CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Revision history of this document

Version Number	Date	Description and reason of revision
01	January 21, 2003	Initial adoption
02	July 8, 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	December 22, 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

Montecristo Hydroelectric Project
Version 3. 04/04/2007

A.2. Description of the small-scale project activity:

Montecristo is a run of river hydroelectric plant of 13.08 MW, built in the Samala River Basin, located about 192 km west of Guatemala City. The owner and operator of the hydroelectric plant is Generadora Montecristo, S.A a subsidiary of ENEL Latin America.

The construction of this hydroelectric plant began on January 31, 2005[1] and the facility will begin operations on February, 2007 with the purpose of generating clean electrical energy, free of greenhouse gas emissions, for the Guatemala Interconnected National System. The Montecristo hydroelectric plant will produce an average of 52.364 GWh annually, which will be sold in the spot market at market rates.

Montecristo Hydroelectric Plant contributes to meet the electrical demand required for the economical national development of the country, thus positively participating in the attainment of the local and national sustainable development goals. In addition, it strengthens local synergies allowing for the preservation of local natural resources and development of the communities through different activities.

Its contribution to sustainable development is summarized as follows:

Environment:

- It will contribute to the reduction of GHG emissions by displacing energy production using fossil fuels. In this, yearly reduces about 35,189 t CO_2 by using renewable resources for the generation of electrical energy.
- It will contribute to the preservation of Samala River Basin through a cooperation agreement with the *Mancomunidad Metropoli de Los Altos*[2] and/or other organizations to carry out a Solid Waste Management Plan. By means of this cooperation agreement, Generadora Montecristo, S.A, will strength the local synergies in order to find solutions to protect the Samala River, where are dumped the solid wastes and the municipal wastewater generated by the second city with more population in Guatemala.

Economic:

- It contributes to poverty reduction by creating employment through the operation of the hydroelectric plant and conservation river basin activities.

[1] See Notice to proceed to Solel Boneh Guatemala, S.A (Contractor).

[2] The ***Mancomunidad Metropoli de Los Altos*** is an organization formed by the municipalities of Quetzaltenango, Zunil, Almolonga, La Esperanza, San Mateo, San Juan Ostuncalco, Salcaja and Olintepeque aimed to work for the local development.

Social:

- It will contribute to improve the quality of life of nearby communities through the pollution reduction by means of the Solid Waste Management Plan.

From its inception, the project considered the reduction of CO_2 emissions and its sales to overcome project financial barriers. The Montecristo hydroelectric project is the third hydroelectric built in cascade over the Samala River, which topographical conditions are less favorable than the first two, and which directly affects the yield capacity of the project. The income flow consideration due to the sale of the CER's permitted the profitability of the project so the investors decided to build the hydroelectric.

Therefore, the Clean Development Mechanism financing shall permit to pay the initial investment of the project and will be part of the funds supporting the activities required to preserve the Samala River Basin.

A.3. Project participants:

Name of party involved	Private and/or public entity(ies)	The party involved wishes to be a project participant
Guatemala (host)	Private entity: Generadora Montecristo, S.A.	No

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

A.4.1.1. Host Party(ies):

Guatemala

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

Quetzaltenango and Retalhuleu

A.4.1.3. City/Town/Community etc:

Zunil (Quetzaltenango) and El Palmar (Retalhuleu)

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :

The Montecristo hydroelectric plant is located 192 km west of Guatemala City and 12 km south of Quetzaltenango City. It can be accessed through the road between Retalhuleu and Quetzaltanango.

Fig. 1 Montecristo Hydroelectric Plant location.

It is located downstream of Santa Maria and El Canada hydroelectrics. The main infrastructure is located between North 1 624 000, East 658 125 and North 1 622 200, East 656 250 coordinates.

The hydroelectric starts with a conveyance system that collects Samala power flows, downstream of El Canada Hydroelectric. The power flows are conveyed by a system including 750 m of low pressures pipe, a 16,000 m^3 regulating reservoir and 1,700 m of high pressures penstock to the powerhouse.

The powerhouse is connected by a 69 kV transmission line to El Canada substation which it links to the 69 kV Interconnected National System.

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

The Project is classified as ID category, in the Renewable electricity generation for a grid for small-scale activity projects, because it does not exceed the 15 MW established in the decision 17/CP. 7.paragraph 6 (c)(i).
Electricity from renewable sources is generated by a run of the river hydroelectric plant with a daily regulation reservoir, using two Francis turbines and two synchronous generators, for a total capacity of 13.08 MW.

The technology used is environmentally safe and used worldwide. During the generation of electricity no fossil fuel is burned, and therefore, no emissions or wastes are dumped into the environment. Generadora Montecristo, S.A. carries out a program to mitigate the environmental impact of the hydroelectric plant during construction, which shall be continued during the plant's operation.

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

Table 1. First crediting period.

		Annual estimation of emission reductions (t CO_2)
Year 1 (May 11, 2007)	2007	22,656
Year 2	2008	35,189
Year 3	2009	35,189
Year 4	2010	35,189
Year 5	2011	35,189
Year 6	2012	35,189
Year 7	2013	35,189
Year 8 (May 10, 2014)	2014	12,533
Total estimated reductions (t CO_2)		246,320
Total number of crediting years		7
Annual average over the first crediting period of estimated reductions (t CO_2)		35,189

A.4.4. Public funding of the small-scale project activity:

Public funding from an annex I party or host country is not used by the project.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

According to the Appendix C of the Simplified Methodologies and Procedures for the small-scale CDM, this Project activity is not a de-bundled component of a larger project activity.

Over Samala River were constructed two hydroelectric plants previously. The Santa Maria hydroelectric which is upriver from Montecristo belongs to the *Instituto Nacional de Electrificación*; therefore Montecristo is not a part of this hydroelectric. El Canada, also upriver from Montecristo and upstream from Santa Maria was constructed by *Generadora de Occidente, Ltda.* a subsidiary of ENEL, but is not considered as the same project activity due to the following reasons.

Tecnoguat, S.A. and Generadora de Occidente, S.A. owned by Enel Latin America, have developed CDM project activities in Guatemala, independently from Montecristo project. The progress of each one of the projects can be seen in the following table:

Table 2. CDM projects proposed by the Enel Latin America's companies in Guatemala.

CDM project	Construction initiation date	Validation initiation date	Registration date
El Canada	February, 2002	April 9, 2003[3]	December 2, 2006
Matanzas	January 1, 2001	September 27, 2005	January 21, 2006
San Isidro	January 1, 2001	September 27, 2005	January 23, 2006
Montecristo	January 31, 2005	May 2006	Pending

These activities are located 1 km beyond the Montecristo Hydroelectric:

- Matanzas Hydroelectric plant located 120 km from the Montecristo plant[4].
- San Isidro Hydroelectric plant located 128 km on direct line from the Montecristo plant[5].
- El Canada Hydroelectric Plant is located 2 km upstream from Montecristo powerhouse.

Montecristo has not been debundled from a large-scale project activity, as it as conceived and promoted in later dates than other projects developed by ENEL Latin America in Guatemala. On the other hand, Montecristo has the authorization to exploit the water resource independently from the other hydroelectric plants owned by ENEL[6] and shall operate in the electric market as an independent generator agent.

[3] See New Methodology Form submitted by Det Norske Verits Certification Ltd and pre-validation report dated May 5, 2003.

[4] See *Instituto Geográfico Nacional* topographic map, San Jerónimo, Guatemala 2161 II E754 and unifilar diagram of the National Interconnected System.

[5] See map coverage of the transmission system. *Instituto Nacional de Electrificación* (National Institute of Electrification). *Empresa de Transporte y control de Energía Eléctrica,* ETCEE. www.inde.gob.gt/inde.htm

[6] See authorization for each hydroelectric issued by *Ministerio de Energía y Minas*.

SECTION B. Application of a baseline and monitoring methodology

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

Simplified baseline methodologies for selected small-scale CDM project activity.

Type I. Renewable energy projects

Category I.D. Renewable electricity generation for a grid

B.2 Justification of the choice of the project category:

The Project qualifies in this category because:

- The Montecristo Hydroelectric plant has a capacity below 15 MW.
- The Montecristo Hydroelectric plant uses the hydro renewable resource of the Salama River.
- The electric energy produced is injected to the Interconnected National System through the transmission line connected to the 69 kV transmission grid.

B.3. Description of the project boundary:

According to the guidance specified in the applicable project category for small-scale CDM project activities contained in appendix B of the simplified M&P for small-scale CDM project activities, the boundaries of the project activity encompasses the physical and geographical site of Montecristo Hydroelectric Plant.

The physical boundaries of the project include the area occupied by the components of the hydroelectric plant, which are:

- Conveyance system and compensation reservoir
- Powerhouse
- 69 kV transmission line

The electric boundaries of the hydroelectric plant are marked by El Canada substation that connects Montecristo to the Interconnected National System. Montecristo is connected to El Canada substation by a 2.8 km transmission line in 69 kV.

The electric energy displaced by Montecristo is produced by plants outside the project boundaries. These plants are part of the Interconnected National System of Guatemala.

B.4. Description of baseline and its development:

- **National policies and circumstances**

With the passing of the General Law for Electricity in 1996, the electricity wholesale market initiated operation administering the energy and power transactions between market agents under free market conditions. The electricity wholesale market allows energy transactions in the opportunity or spot market, and capacity and energy transactions in the contract market, according to mutually agreed contracts between market agents.

Investment in electric generation plants is free according to competitive market conditions and there is not centralized planning for the expansion of the generation system in Guatemala.

The *Administrador del Mercado Mayorista*, AMM, (Wholesale Market Administrator)[7] is responsible for the efficient operation of the wholesale market and manages the economic load dispatch, minimizing the total cost of the generation operation.

- **Scenario of the baseline**

The baseline for the electric energy sector in Guatemala determines the CO_2 emissions per MWh taking into consideration national conditions, trends in electricity demand, economic dispatch characteristics, and the technical specifications of the generation facilities in the Interconnected National System.

The emissions coefficient of the baseline represents the CO_2 emissions produced during the electric energy generation by the operating plants, represented by the Operating Margin emission factor, and the CO_2 emissions that would be produced by those plants that will be added to the grid during the accreditation period, represented by the Build Margin emission factor.

