumption by Fuel

Fuel	(Gal/yr)	(lts/yr)	(m^3/yr)	(ton/yr)
Diesel	13,595,160	51,457,681	51,458	45,283
Bunker	143,884,664	544,603,453	544,603	514,650
Coal	----------	----------	----------	356,086

CO_2 Emissions

Fuel	(ton/yr)	(kton/yr)	Energy Consumption (TJ/yr)	Fraction of Carbon Oxidised	Emission Factor (tC/TJ)	CO_2 Emissions (tCO_2/yr)
			IPCC (Oil&Oil Products), Energy chapter, Table1-6, Page1.29.		IPCC, Energy chapter, Table 1-1(primary guels, secondary fuels), Page 1.13.	
Diesel	45,283	45	1,962	0.99	20.2	143,873
Bunker	514,650	515	20,684	0.99	21.1	1,584,234
Coal	356,086	356	10,569	0.98	25.8	979,797
Total						**2,707,904**

Electricity Generation by technology

Technology	As reported by AMM, "Informe estadístico 2001". (GWh/yr)	(MWh/yr)
I.C. Motor	1,781	1,780,710
Steam Turbine	1,427	1,426,600
Gas Turbine	107	106,940
Total		**3,314,250**

Operating Margin

EF_{OM} (tCO_2/MWh)	**0.817**

Emision Factor_2002

Emission Reductions - Candelaria Hydroelectric Project

Conversion Factors

1 Gallon	3.785	litre		
1kJ	1.00E-09	TJ		
1MWh	0.0036	TJ		
1 ton C	3.67	Ton CO2		
1GWh	1,000	MWh		
Diesel Density	0.88	kg/l o ton/m3		
Diesel Lower Heating Value	43.33	TJ/kton MJ/kg	0.0381 TJ/m3	IPCC guidelines
Bunker Density	0.95	kg/l o ton/m3		
Bunker Low Heating Value	40.19	TJ/kton	0.0380 TJ/m3	IPCC guidelines
Coal Low Heating Value	29.68	TJ/kton	IPCC guidelines	

Consumption by Fuel

Fuel	(Gal/yr)	(lts/yr)	(m^3/yr)	(ton/yr)
Diesel	16,264,357	61,560,591	61,561	54,173
Bunker	180,418,084	682,882,447	682,882	645,324
Coal	----------	----------	----------	389,854

CO_2 Emissions

IPCC (Oil&Oil Products), Energy chapter, Table1-6, Page1.29.

IPCC, Energy chapter, Table 1-1(primary guels, secondary fuels), Page 1.13.

Fuel	(ton/yr)	(kton/yr)	Energy Consumption (TJ/yr)	Fraction of Carbon Oxidised	Emission Factor (tC/TJ)	CO_2 Emissions (tCO_2/yr)
Diesel	54,173	54	2,347	0.99	20.2	172,120
Bunker	645,324	645	25,936	0.99	21.1	1,986,483
Coal	389,854	390	11,571	0.98	25.8	1,072,712
Total						3,231,315

Electricity Generation by technology

As reported by AMM, "Informe estadístico 2002".

Technology	(GWh/yr)	(MWh/yr)
I.C. Motor	2,215	2,215,130
Steam Turbine	1,589	1,588,870
Gas Turbine	147	147,060
Total		3,951,060

Operating Margin

EF_{OM} (tCO_2/MWh)	0.818

Emision Factor_2003

Emission Reductions - Candelaria Hydroelectric Project

Conversion Factors

1 Gallon	3.785	litre		
1kJ	1.00E-09	TJ		
1MWh	0.0036	TJ		
1 ton C	3.67	Ton CO2		
1GWh	1,000	MWh		
Diesel Density	0.88	kg/l o ton/m3		
Diesel Lower Heating Value	43.33	TJ/kton MJ/kg	0.0381 TJ/m3	IPCC guidelines
Bunker Density	0.95	kg/l o ton/m3		
Bunker Low Heating Value	40.19	TJ/kton	0.0380 TJ/m3	IPCC guidelines
Coal Low Heating Value	29.68	TJ/kton	IPCC guidelines	