In a transparent and conservative manner, the emissions coefficient of the baseline is calculated as the average of the "approximate Operating Margin" and the "Build Margin".

The Operating margin emission factor is calculated using the mix of operating plants that are displaced by the energy generated by Montecristo. In this case the mix includes all the thermal plants in operation, excluding hydroelectric, geothermal and must-run[8] facilities because they are not displaced according to the economic load dispatch.

According to 2004 data generation[9], the total energy produced by both the renewable and must-run plants (hydroelectric, geothermal plants and cogenerators during harvest season) was 3,336 GWh, representing an average power of 361 MW, equivalent to the total base load of the system. The next graph shows a load duration curve where the base load was 359 MW, which is slightly lower than the average power from the renewable and must-run plants. This means, renewable and must-run plants margin the equivalent of an hour during the year, and remaining marginal plants are mainly thermal plants.

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[7] General Law of Electricity, article 44, http://www.cnee.gob.gt/html/marco/marco.htm

[8] The must-run plants belong to those plants having "take or pay" contracts negotiated before the enactment of the General Electricity Law. These plants are the cogenerators using bagasse as fuel during the harvest season, except for Magdalena II and Pantaleón II that sell their energy in the opportunity market.

[9] *Administrador del Mercado Mayorista*, AMM, www.amm.org.gt

This condition will continue during the first crediting period, because the additions in renewable generation to cover the load base will be compensated by the demand growth.

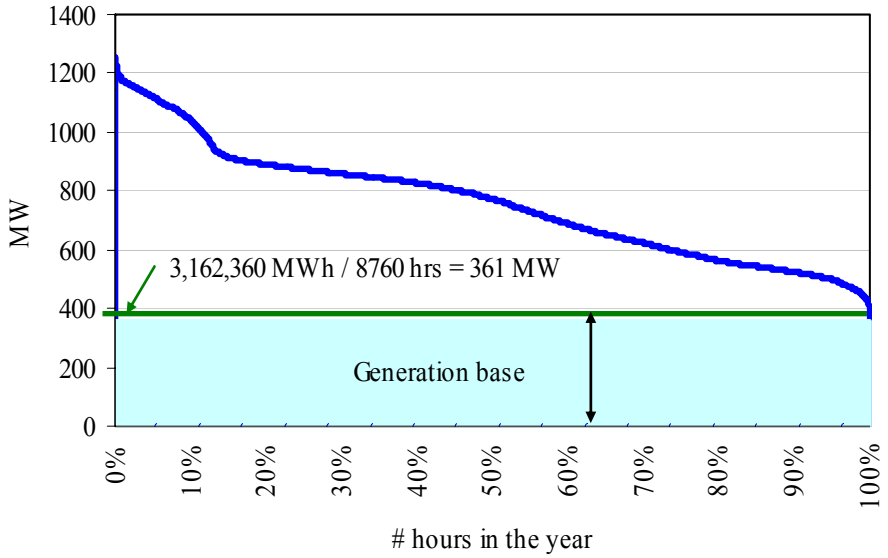

Fig. 2. Base load coverage by the hydroelectric, geothermal and must-run plants.

On the other hand, during the 2002, 2003 and 2004 years, both renewable and thermal plants have been built, whose mix of plants indicates the future trend of the capacity additions in the National Interconnted System, condition reflected by the Building Margin emission factor.

Therefore, the CO_2 emission coefficient calculated as the combination between the Operating and Build Margins describes, in a conservative manner, the baseline of the hydro-thermal system in Guatemala, where thermal generation predominates.

According to the 2004 data[10], renewable sources (hydroelectrics and geothermal plants) contribute 39.11% of the generation and thermal sources 60.89% of the generation to supply the energy demand of 7,009.25 GWh in Guatemala. The hydroelectric and geothermal plants are considered renewable. The thermal plants include those using coal, and those using fuel oil No. 6 or diesel No. 2.

Baseline conditions will continue during the entire crediting period, since the short term demand can be supplied with the plants currently installed. This can be concluded from the conditions in 2004, when the system peak period of 1,255.8 MW was covered by the installed capacity from existing hydroelectric and geothermal plants, 712.86 MW, and 1,146.97 MW from thermal sources[11].

[10] *Administrador del Mercado Mayorista*, AMM, 2004 Statistics Report , page 1, www.amm.org.gt

[11] *Administrador del Mercado Mayorista*, AMM, Installed capacity , www.amm.org.gt

- **Considerations if the Montecristo hydroelectric plant did not exist**

In absence of Montecristo Hydroelectric Plant, the AMM would be required to dispatch a thermal facility equivalent in power and energy to the Montecristo plant generation, in order to supply the demand and grid losses of the Interconnected National System. Considering the present conditions of demand and installed power prevailing in the crediting period, the replaced thermal plant could correspond to one that uses coal or fossil fuels.

The energy produced by the hydroelectric, geothermal, and must-run plants now installed is not enough to meet the demand of the system, even during the periods of minimum demand of the rainy season[12], requiring an additional mix of thermal plants. This mix of thermal plants is set up by the marginal units because of their high operational cost respect to renewable plants.

The first criterion used to coordinate the economic dispatch is the stacking of units in an order of merit according to the variable generation costs; these are declared weekly by the generators. This way, the plants are dispatched, first those with minimum operating costs like hydro-electric and geothermal plants, followed by must-run plants, and finally, the more expensive thermal plants.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

- **Explaining why the Project activity is additional:**

The additionality of the project activity is demonstrated by taking in to consideration the barriers the project faces. The demonstration and assessment of additionality used the Attachment in Appendix B for small-scale project[13].

The CDM incentive was seriously considered during the design phase of the project to overcome barriers, and proof of it is the fact that the cash flow due CER's sale was considered in the financial model of the project[14].

The sale of CER's was considered from the inception of the project, having made different approaches to negotiate an Emissions Reduction Purchase Agreement. The World Bank signed an Intention Letter to buy all reduced emissions generated by Montecristo. Likewise, a PIN has been submitted to the Carbon Business Unit of the World Bank offering the project to the Italian Carbon Fund[15] and other purchase offers have been received from different private funds.

[12] See the graphs of generation dispatch, AMM 2004 Statistic Report, page 3; and post-dispatch report, October 19, 2004, that was the date of maximum hydroelectric generation in 2004. www.amm.org.gt

[13] EB Report 16, Annex 1.

[14] The financial Model and Montecristo Assumptions Book is available to the Operational Entity Designed during validation process.

[15] See Project Idea Note submitted to Italian Carbon Fund on October 31, 2003.

Barriers identification:

– **Financial barriers**

The Montecristo Project is downstream from Santa Maria and El Canada Hydroelectric plants, in less-favorable topographical conditions than these two. Under these circumstances, the project shows financial barriers due to the fact that the projected power and energy volumes are not high enough to allow an income flow to make the project profitable, and thus the CDM financing was considered to implement it.

Therefore, in view of the actual sale of the carbon emissions reductions which make the project profitable, the investors decided to implement the construction of the Montecristo hydroelectric.

The financial analysis of the project results in an **IRR (internal rate of return) of 12.83%,** considering the sale of the CER's as part of the annual revenues. Besides, it is assumed that the energy will be sold in the spot market at market rates and the capacity will be sold through short-term contracts (1-3 years).

The applied valuation methodology for the financial analysis is the post tax Discounted Cash Flows (DCF) to shareholders, under the following assumptions:

- Total estimated investment: $23,015,616
- Annual plant energy: 52.364 GWh
- Annual revenues:
  - Energy and power: 63.84$/MWh (equivalent monomic price estimated for 2006)
  - CER's: 8 US$/ton
- Annual operating costs: $533,560.04
- Renewable Law: 10 year Income Tax holiday as of the first day of operations
- Construction period: 18 months
- Valuation horizon: 50 years (equal to duration of the concession),
- Terminal value: None.

The capital funding of Generadora Montecristo, S.A. was made up 100% of equity and zero debt.

ENEL analyzed the investment decision in November 2004 and the final analysis was done in January 2005 after the negotiation with contractors. The final analysis considered an **equity cost of 11.6 %** and **hurdle rate equal to 13.6%,** where the hurdle rate reflects a creation of value in excess of the cost of equity of 2%.

The reason to finance the construction of the facility through 100% equity is that according to the Guatemala Renewable tax incentive law, hydro power plants are exempt of Income Taxes (tax holiday) for there first 10 years of operation; therefore, project finance will become a source of value destruction to share holders since debt will not bring any tax shield. The equity cost was calculated through the Capital Assets Price Model, as follows:

$$K_e = RFR + CR + \beta * MRP$$

Where:

K_e = Cost of Equity

RFR = Risk free rate
= USA bond (10 year government bond yield) [16]
= 4.43%

CR = Country risk[17]
= 3.5%

$B_{unlevered}$ = Beta coefficient (or variability of the issue)
= 0.74 [18]

MRP = Market Risk Premium
= (expected market return – risk free rate)
= 9% - 4% = 5 %

Therefore:

Equity cost	=	4.43% + 3.50% + 0.74*(9%-4%)
	=	11.6 %

– **Technological barrier**

Montecristo Hydroelectric plant face up risks to produce electricity due to the tendency to variations on hydrologic cycles, which affects the hydraulic resource availability and consequently energy production. This situation is caused by global climate phenomenons like "el niño" or "la niña", and local situations like deforestation and river basin degradation.

The map of annex 5.B shows the dynamic of the land cover in Quetzaltenango, where is the hydroelectric plant[19]. According to Instituto Nacional de Bosques the deforestation rate is 0.19% annually in Quetzaltenango and there are losses of forestal resources all over the Samala River Basin. Annex 5.B shows a map of the dynamic forestall cover.

In consequence, there is uncertainty in project incomes due resource availability in the long term. In addition, project cash flows could be seriously affected when the circumstances of this barrier coincide with market barrier.

[16] US Bond 10Y, average 6 months to September 27, 2004. Data are available to Operational Entity designated.

[17] Guatemala Govt Bond in USD 10y Spread vrs US 10y Treasury Bond 20 *Sep 04.*

[18] Investment Valuation. Damodaran, Aswath. Reference values for Oil Field Services

[19] *Instituto Nacional de Bosques*, cartographic maps, www.inab.gob.gt

– **Market barrier**

Montecristo Hydroelectric Plant face up a market barrier because does not have a long term Power Purchase Agreement and the energy produced will be sold in the opportunity or spot market at variable market rates. The opportunity market is relative volatile because depends of general system hydrology, volatility of international fuel markets and increased transactions in the Regional Electric Market with the entry into operation of the SIEPAC regional grid.

This means uncertainty in project incomes due market prices, which is more sensitive for the project considering the perturbations on hydrologic cycles.

CER's income could stabilize cash flows strengthening project finances.

Registration Impact.

Registration of the Montecristo Hydroelectric Plant as a CDM project will create financial benefits from the CER sales. This will allow Generadora Montecristo, S. A. to meet its financial obligations and the preservation of the Samala River Basin, to ensure, in the long term, the production of electric energy free of GHG emissions.

Therefore the **Montecristo Hydroelectric Plant is additional**, because without the CDM financing this project would not be profitable and would have not been built. Therefore, it requires the financing of the CDM to overcome the barriers faced by the project, in order to generate the reduced emissions of CO_2 that otherwise would not have happened.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

The baseline scenario and the emission rate calculation is based on the electricity that otherwise would have been generated by the plants connected to the grid and by addition of future plants.

Step 1. Operating Margin emission factor.

The Operating Margin emission factor (EF_{OM}) is calculated using the Simple OM method, because low-cost/must run resources constitutes less than 50% of total grid generation in average of the five must recent years.

The low-cost/must run resources include hydro, geothermal and low-cost biomass (cogenerators plants during harvest season), which means the 48% of the energy generated in the interconnected system in average, as is shown in the following table.

Table 3. Composition of the total grid generation during the five must recent years[20].

	2001	2002	2003	2004	2005
Hydroelectric	2,263.90	2,063.52	2,176.59	2,547.17	2,937.76
Geothermal	193.67	129.99	195.02	194.23	146.24
Cogenerators (bagasse)	535.85	569.54	556.01	595.26	727.08
Fuel fired plants	2,778.77	3,595.68	3,633.27	3,672.59	3,431.77
Total	5,772.19	6,358.73	6,560.89	7,009.25	7,242.86
% Renewable and low cost plants	52%	43%	45%	48%	53%

The Operating Margin emission factor reflects the average emissions generated by all the plants connected to the grid, excluding hydraulic, geothermal cogenerators plants and the power plants registered as CDM projects[21]. Also imports are included. See details in Annex 2, Table A2.

For Operating Margin emission factor calculation, the emission factor of imports is considered equal to 0 tCO_2 per MWh because the electricity imported comes from connected electricity systems in other countries of Central America.

The Operating Margin emission factor is calculated *ex-ante* and fixed for the first crediting period. It will be up dated at the renewal of the crediting period.

Step 2. Build Margin emission factor.

The Build Margin emission factor represents the tendency of the mix of generation and is calculated similar to the Operating Margin emission factor for the five most recent plants and for the most recent plants that represent the 20% of the power of the system.
The Building Margin emission factor is calculated *ex-ante*. (See details in Annex 2, Table A4).

To calculate the BM emission factor, the generation of Hydro El Canada is excluded because this plant was registered as a CDM Project. Additionally imports are excluded because at the moment of submit the PDD is not clear the interchange of electricity through the Interconnection System of Central America (*Sistema de Interconexión Eléctrica de los Paises de América Central*, SIEPAC).

Step 3. Base line emission factor.

The baseline emission factor is calculated as the weighted average of the OM emission factor and the BM emission factor, where the weight factor is equal to 0.5 for OM and 0.5 for the BM, for the first crediting period, as is described in the following expression:

CO_2 Emissions factor (t CO_2/MWh) =	0.5 (Operation Margin emission rate) + 0.5 (Building Margin emission rate)

[20] Annual energy generation data. *Administrador del Mercado Mayorista*, AMM.

[21] Las Vacas, El Canadá, San Isidro and Matanzas hydroelectric plants.

The Baseline emission shall allow the *ex-post* estimations of the emissions reduced by the project activity in the base line scenario.

Data vintages

- For the calculation *ex-ante* of the OM emission factor:
  2003, 2004 and 2005
- For the calculation *ex-ante* of the BM emission factor:
  2005

Definition of boundaries

For determining the Operating Margin emission factor and the Build Margin emission factor, the spatial extent of the project boundary includes the project site and is limited to the project electricity system. The project electricity system is the spatial extent of the power plants connected to the Guatemalan electric grid and dispatched without significant transmission constraints.

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	**Electricity by generating units**
Data unit:	MWh
Description:	Annual energy produced by the plants connected to the grid during 2003, 2004 and 2005
Source of data used:	*Administrador del Mercado Mayorista*, AMM
Value applied:	Please see table A1, annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Electricity generated by the plants data is used to calculate the apparent fuel consumed per plant and Operating Margin and Build Margin. Electricity is measured through measurement equipment installed in each plant.
Any comment:	

Data / Parameter:	**Fuel consumption rate**
Data unit:	kWh/l
Description:	Fuel consumption rate of each generating unit connected to the grid
Source of data used:	Agents generators and benchmark of the plants data
Value applied:	This information is confidential, but is available to Operational Entity designated
Justification of the choice of data or description of measurement methods and procedures actually applied :	Electricity generated by the plants data is used to calculate the apparent fuel consumed per plant and Operating Margin and Build Margin. Electricity is measured through measurement equipment installed in each plant.
Any comment:	

Data / Parameter:	Fuels density
Data unit:	Tonnes/l
Description:	Fuels density for type of fuel used by the units connected to the grid
Source of data used:	EIA
Value applied:	Refer to table 8
Justification of the choice of data or description of measurement methods and procedures actually applied :	By means of the fuel density data is calculated the mass of the fuel consumed.
Any comment:	

Data / Parameter:	Net calorific values
Data unit:	$TJ/10^3$ tonnes
Description:	Net calorific values
Source of data used:	2006 IPCC Guidelines
Value applied:	Default values
Justification of the choice of data or description of measurement methods and procedures actually applied :	By means of the net calorific values and the mass of the fuel consumed is calculated the apparent fuel consumed during each year by the generating units.
Any comment:	

Data / Parameter:	Carbon content
Data unit:	tC/TJ
Description:	Carbon content for each type of fuel
Source of data used:	2006 IPCC Guidelines
Value applied:	Default values. Please see table A1, annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	The carbon content is used to calculate the carbon emitted per each type of fuel consumed in each plant during 2003, 2004 and 2005.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

The activity of the project does not have GHG emission and leakages.

The Montecristo Hydroelectric plant does not have any GHG emissions due to the flooding of forest lands; therefore there is no methane production. In the other hand, during its operation the emissions due the emergency plant for auxiliary services are negligible.

The emissions reduced per year by the hydroelectric, in the baseline setting, are calculated using the following equation:

$$BE_y\ (t\ CO_2) = \text{Montecristo energy}_y\ (MWh) \bullet EF_{2003\text{-}2005}\ (t\ CO_2/MWh) \qquad \text{Eq. 1}$$

Where:

BE_y = Emissions in the baseline (t CO_2)

Montecristo energy $_y$ = Energy produced by the Montecristo Hydroelectric during a year *y*, is given in (MWh).

$EF_{2003\text{-}2005}$ = Emission factor (t CO_2/MWh), calculated *ex-ante* using 2003, 2004 and 2005 data vintages.

y = each year of the crediting period

The emissions factor of the Interconnected National System is calculated conservatively as the average of the emission factors of both Operating Margin and Building Margin, according to equation 2.

$$EF_y\ (t\ CO_2/MWh) = 0.5 \bullet EF_{OM\,y} + 0.5 \bullet EF_{BM,y} \qquad \text{Eq. 2}$$

Where:

$EF_{OM\,y}$ = Operating Margin emission factor (t CO_2/MWh)

$EF_{BM\,y}$ = Building Margin emission factor (t CO_2/MWh)

Operating Margin emission factor

The Operating Margin emission factor represents the CO_2 emissions of the plants in operation from the generation mix. This factor excludes both the low-cost and must-run plants, which in Guatemala, is the total energy produced by the hydroelectric and geothermal plants, and by the cogenerators using bagasse during the harvest period. See Item B5.

The Operating Margin emission factor is calculated using Equation 3 and data vintages for a 3-year average, based on the most recent statistics available at the time of PDD submission. It is calculated as the generation-weighted average emissions per electricity units serving the system.

$$EF_{OM,y} = \frac{\sum_{i,j} F_{i,j,y} \bullet COEF_{i,j}}{\sum_{j} GEN_{j,y}} \qquad \text{Eq. 3}$$

Where:

$EF_{OM,y}$ = Operating Margin emission factor (t CO_2/MWh).

y = Using 2003, 2004 and 2005 data for the first crediting period, considering an *ex-ante* calculation.

$F_{i,j,y}$ = The apparent amount of fuel *i*, for each relevant power source *j* of the SNI, for year *y*, expressed in TJ/year.

$COEF_{i,j}$ = The CO_2 emissions coefficient of the plants connected to the grid that use fuel *i* (tCO_2/TJ). It is determined using Equation 6.

$\sum_{j} GEN_{j,y}$ = The summary of the generation from each relevant source power j (MWh), during the year *y*, and includes imports to the grid from *Mercado Eléctrico Regional*, MER.

The calculation of the terms defined previously is as follow:

Apparent amount of fuel, $F_{i,j,y}$:

The apparent amount of fuel consumed by each relevant power source of the Interconnected National System, SNI, is calculated by using the plants efficiency data given by the generator agents.

This estimation was chosen because no information about values of reference for the efficiency of generating plants or the amount of fuel per plant consumed for energy generation in Guatemala were identified in a periodical report. Therefore, the apparent fuel used per year, per unit generating *j*, that burns fuel oil No. 6 or diesel, is calculated using Equation 4.

$$F_{i,j,y} = (\text{Annual Energy}_j / \eta_j) \bullet \rho \bullet NCV \qquad \text{Eq. 4}$$

Where:

Annual Energy $_j$ = The annual energy (MWh/year) of each generating unit j, delivered to the grid during the year *y*, according to recorded data by the *Administrador del Mercado Mayorista*, AMM. These data are the result of the commercial measurement, whose breakdown per generating unit does not appear in the statistics reports, and therefore, they have to be obtained directly from the AMM.