Consumption by Fuel

Fuel	(Gal/yr)	(lts/yr)	(m^3/yr)	(ton/yr)
Diesel	12,400,068	46,934,257	46,934	41,302
Bunker	150,572,604	569,917,306	569,917	538,572
Coal	----------	----------	----------	366,000

CO_2 Emissions

				IPCC (Oil&Oil Products), Energy chapter, Table1-6, Page1.29.	IPCC, Energy chapter, Table 1-1(primary guels, secondary fuels), Page 1.13.
Fuel	**(ton/yr)**	**(kton/yr)**	**Energy Consumption (TJ/yr)**	**Fraction of Carbon Oxidised**	**Emission Factor (tC/TJ)**	**CO_2 Emissions (tCO_2/yr)**
Diesel	41,302	41	1,790	0.99	20.2	131,226
Bunker	538,572	539	21,645	0.99	21.1	1,657,871
Coal	366,000	366	10,863	0.98	25.8	1,007,076
Total						**2,796,173**

Electricity Generation by technology

Technology	As reported by AMM, "Informe estadístico 2003". (GWh/yr)	(MWh/yr)
I.C. Motor	2,605	2,605,170
Steam Turbine	1,499	1,499,320
Gas Turbine	85	85,000
Total		**4,189,490**

Operating Margin

EF_{OM} (tCO_2/MWh)	**0.667**

BM Estimation

Build Margin analysis and estimation

Referencias

Conversion Factors

1 Gallon	3.785	litre		
1kJ	1.00E-09	TJ		
1MWh	0.0036	TJ		
1 ton C	3.67	Ton CO2		
1GWh	1,000	MWh		
Diesel Density	0.88	kg/l o ton/m3		
Diesel Lower Heating Value	43.33	TJ/kton MJ/kg	0.0381 TJ/m3	IPCC guidelines
Bunker Density	0.95	kg/l o ton/m3		
Bunker Low Heating Value	40.19	TJ/kton	0.0380 TJ/m3	IPCC guidelines
Coal Low Heating Value	29.68	TJ/kton	IPCC guidelines	

Total GRID Generation - 2003	6,695	(GWh)
	6,694,600	(MWh)
20 % of total GRID Generation - 2003	1,338,920	(MWh)

http://cdm.unfccc.int/Projects/registered.html

Generation (Including Low Cost/Must Run)											
Plant Identification	**Technology**	**Fuel Type**	**Year online**	**Generation (GWh/yr)**	**Generation (MWh/yr)**	**Average Plant Efficiency (%)**	**Fuel Consumption (TJ/yr)**	**Emission Factor (tonC/TJ)**	**Fraction Carbon Oxidized**	**Conversion Factor (C–>CO2)**	**Emissions (ton CO_2 / yr)**
El Canadá	Hydroelectric	Renewable	2003	13.02	13,020	100%		0	0.00	3.67	0
Electrogeneración	IC Motor	Bunker Fuel	2003	3.89	3,890	33%	42	21.1	0.99	3.67	3,250
Amatex	IC Motor	Bunker Fuel	2003	20.25	20,250	33%	221	21.1	0.99	3.67	16,920
Arizona	IC Motor	Bunker Fuel	2003	561.40	561,400	33%	6,124	21.1	0.99	3.67	469,083
Calderas	Geothermal	Renewable	2002	32.69	32,690	100%		0	0.00	3.67	0
San José	Steam Turbine	Coal	2000	892.06	892,060	35%	9,175	25.8	0.98	3.67	850,639.9
Total				1,523	1,523,310						1,339,894

Build Margin (BM)

EF_B_M ($tonCO_2$/MWh)	0.880

Appendix 5: Further background information on monitoring plan

N/A

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Appendix 6: Summary of post registration changes

As shown in section A.3. Technologies and/or measures, the turbine capacity value was updated to 4.456 MW; in addition, and explanation about the delimitation of the installed capacity of the plant (4.3 MW) because of the generator's capacity is indicated in the footer of the same section.

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History of the document

Version	Date	Nature of revision
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	EB 66 13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the project design document form for CDM project activities" (EB 66, Annex 8).
03	EB 25, Annex 15 26 July 2006	
02	EB 14, Annex 06b 14 June 2004	
01	EB 05, Paragraph 12 03 August 2002	Initial adoption.
Decision Class: Regulatory **Document Type:** Form **Business Function:** Registration		