η_j = Rate of fuel consumption of the plant$_j$ (10^3 kWh/gal). These values are given directly by power producers in some cases. The cogenerator's rate of fuel consumption is calculated from the data published in a Cogeneration Statistics Report[22] and the remaining data is obtained from a benchmark analysis. The benchmark analysis considers reference power plants of Honduras and El Salvador, which have similar conditions of capacity installed, vintage and technology than the plants of Guatemala without information.
These data are confidential, since they represent cost reduction policy of the generator companies; hence, they are not published in this document. However, data is available for the verification of the information during the validation process.

ρ = Fuel density (kg/gal) or (10^3 tons/gal).
The density of fuel oil No. 6 corresponds to the average value given by EIA for petroleum products[23] and the density of diesel is given by Tampa plant as is shown in table 4.

Table 4. Average fuel density.

Fuel Oil No.6	Diesel
API gravity = 11	API gravity = 35.5
3.758 kg/gal	3.207 kg/gal

NCV = Net caloric values for each fuel (TJ/10^3 tons), according to the "IPCC 2006 Revised Guidelines and the IPCC Good Practice Guidance".

The apparent fuel used per year, per unit generating *j* that burns bituminous coal, is calculated using Equation 5.

22 http://www.cengicana.org/Portal/Biblioteca/PublicacionesCENGICANA/Boletines/Cogeneracion/Boletin%20Cogeneracion%206,2%20En2005.pdf

23 **www.eia.doe.gov/oiaf/1605/87-92rpt/tabla4a.gif**

$$F_{i,j,y} = \text{Annual Energy}_j \bullet \eta_j \bullet 1055/1x10^{12} \text{ (J/BTU)} \quad \text{Eq. 5}$$

Where:

Annual Energy $_j$ = The annual energy (MWh/year) of each generating unit j, delivered to the grid during the year *y*, according to recorded data by the *Administrador del Mercado Mayorista*, AMM.

η_j = The plant$_j$ efficiency data (BTU/kWh) are given by the generator agents.

The second factor in the numerator of the Operating Margin equation represents the emissions coefficient of the plants connected to the grid and is defined and calculated as follows:

$COEF_{i,j}$ = The CO_2 emissions coefficient of the plants connected to the grid that use fuel *i* (tCO_2/TJ). It is determined using Equation 6.

$$COEF_{i,j} = EF_{CO2} \bullet \text{Oxidation Factor} \bullet (44/12) \quad \text{Eq. 6}$$

Where:

EF_{CO2} *i* = The CO_2 emissions factor of the fuel *i* and is an indicator of the carbon content. Reference values are taken from the "IPCC 2006 Revised Guidelines and the IPCC Good Practice Guidance", expressed in tC/TJ.

Oxidation Factor = Reference values of the oxidation factors from the "IPCC 2006 Revised Guidelines and the IPCC Good Practice Guidance".

44/12 = Ratio of molar weight between CO_2 and carbon (CO_2/C).

Finally, the denominator of the Operating Margin Equation is:

$\sum_j GEN_{j,y}$ = The summary of the generation from each relevant source power j (MWh) including imports, during the year *y,* expressed in MWh.

Building Margin emission factor

The Building Margin emission factor represents the trend of the generation mix. It is calculated in similar way to the Operating Margin emission factor for both the five most recent plants and for the most recent plants representing 20% of the energy of the system, taking the value that comprises the larger annual generation.

It is calculated using the following equation:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \bullet COEF_{i,m}}{\sum_{m} GEN_{m,y}} \qquad \text{Eq. 7}$$

Where:

$EF_{BM,y}$ = Building Margin emission factor (t CO_2/MWh)

$F_{i,m,y}$ = The apparent quantity of fuel *i*, for each relevant source power *m* of the National Interconnected System, for the reference year y. Where *m* is determined among the 5 most recent plants or those recent plants contributing the 20% of the National Interconnected System energy, expressed in TJ/year.

It is assumed that among this group of plants, the hydroelectric El Canada is not included, since it was registered as a CDM projects on December 2, 2006.

This value is calculated using equations 4, 5 and 6 for the most recent plants.

y = 2005 during the first crediting period, considering an *ex-ante* calculation.

$COEF_{i,m}$ = The CO_2 emissions coefficient of the most recent plants (tCO_2/TJ), connected to the grid, that use fuel *i*

$\sum_{j} GEN_{m,y}$ = The summary of the generation of each relevant source power *m*, during the year *y*, in MWh.

B.6.4 Summary of the ex-ante estimation of emission reductions:

In conclusion, the emission reductions due Montecristo Plant is equal to the energy produced by the plant multiplied by the emissions coefficient of the baseline, as indicated in equation 1 and described in table 10, because the activity of the project does not produce GHG emissions and there are not leakages.

The calculation ex-ante of the emissions reductions for the first crediting period is summarized in the following table.

Table 10. Emission reductions estimated for the first crediting period.

	Estimation of project activity emission reductions (t CO_2e)	Estimation of baseline emission reductions (t CO_2e)	Estimation of leakage (t CO_2e)	Estimation of GHG emissions (t CO_2e)
	A = B – C – D	**B = 0.672*EGy**	**C**	**D**
Year 1 (May 11, 2007)	22,656	22,656	0	0
Year 2	35,189	35,189	0	0
Year 3	35,189	35,189	0	0
Year 4	35,189	35,189	0	0
Year 5	35,189	35,189	0	0
Year 6	35,189	35,189	0	0
Year 7	35,189	35,189	0	0
Year 8 (May 10, 2014)	12,533	12,533		
Total (tCO2)	**246,320**	**246,320**	**0**	**0**

B.7 Application of a monitoring methodology and description of the monitoring plan:

According to the simplified baseline methodologies for selected small-scale CDM project activities, category I.D. (renewable electricity generation for a grid), **the monitoring methodology shall consist of metering the electricity generated by the hydroelectric plant.**

The monitoring methodology, based on the measurement of the generated electricity, is applicable for the Montecristo Hydroelectric Plant because of the following reasons:

- It is a plant with a nominal capacity of less than 15 MW.
- Measurement of the electric energy generated by the plant is made through a meter and a process that complies with the Commercial Coordination Norm No. 14 of the Wholesales Administrator Market, AMM. Please, see monitoring plan in Annex 4.

  The meter is located in the Montecristo substation on 69 kV bus. Therefore, it measures the energy produced within the boundaries of the project activity, and which is exported to the grid.
- The project activity does not have any leakage; hence, it is not necessary to monitor any other variable.

B.7.1 Data and parameters monitored:

The following table shows the data and parameters monitored during the first crediting period.

Data / Parameter:	Electric energy produced by Montecristo Hydroelectric Plant
Data unit:	MWh
Description:	Electricity produced by Montecristo Hydroelectric Plant.
Source of data to be used:	Measurement by the operator of the hydroelectric plant.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	52,364 MWh
Description of measurement methods and procedures to be applied:	Electricity produced will be registered by the metering equipment verified by the *Administrador del Mercado Mayorista*. The measurement methods and procedures applied are according to the AMM Standard of Commercial Measurement System (Standard No. 14).
QA/QC procedures to be applied:	A quality management system will be follow, including procedures to download data, registration of information and calculation. The information downloaded by the personnel of the plant is compared with the information downloaded by AMM.
Any comment:	

B.7.2 Description of the monitoring plan:

Operational and management structure

The monitoring of the emissions reductions will be made according to the operational structure shown in figure 3. The first step is the measuring process, followed by verification of the measurement, calculation of the emissions reductions, and finally, review and analysis of results. Generadora Montecristo, S.A. General Manager will be responsible for the monitoring process.

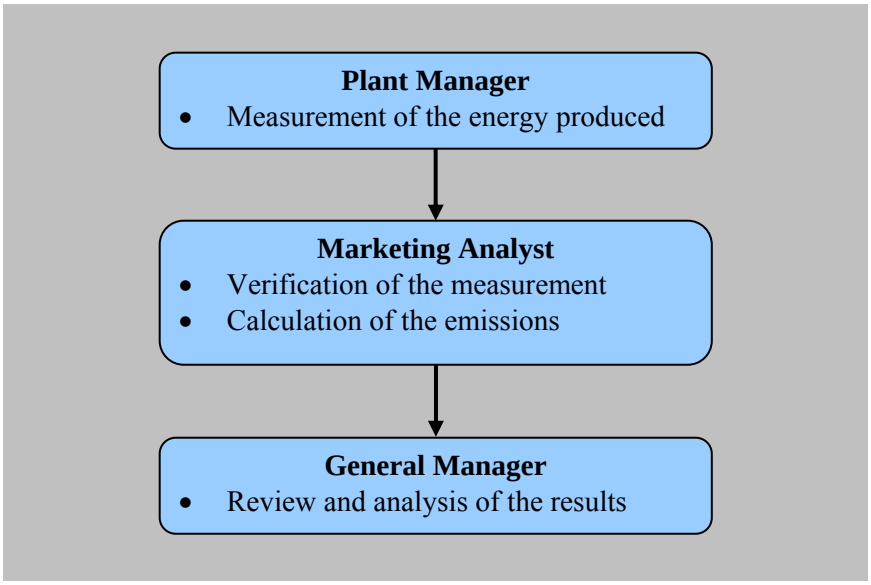

Fig. 3 Operational structure of the monitoring plan.

The quality control and quality assurance procedures observed during the monitoring stage involve:

- Use of electric energy meters with accuracy according to national (AMM) and international (ANSI) standards.
- Verification of the measurement of the plant used for calculating the emissions reductions against the commercial measurement used by the AMM for the payment of operations in the electricity market.
- Use of clear and defined procedures for data recording.
- The monitoring plan includes a nonconformance and corrective/prevention actions procedure. Please see the monitoring plan in annex 4, section A8.

B.8 Date of completion of the application of the baseline and monitoring methodology and the name of the responsible person(s)/entity(ies)

Date of completation: 01/03/2007.
Name of the responsible person:

Alaide González
alaidegl@itelgua.com
Energía y Medio Ambiente

SECTION C. Duration of the project activity / crediting period

C.1. Duration of the small-scale project activity:

C.1.1. Starting date of the small-scale project activity:

31/01/2005

C.1.2. Expected operational lifetime of the small-scale project activity:

50 y (This is the duration of the concession)

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

C.2.1. Renewable crediting period:

7 y

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

11/05/2007

C.2.1.2. Length of the first crediting period:

7 y

C.2.2. Fixed crediting period:

It does not apply.

C.2.2.1. Starting date:

It does not apply.

C.2.2.2. Length:

It does not apply.

SECTION D. Environmental impacts

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

The Environmental Impact Assessment was made in observance to Guatemalan Laws [24]. The assessment was approved by the *Comisión Nacional de Ambiente* (National Comission of the Environment) on May 20, 2003.

The Environmental Impact Assessment used a methodology that combines an interaction matrix with a cause-effect network. This combined methodology allowed the analysis of the environmental impact of the hydroelectric during the construction, works abandonment and operation, and over the different environmental components. Impacts and changes in the geo-physical, hydraulic, biotic, and socio-economic systems were analyzed.

Based on the results obtained by the Interaction matrix for impact evaluation, hereinafter are defined the higher impact actions, as well as the components more susceptible to alteration in the natural and social environment of the influence area of the Montecristo Hydroelectric.

The hydroelectric is built in a sub-tropical forest area which has been previously modified by intense agricultural activity and wood extraction. Considering this environmental scenario, the probability of occurrence and characteristics of the identified environmental impacts which could happen due to the construction and operation of the hydroelectric was established the Environmental Management Plan, which results will be periodically evaluated through the Environmental Monitoring Plan.

The Environmental Management Plan considers the implementation of prevention, mitigation, control and rehabilitation procedures needed. The assessment is available upon request to the Approved Operational Entity carrying out the validation.

The Environmental Management Plan and Environmental Monitoring Plan have been executed since plant construction beginning. It is executed by the Construction Supervisor, evaluating the fulfillment of the actions and procedures indicated in the Environmental Management Plan, and the observations are reported periodically.

The environmental Monitoring Plan includes for each activity and aspect of the plant construction and operation the following items:

- General description of the activity that may causes an environmental impact.
- Corrective or mitigation action indicated in the Environmental Management Plan.
- Description of the action executed.
- Results: executed or in process.

In conclusion, the Environmental Impact Assessment reveals that the construction and operation of Montecristo Hydroelectric Plant implies temporal and non-significative environmental impacts that could be mitigated and corrected observing the Environmental Management Plan.

[24] Law for Protection and Improvement of the Environment.

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

The construction and operation of the Montecristo Hydroelectric Plant will not imply any significant environmental impacts.

SECTION E. Stakeholders' comments

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

Before the construction of the plant, the comments from the stakeholders were known through an open survey to the inhabitants and an interview addressed to authorities and leaders of the communities in the area influenced by the project. The survey was carried out according to the interview model attached in the report of the environmental assessment study.

Consultation with the interested parties was carried out during September 28 and 29, and between October 10 and 14, year 2002. A total of 100 interviews were made to all inhabitants.

The communities where the surveys were carried out are Zunil, El Palmar y San Felipe, as well as Santa Maria de Jesús y San Miguelito Calaguache.

In addition, a press release was published in two newspapers in order to know the stakeholders comments about the environmental assessment study before the construction of the plant facility.

E.2. Summary of the comments received:

An 80% of the people interviewed said the hydroelectric would promote local development through employment generation. However, in the community of San Miguelito Calaguache of the Municipality of El Palmar, the inhabitants were of the opinion that the construction of the hydroelectric would only create temporary employment.

Eight percent of the interviewed population answered that the construction of the hydroelectric might cause damages due to harvest destruction.

Forty-two percent of the interviewed parties answered that industrial activities damage water sources.

Some of the opinions of the interested parties were that Generadora Montecristo, S.A. should hire local personnel, pay taxes and sell electric power to the area inhabitants at a special price.

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

Environmental:

1. Generadora Montecristo, S.A. has agreements to reforest the lands affected by construction works, with productive plantings such as coffee, which in addition of complying with the reforestation purpose might bring an economic benefit to its inhabitants.

2. Generadora Montecristo, S.A. will support *Mancomunidad Metropolí de Los Altos* and/or other organizations to carry out a Solid Waste Management Plan.

Social and economic:

1. Generadora Montecristo, S.A. has complied with that required by the laws of Guatemala, and has paid all taxes that appertain thereto.

2. Generadora Montecristo, S.A. cannot sell electric power to the inhabitants of the communities close to the hydroelectric, since this is not its task as Generating Agent, as provided by the General Electricity Law.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Enel Latin America
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Represented by:	
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funds are available.

Annex 3
BASELINE INFORMATION

TABLE A1	A	B	C	D	D	F	V	U	T
Fuel consumption per plant TJ/year	Availble MW	Starting year	Energy produced (GWh) 2003	Energy produced (GWh) 2004	Energy produced (GWh) 2005	Fuel	Fuel Consumption 2003 TJ/year	Consumption 2004 TJ/year	Consumption 2005 TJ/year
	AMM		AMM	AMM		Plant data			
STEAM TURBINES			**894.97**	**1,029.96**	**979.10**		**10,172.5**	**11,681.7**	**11,104.8**
SAN JOSÉ	128.9	2000	892.06	1,029.96	979.10	Bituminous Coal	10,117.7	11,681.7	11,104.8
ESCUINTLA VAPOR 2	24.0	1977	0.08	-	-	Fuel Oil No.6	1.3	-	-
LAGUNA VAPOR 3	11.0	1959	2.81	-	-	Fuel Oil No.6	53.4	-	-
LAGUNA VAPOR 4	11.0	1961	0.01	-	-	Fuel Oil No.6	0.2	-	-
GAS TURBINES			**84.78**	**7.02**	**19.17**		**1,217.92**	**93.07**	**259.71**
TAMPA	79.3	1995	15.25	1.87	3.36	Diesel	153.1	18.7	33.7
GGG STEWART & STEVENSON	23.0	1995	12.85	2.11	6.86	Diesel	161.1	26.4	86.0
ESC.GAS 5	15.0	1985	6.41	0.52	1.84	Diesel	99.4	8.0	28.6
LAG. GAS 4	27.0	1989	16.03	-	-	Diesel	260.1	-	-
ESC.GAS 3	17.0	1976	8.99	0.95	3.21	Diesel	134.8	14.3	48.1
ESC.GAS 4	*	1976	-	-	-	Diesel	-	-	-
LAGUNA GAS 2	17.0	1978	22.52	-	-	Diesel	365.4	-	-
ESCUINTLA GAS 2	*	1968	-	-	-	Diesel	-	-	-
LAGUNA GAS 1	8.0	1964	2.72	1.58	3.90	Diesel	44.1	25.7	63.3
INTERNAL COMBUSTION MOTORS			**2,605.17**	**2,621.56**	**2,427.24**		**23,732.72**	**23,463.78**	**21,828.43**
ELECTROGENERACIÓN	15.0	2003	3.89	82.37	69.53	Fuel Oil No.6	36.9	782.4	660.4
ARIZONA	160.0	2003	561.40	1,147.03	1,024.83	Fuel Oil / Oremulsion	4,889.7	9,935.4	8,926.1
AMATEX	15.0	2003	20.25	8.45	8.36	Fuel Oil No.6	192.3	80.3	79.4
LA ESPERANZA	124.0	2000	739.98	606.49	523.27	Fuel Oil No. 6	6,540.8	5,360.9	4,625.2
LAS PALMAS	65.0	1998	460.91	307.16	291.85	Fuel Oil No. 6	4,165.7	2,776.1	2,637.8
GENOR	41.6	1998	156.33	82.21	134.72	Fuel Oil No.6	1,475.3	775.8	1,271.3
LAGOTEX	25.0	1996	96.61	87.77	71.76	Fuel Oil No. 6	911.7	828.2	677.2
SIDEGUA	36.0	1995	86.93	78.79	94.52	Fuel Oil No. 6	841.2	762.5	914.8
PQPC	110.0	1993	444.78	174.80	154.50	Fuel Oil No. 6	4,345.8	1,707.9	1,509.6
GENERADORA PROGRESO	19.0	1993	34.11	46.48	53.91	Fuel Oil No. 6	333.3	454.2	526.8
COGENERATORS (Non harvest)			**48.35**	**14.05**	**1.15**		**680.75**	**198.40**	**17.40**
San Diego	5.0	2005	-	-	-	Fuel Oil No. 6	-	-	-
PANTALEÓN II	20.0	2005	-	-	0.00	Fuel Oil No. 6	-	-	0.0
MAGDALENA II	41.0	2005	-	-	-	Fuel Oil No. 6	-	-	-
PANTALEÓN	38.5	1991	14.19	0.00	0.12	Fuel Oil No. 6	197.7	0.0	1.7
SANTA ANA	33.8	1995	5.16	3.20	0.14	Fuel Oil No. 6	67.9	42.2	1.9
LA UNIÓN	29.5	1995	5.71	0.08	0.16	Fuel Oil No. 6	67.5	1.0	1.9
CONCEPCIÓN	27.5	1994	13.38	9.73	0.04	Fuel Oil No. 6	189.4	137.8	0.6
MADRE TIERRA	19.0	1996	3.99	0.01	0.08	Fuel Oil No. 6	58.1	0.1	1.2
MAGDALENA	15.4	1994	4.16	-	0.00	Fuel Oil No. 6	70.3	-	0.0
TULULA	16.5	2001	0.02	-	0.02	Fuel Oil No. 6	0.4	-	0.4
DARSA	1.0	2003	1.74	1.02	0.58	Fuel Oil No. 6	29.4	17.3	9.8
COGENERATORS (Harvest Season)			**556.01**	**595.26**	**726.51**		**2,252.49**	**2,430.16**	**2,986.84**
San Diego	5.0	2005	-	-	5.33	Bagasse 71%, Fuel oil No.6 29%	-	-	21.8
PANTALEÓN II	20.0	2005	-	-	34.98	"	-	-	143.0
MAGDALENA II	41.0	2005	-	-	23.66	"	-	-	117.4
PANTALEÓN	38.5	1991	130.10	156.35	161.30	"	531.7	639.0	659.2
SANTA ANA	33.8	1995	105.36	97.69	103.12	"	407.1	377.4	398.4
LA UNIÓN	29.5	1995	116.74	117.51	130.76	"	405.1	407.8	453.8
CONCEPCIÓN	27.5	1994	94.35	87.64	108.64	"	391.9	364.1	451.3
MADRE TIERRA	19.0	1996	38.63	48.52	66.40	"	165.0	207.3	283.7
MAGDALENA	15.4	1994	60.36	69.73	67.75	"	299.6	346.1	336.3
TULULA	16.5	2001	9.53	16.25	22.07	"	47.3	80.7	109.6
DARSA	1.0	2003	0.95	1.58	2.49	"	4.7	7.8	12.4
Geothermal			**195.02**	**194.23**	**146.24**				
Orzunil	24.0	1999	162.33	160.04	120.70	Geothermal Steam	-	-	-
Calderas	5.0	2002	32.69	34.19	25.55	Geothermal Steam	-	-	-
Hydroelectrics			**2,021.26**	**2,257.85**	**2,614.81**				
Palin II	5.8	2005	-	-	5.95	Water	-	-	-
RENACE	60.0	2004	-	160.12	278.97	Water	-	-	-
PASABIEN	12.0	2000	42.84	42.10	56.29	Water	-	-	-
POZA VERDE	8.1	2001	36.35	35.74	38.68	Water	-	-	-
SECACAO	15.5	1998	97.30	104.93	105.83	Water	-	-	-
RIO BOBOS	10.0	1995	43.58	51.41	37.27	Water	-	-	-
CHIXOY	300.0	1983	1,229.22	1,309.97	1,487.18	Water	-	-	-
AGUACAPA	90.0	1982	260.80	246.60	265.47	Water	-	-	-
CHICHAIC	0.6	1979	-	-	2.87	Water	-	-	-
JURÚN MARINALÁ	60.0	1970	207.89	199.93	233.53	Water	-	-	-

Table A2. Operating margin

TABLE A2.1	A	B	C	D	E	F
2003 Operating Margin	Fuel Consumption TJ/year	Carbon Content tC/TJ	Fraction Carbon Oxidised	Emissions tC02/year	Generation GWh	Emissions Rate tCO2 / MWh
	See table A1	Inventory Workbook (IPCC, 2006)	Inventory Workbook (IPCC, 2006)	(=A * B * C) * 44/12	See Table A2	(= D / E)
Bunker	26,721	21.10	1.00	2,067,303	2,820	0.73
Orimulsion	-	21.00	1.00	-	-	-
Diesel	1,218	20.20	1.00	90,207	85	1.06
Bituminuos coal	10,118	25.80	1.00	957,130	892	1.07
	38,056			**3,114,640**	**3,796**	**0.820**

TABLE A2.2	A	B	C	D	E	F
2004 Operating Margin	Fuel Consumption TJ/year	Carbon Content tC/TJ	Fraction Carbon Oxidised	Emissions tC02/year	Generation GWh	Emissions Rate tCO2 / MWh
	See table A1	Inventory Workbook (IPCC, 2006)	Inventory Workbook (IPCC, 2006)	(=A * B * C) * 44/12	See Table A2	(= D / E)
Bunker	16,157	21.1	1.00	1,250,005	1,663	0.75
Orimulsion	9,935	21.0	1.00	765,029	1,147	0.67
Diesel	93	20.2	1.00	6,894	7	0.98
Bituminuos coal	11,682	25.8	1.00	1,105,088	1,030	1.07
	37,867			**3,127,016**	**3,847**	**0.813**

TABLE A2.3	A	B	C	D	E	F
2005 Operating Margin	Fuel Consumption TJ/year	Carbon Content tC/TJ	Fraction Carbon Oxidised	Emissions tC02/year	Generation GWh	Emissions Rate tCO2 / MWh
	See table A1	Inventory Workbook (IPCC, 2006)	Inventory Workbook (IPCC, 2006)	(=A * B * C) * 44/12	See Table A2	(= D / E)
Bunker	24,833	21.1	1.00	1,921,222	2,642	0.73
Orimulsion	-	21.0	1.00	-	-	-
Diesel	260	20.2	1.00	19,236	19	1.00
Bituminuos coal	11,105	25.8	1.00	1,050,519	979	1.07
	36,197			**2,990,976**	**3,640**	**0.822**

TABLE A2.4	Operating Margin	Generation (GWh)	Imports (GWh)
2003	0.820	3,796.41	23.52
2004	0.813	3,847.25	33.50
2005	0.822	3,639.84	15.02
		11,283.50	72.04
Weightened average emission per electricity unit ($tC0_2$/MWh)			**0.813**

Table A3. Build Margin

TABLE A3 Build Margin	A Starting year	B Fuel consumption TJ/year	C Carbon content tC/TJ	D Fraction carbon oxidised	E Emissions $tC0_2$/year	F Generation GWh	G Emissions rate tCO_2/MWh
	See table A1	See table A1	Inventory Workbook (IPCC, 2006)	Inventory Workbook (IPCC, 2006)	= (B * C * D) * 44/12	See Table A2	= (D / E)
Option 1. Five most recent plants							
Palín II	2005	-	0.00	0.00	0	5.95	0
San Diego	2005	21.79	21.10	1.00	1,685.89	5.33	0.316
Pantaleón II	2005	142.96	21.10	1.00	11,060.65	34.98	0.316
Magdalena II	2005	117.45	21.10	1.00	9,086.39	23.66	0.384
Renace	2004	-	0.00	0.00	-	160.12	-
		282.20	0.00	0.00	21,832.94	230.04	**0.095**
Option 2. Additions represents 20% of the system generation			1,382.85				
Palín II	2005	-	0.00	0.00	-	5.95	-
San Diego	2005	21.79	21.10	1.00	1,685.89	5.33	0.316
Pantaleón II	2005	142.96	21.10	1.00	11,060.65	34.98	0.316
Magdalena II	2005	117.45	21.10	1.00	9,086.39	23.66	0.384
Renace	2004	-	0.00	0.00	-	278.97	-
Electrogeneracion	2003	660.37	21.10	1.00	51,090.49	69.53	0.735
Amatex	2003	79.39	21.10	1.00	6,142.46	8.36	0.735
Darsa	2003	22.12	21.10	1.00	1,711.17	3.07	0.558
Arizona	2003	8,926.05	21.10	1.00	690,578.77	1,024.83	0.674
		9,970.13			771,355.84	1,454.68	**0.530**

Table A4. Baseline emission factor

TABLE A4		units	equation or source	
A	Estimated operating margin emission rate	tCO_2/MWh	Table A2	0.813
B	Estimated build margin emission rate	tCO_2/MWh	Table A3	0.530
C	Estimated baseline emission rate*	tCO_2/MWh	(= (A + B) / 2)	**0.672**

***** The baseline emission rate is calculated *ex-ante*.

TABLE A5 Emisssions estimated		Units	Equation or source	
A	**Montecristo capacity**	MW	project developers	13.08
B	**capacity factor**	%	project developers	45.7%
C	**annual generation**	MWh	(=A * B * 8760)	52,364
D	**baseline emission rate**	tCO_2/MWh	See Table A4	0.672
E	**annual emissions reductions**	tCO_2	(= C * D)	35,189
F	**crediting period**	years	project developers	2007 - 2014
G	**crediting lifetime**	years	difference	21
H	**total emissions reductions over crediting lifetime**	tCO_2	(= E * G)	**738,961**

Annex 4

MONITORING PLAN

The monitoring plan comprises two parts. The first one refers to the compilation and filling of all the relevant data needed to estimate the emissions reductions by the hydroelectric as specified in the decision 17/CP.7, document FCCC/CP/2001/13Add.2.

The second part presents the sustainable development monitoring plan, which is not a CDM project requirement, but it is a tool that will allow auditing the impact of the CDM project financing on sustainable development.

A. Monitoring of the emissions reductions

A.1 Objective:

The objective of the present plan is to assure the complete, consistent, clear, and accurate monitoring and calculation of the emissions reductions, within the Montecristo Hydroelectric boundaries, during the crediting period.

A.2 Methodology:

According to the simplified baseline methodologies for selected small-scale CDM project activities, category I.D, the monitoring methodology shall consist of metering the electricity generated by the hydroelectric plant.

A.3 Boundaries

The boundaries of the project activity will remain constant during the entire crediting period as defined in Item B4.

A.4 Equipment to be used

The equipment to be used satisfies the AMM Standard of Commercial Measurement System (Standard No. 14)[25].

The measuring transformers observe Norm ANSI/IEEE C57.13 as follows:

	Accuracy type (%)	Burden
PT	0.3	75 VA
CT	0.3	22.5 VA

[25] http://www.amm.org.gt/pdfs/normas/ncc-14.pdf

The meter complies with Norms IEC 687 o ANSI/IEEE 12.20 with an accuracy of 0.2% and (3) elements. The electric energy meter records active energy every 15 min. and stores the data accumulatively.

The equipment accuracy will be audited annually by the *Administrador del Mercado Mayorista* (AMM) as of 2007, using a reference gauge, as is indicated in the AMM measurement equipment calibration procedure[26].

A.5 Installation Point of the Electric energy metering equipment

The commercial meter is installed in Montecristo substation in the 69 KV bus, which measures the energy produced by Montecristo Hydroelectric.

A.6 Personnel responsible:

- General Manager is responsible of the Monitoring Plan.
- Plant Manager of Montecristo hydroelectric is responsible of the electric energy measurement.
- The Marketing Analyst engineer of Generadora Montecristo, S.A. is in charge of the monitoring process.

Personnel who carry out the monitoring function are trained continuously as is indicated in the monthly training planning. New personnel have to follow up a training program and are formed in the specific skills required to carry out the Monitoring Plan.

A.7 Measuring and calculation procedure

A.7.1 Measuring

The Plant Manager reads the meters installed in Montecristo substation monthly, reports it in the spreadsheet for measurement control and stores the data discharged from the meter electronically.

The meter reading and data discharge of the monitoring month takes place during the first week of the following month.

A.7.2 Calculation energy produced and verification

The person in charge of monitoring will verify the accuracy of the recorded energy data. For this purpose, data will need to be compared against the information of the commercial measurements published by the *Administrador del Mercado Mayorista*, AMM in the Monthly Transaction Report.

The measuring verification is carried out as it is shown in the following spreadsheets for measurement control:

[26] http://www.amm.org.gt/pdfs/proc_tecnicos/Verificaciones_Puntos_Medicion_Comercial_AMM.pdf

Montecristo Hydroelectric measurement control		**Year:**	
A	B	C	D
Month	**Montecristo measurement (MWh)**	**AMM commercial measurement (MWh)**	**Montecristo validated generation (MWh)**
			If B=C, measurement is validated
January			
February			
March			
April			
May			
June			
July			
August			
September			
October			
November			
December			
Annual total			

Montecristo Hydroelectric Plant								
Electricity generation during the first crediting period (MWh)								
Month	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
January								
February								
March								
April								
May								
June								
July								
August								
September								
October								
November								
December								
Total								

A.7.3 Calculation of emissions reductions

The person in charge of monitoring calculates the emissions reductions each year during the crediting period in a spreadsheet, where the emissions factor is determined *ex ante* according to Item E2.

The spreadsheet used is as follow:

Montecristo Hydroelectric Plant. First Crediting period.			
	A	B	C
Year	**Annual validated generation (MWh)**	**Emission factor (ton CO_2/MWh)**	**Emissions reductions (ton CO_2)**
		0.672	A * B
2007			
2008			
2009			
2010			
2011			
2012			
2013			
2014			

A.8 Quality control and quality assurance procedures

A **Nonconformance and corrective/prevention actions procedure** will be managed in order to reduce the remaining uncertainties of the emissions reductions monitored.

A.8.1 Purpose

The purpose of this procedure is to establish and outline the process for identifying, documenting and analyzing nonconformities, and implementing preventive and corrective actions in respect to the Monitoring Plan of the Montecristo Hydroelectric.

A.8.2 Responsibilities

The Plant Manager in charge of metering and the engineers in charge of monitoring process:

- Will be in charge of the procurement, from its opening to its closure, of the nonconformities arisen, regarding to the part of the Monitoring Plan of their competency.
- Analyze along with the General Manager the identified nonconformities.
- Registry of nonconformities.
- Implement preventive and corrective actions

General Manager is in charge of:

- Analyze nonconformities along with the persons in charge of measuring and monitoring and identify appropriate corrective and preventive actions.
- Planning corrective and preventive actions establishing their scope, responsibilities, methodology, implementation and controls considered convenient.
- Verify the close-out and effectiveness of corrective and preventive actions.

A.8.3 Methodology

This methodology indicates the process followed for the identification, implementation and verification of corrective or preventive actions taken to eliminate the causes of such real or potential nonconformities.

A.8.4 Nonconformities

The party that detects a non-conformity regarding the requirements of the Monitoring Plan is under the obligation to register the same. After evaluating the same, the party in charge of the metering or the monitoring shall issue a Non-Conformity Report, where after analyzing the causes, shall propose the corrective and preventive actions it deems advisable. Next he (she) shall submit the mentioned report to the Marketing Analyst for analysis, registration, and treatment.

The Marketing Analyst after receiving the report, shall analyze the non-conformity, and together with the Plant Manager and General Manager shall determine the non-conformity treatment, mentioning in the report the corrective and preventive actions agreed to solve the same, the party responsible to carry them out, and the term estimated therefor.

Copy of the Non-Conformity Report shall be sent to the officer in charge of solving the same.

The General Manager shall verify the application of the measures approved to solve the non-conformity and shall proceed to close the Non-Conformity Report once the resolution has been satisfactorily implemented.

To solve those non-conformities that due to their nature might seriously affect the calculation of the reduced emissions of CO_2, and independently from that contained in this procedure, the most adequate immediate actions shall be adopted.

A.8.5 Corrective and Preventive Actions

Independent from the interest of optimizing the Monitoring Plan, corrective or preventive actions arise as consequence of nonconformities identified in audits and regular check-ups of the activities of the plant.

The General Manager together with the officer in charge of measurement or monitoring shall be responsible to determine the corresponding corrective and preventive actions (establishing their scope, responsibilities, methodology, implementation term thereof and the controls deemed convenient) as well as complying with the Non-Conformity Report in the area, which makes reference to implementation and verification of the agreed actions.

Once the corrective and preventive actions have been established, the responsible party shall undertake the implementation of the projected activities, as well as the established verifications.

The responsible party shall include in the Non-Conformity Report the results obtained, as well as any remark deemed important. If necessary, the Non-Conformity Report shall be accompanied by the sheets or documents deemed required.

When the corrective/preventive actions have been carried out in the foreseen stage, in a satisfactory manner, and the controls have given a correct result, the required changes se shall be recorded in the pertinent documents, and the party responsible shall close and file the Non-Conformity Report.

A.8.6 Records

The monitoring officer shall be in charge keeping a file of the Non-Conformity Reports where there is full detail of each non-conformity, from the moment of its appearance to its final closing. The format of nonconformance and corrective/preventive actions report is shown as follows:

<table>
<tr><td>Montecristo Hydroelectric</td><td>Nonconformance Report and Corrective/preventive Actions</td><td>Nº.: Page 1 of
Opening Date:
Closure Date:</td></tr>
<tr><td colspan="3">Non-conformance Identification
Identifying person:

Description:

Causes analysis:</td></tr>
<tr><td colspan="3">Preventive action
Description:

Estimated implementation term:</td></tr>
<tr><td>Responsible (signed)</td><td colspan="2">Responsible:

Date:</td></tr>
<tr><td colspan="3">Corrective action
Description:
Estimated implementation term:</td></tr>
<tr><td>Responsible (signed)</td><td colspan="2">Responsible:

Date</td></tr>
<tr><td colspan="3">Evidence of the execution and resolution proof
Verifications carried out:</td></tr>
<tr><td>Responsible</td><td colspan="2">General Manager:

Closure Date:</td></tr>
</table>

B. Monitoring the contribution to the sustainable development

B.1 Objective

- Evaluate the assistance of the CDM project to the sustainable development.
- Confirm that the emissions reductions come from a friendly environment activity that supports the communities within its area.

B.2 Personnel responsible

The person responsible of monitoring the sustainable development indicators is the engineer in charge of the monitoring. This person will be trained for this purpose.

B.3 Monitoring indicators

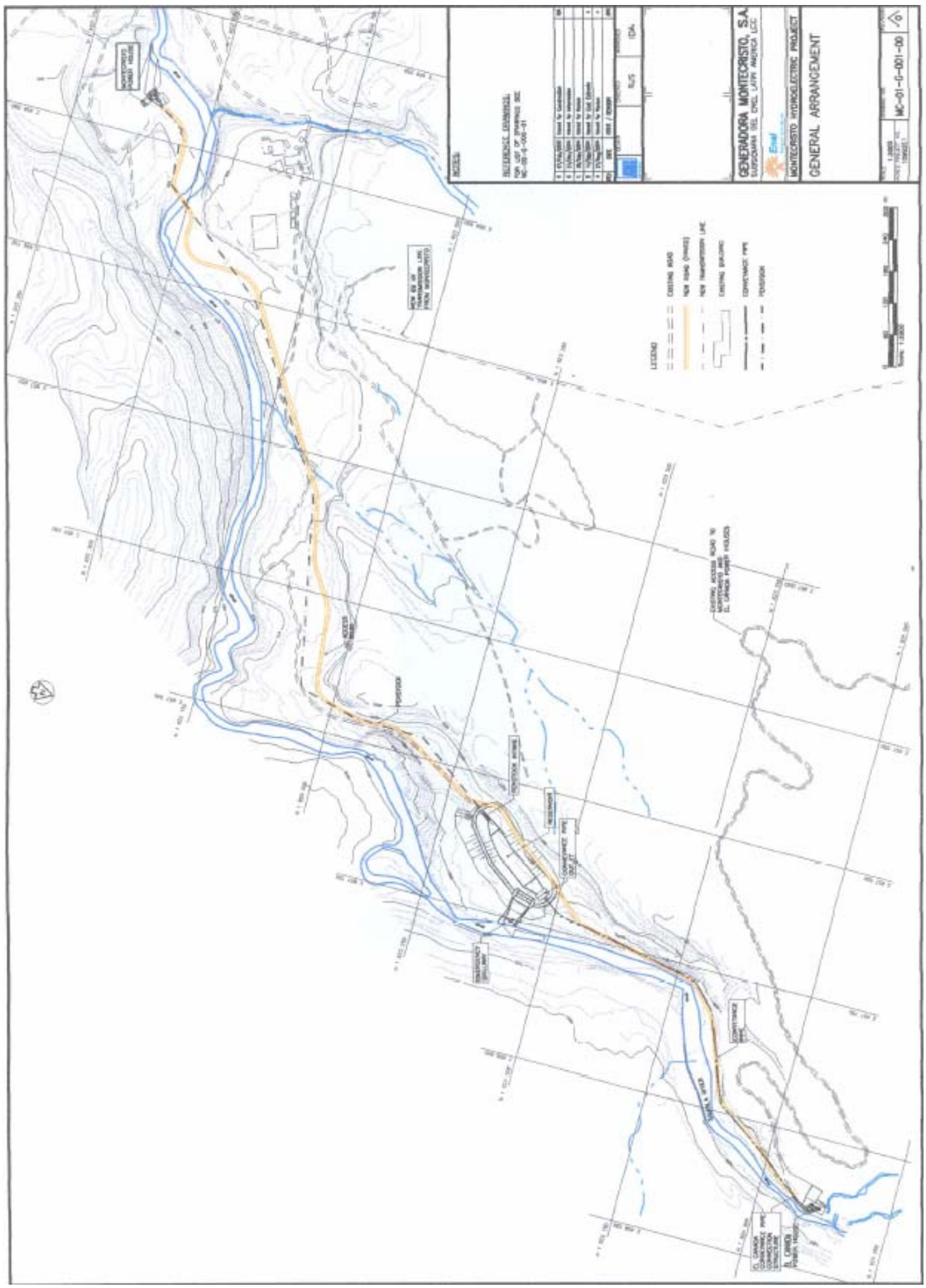
Montecristo Hydroelectric Plant		
Year:		
Dimension	**Criteria**	**Indicators**
Environmental	1. CO_2 emissions reduction by using renewable energy sources. 2. Natural resources conservation	1. GHG Emission reductions (ton CO_2) 2. No. activities and/or components of the Solid Waste Managagement Plan carried out by *Mancomunidad Metropolí de Los Altos* and/or other organizations, which is supported by Generadora Montecristo, S.A.[27]
Economical	1. Contribution to poverty reduction	1.1 No. Steady jobs/year 1.2 No. Temporary jobs/year
Social	1. Contribution to improvement of life quality in the long term.	1. No. of open landfills on Samala River Basin closed by *Mancomunidad Metropolí de Los Altos* and other organizations[28] or other projects developed in relation of the Solid Waste Management.

[27] The goal of this indicator is to verify the continuity of the Solid Waste Management Plan, which is carried out by *Mancomunidad Metropolí de Los Altos* and/or other organizations supported by Generadora Montecristo, S.A. At the moment of submit the PDD, Generadora Montecristo, S.A. and the Mancomunidad discuss the terms of a cooperation agreement to carry out the Solid Waste Management Plan.

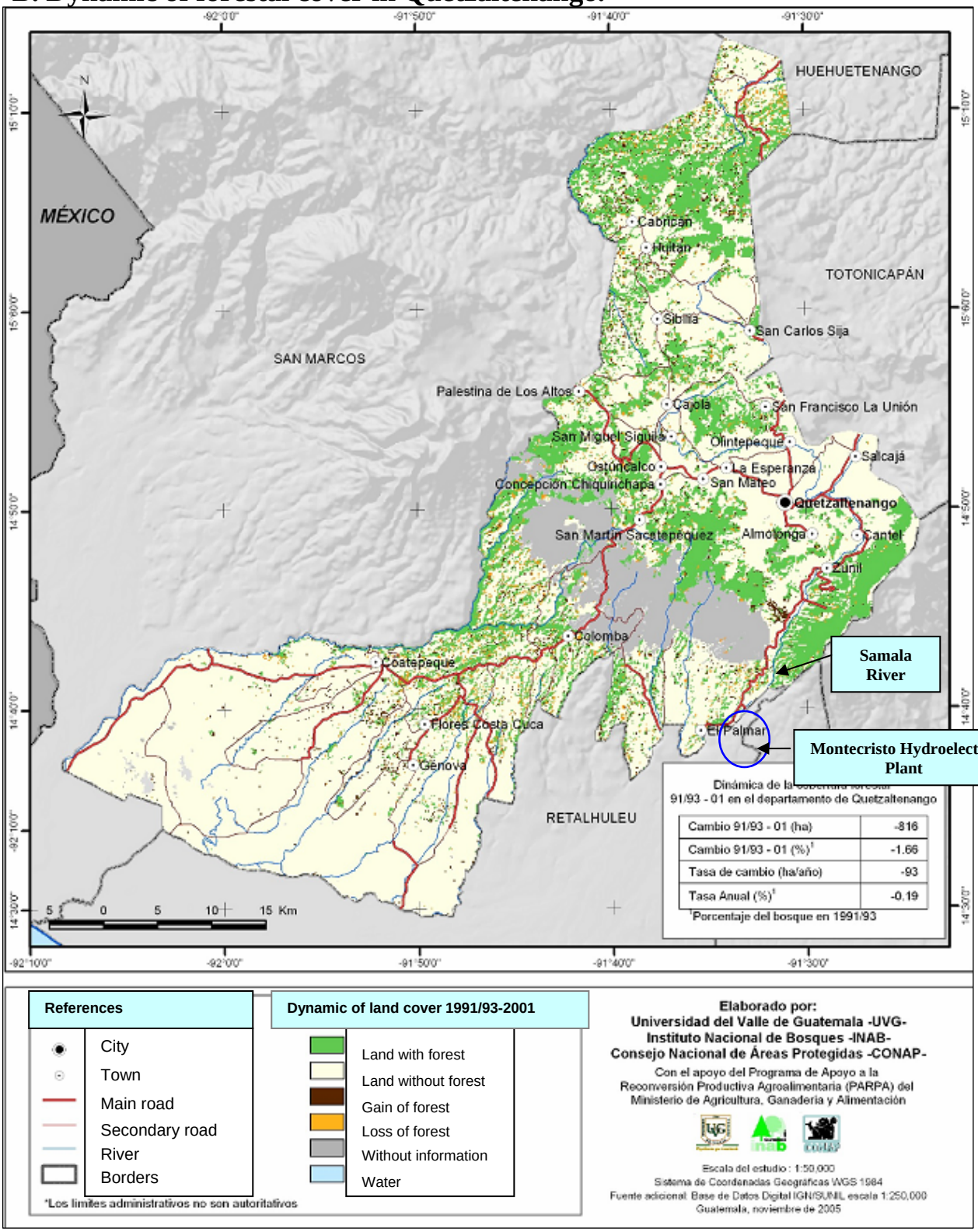
[28] This is an indirect benefit of the project because the Solid Waste Management Plan is in charge of the *Mancomunidad Metropolí de Los Altos* and/or other organizations, but the Solid Waste Management Plan would not be possible without the support of Generadora Montecristo, S.A. This plan will avoid the open landfills and in this way will contribute to improve the quality of life in the communities surrounded the hydroelectric plant.

Annex 5

A. General Arrangedment



B. Dynamic of forestal cover in Quetzaltenango.



Annex 6

Letter of Approval by the Designated National Authority of Guatemala

MINISTERIO DE AMBIENTE Y RECURSOS NATURALES
GUATEMALA, C.A.

MINISTRO

January, 08 2007
Letter of Approval No. AND 009

Generadora Montecristo, S.A.
Diagonal 6, 10-65 Zona 10
Centro Gerencial Las Margaritas
Torre I, Nivel 8 Oficina 801
Ciudad de Guatemala

TEL: (502) 2339-3173
Fax: (502) 2339-3176

Letter of Approval for ***"Montecristo Hydroelectric Project"***

As authorized representative of the Designated National Authority for Guatemala by Governmental Resolution No. 388-2005 and under the Kyoto Protocol, I hereby confirm that:

i. Guatemala has ratified the Kyoto Protocol;
ii. The participation of the Guatemala in the CDM and the project is voluntary;
iii. The Project will assist Guatemala to achieve sustainable development;
iv. The DNA will cooperate with the Project Participants and the CDM Executive Board to facilitate the CDM process and give assistance, where necessary, for the issuance and transfer of Certified Emission Reductions (CERs) to the Project Participants; and

As authorized representative of the Designated National Authority for Guatemala by Governmental Resolution No. 388-2005 and under the Kyoto Protocol, I further authorize:

i. The participation of the "Generadora Montecristo S.A." as Project Participants in the Project; and
ii. The CDM Executive Board to issue and allocate CERs for any verified greenhouse gas reductions from the Project.

As authorized representative of the Designated National Authority for Guatemala by Governmental Resolution No. 388-2005 and under the Kyoto Protocol, I further acknowledge "Montecristo Hydroelectric Project" title and interest to all of the greenhouse gas emission reductions generated by the Project (and any CERs which are created out of the Project).

With this Letter I approve on behalf of Guatemala the "Montecristo Hydroelectric Project" as a Clean Development Mechanism (DM) project for the purpose of Article 12 of the Kyoto Protocol.

Yours sincerely,

MINISTERIO DE AMBIENTE Y RECURSOS NATURALES
MINISTRO

Juan Mario Dary Fuentes
MINISTRO DE AMBIENTE
Y RECURSOS NATURALES

20 Calle 28-58 Zona 10 Edificio MARN

MINISTERIO DE AMBIENTE Y RECURSOS NATURALES
GUATEMALA, C.A.

MINISTRO

Guatemala, 08 de enero de 2007
Carta de Aprobación No. AND 009

Señores
Generadora Montecristo, S.A.
Diagonal 6, 10-65 Zona 10
Centro Gerencial Las Margaritas
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TEL: (502) 2339-3173
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Carta de aprobación:
"Proyecto Hidroeléctrico Montecristo"

Como representante autorizado de la Autoridad Nacional Designada para Guatemala, según Acuerdo Gubernativo No. 388-2005, y bajo el Protocolo de Kyoto, confirmo que:

i. Guatemala ha ratificado el Protocolo de Kyoto.

ii. La participación de Guatemala en el Mecanismo de Desarrollo Limpio (MDL), y el proyecto es voluntaria;
iii. El proyecto asistirá a Guatemala en su esfuerzo por un Desarrollo Sostenible;
iv. La Autoridad Nacional Designada cooperará con los participantes del proyecto y la Junta Ejecutiva del MDL para facilitar el proceso del MDL y proporcionar asistencia cuando sea necesario para la emisión y transferencia de los certificados de reducción de emisiones (CERs), para los participantes del proyecto; y

Como representante autorizado de la Autoridad Nacional Designada para Guatemala, según Acuerdo Gubernativo No. 388-2005, bajo el Protocolo de Kyoto, autorizo:

i. La participación del "Generadora Montecristo S.A." como participante en el proyecto; y
ii. A la Junta Ejecutiva la emisión y adjudicación de CERs para cualquier reducción verificada de gases de efecto invernadero proveniente del proyecto.

Como representante autorizado de la Autoridad Nacional Designada para Guatemala, según Acuerdo Gubernativo No. 388-2005, y bajo el Protocolo de Kyoto, reconozco a los participantes en el proyecto, el derecho, título y beneficios de todas las reducciones de gases de efecto invernadero generados por el "Proyecto Hidroeléctrico Montecristo".

Con esta carta apruebo en nombre de Guatemala el proyecto "Proyecto Hidroeléctrico Montecristo", como un proyecto del Mecanismo de Desarrollo Limpio, para los propósitos del artículo 12 del Protocolo de Kyoto.

Atentamente,

MINISTERIO DE AMBIENTE Y RECURSOS NATURALES
MINISTRO

Juan Mario Dary Fuentes
MINISTRO DE AMBIENTE
Y RECURSOS NATURALES

20 Calle 28-58 Zona 10 Edificio MARN