CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)

GUATEMALA:
LAS VACAS HYDROELECTRIC PROJECT

April 2005

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SECTION A. General description of project activity

A.1 Title of the project activity:

Las Vacas Hydroelectric Project.

A.2. Description of the project activity:

The project activity consists of a hydroelectric plant using wastewater as a main source with a installed capacity of 45 MW located at an reservoir on the Las Vacas river 18 kilometres northeast of Guatemala City. Construction of the first phase was finished on May 2002 with 20 MW, second and third phase of the Project to total 45 MW were available on May 2003.

The Las Vacas hydroelectric plant (Hidroeléctrica Río Las Vacas – HRLV) generates an average of 120 GWh of electricity per year that is sold to COMEGSA, Guatemala's largest power purchaser, under a Power Purchase Agreement (PPA). The project is connected to Guatemala's national electric system, thus displacing electricity on the national grid that is primarily generated by fossil fuel. Electricity produced by the Las Vacas plant is transmitted to the national grid via a 18 km transmission line that connects the plant to the Ciudad Quetzal substation. Because of the plant's proximity to Guatemala City, the major demand centre, the project improves voltage levels and reduces transmission losses by an estimated 0.86 MW[1].

The hydroelectric plant is designed as a Peaking Plant in which water is stored in a reservoir in order to produce electricity during the peak demand hours.

The Las Vacas project contributes to the sustainable development of the region in a number of ways:

- by creating new jobs in the region and thus improving local income levels and living standards;
- injecting new investment in the region that helps improve local infrastructure, assists local businesses, and creates indirect jobs to support the project;.
- reducing dependence on imported fossil fuel;
- reducing local air contaminants generated burning fossil fuels, eg. CO, NOx, SO_2, particulates;
- improving availability, reliability and voltage levels of electricity in the region and reducing transmission losses;
- improving water quality in the Las Vacas river by oxygenating the water, collecting and recycling plastics that gather at the dam, and by dredging and sorting sediments in the river for use in the construction industry;
- improving tree cover and reducing soil degradation in the area by initiating a number of reforestation programs;
- increasing local awareness of environmental issues by initiating an environmental program in the local schools.

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[1] Calculated via a computer simulation of the interconnected national system (NIS) with and without Project generation.

Three important local environmental initiatives are being carried out as part of the Las Vacas project that contribute to the sustainable development of the region. The objectives of these initiatives are to improve water quality in the Las Vacas river basin, recycle waste products that collect in the river, reduce soil degradation and increase forest cover in the local area. The main initiatives are:

- a plastics recycling plant;
- a sludge storage area; and
- reforestation program

Figure 1: **Plastic Recycling Plant**

The **plastics recycling plant** begins with a receiving area where waste floating plastics that end up at the dam are extracted and transported to the processing plant via a conveyer belt. The plastics are ground up into smaller pieces that are processed in an extruder that raises the temperature of the material such that it can be moulded into plastic posts, the final product of the processing plant. These posts are then used locally for fencing.

In august 2004, HRLV was awarded with the "Latin American Environmental Innovation Prize" in the medium sized businesses category, issued by Comisión Centroamericana de Ambiente y Desarrollo (CCAD) in recognition to the plastic recycling plant design and operation (http://www.ccad.ws/noticias/2004/3/premio.htm).

This prize is intented to recognize the best practices and implementation of innovative technologies in the environmental area as well as reducing environmental impacts all through Latin America.

The **sludge storage area**, located near the dam, extracts and sorts solids for use in the local construction industry. Sediment is dredged from the reservoir and then sorted by size into sand and gravel products.

Figure 2: Tree nursery of the Las Vacas project

Within the perimeter of the HRLV property a **reforestation program** has been initiated. Currently, 25.69 hectares of land have been reforested as part of Las Sidras Project; 100 hectares in the Los Morales project, 100 hectares in the Chuapon Project and 52.46 hectares in La Campana project. Five local tree species have been planted through these project, in the following proportions: pine (96.5%), cedar (0.5%), matilisguate (1%), flamboyant (1%), cassia (1%). In addition, a reforestation program has been initiated with the private and public schools in the area with the aim of increasing environmental awareness among the young people of Guatemala.

The next figure shows the location of the main environmental activities.

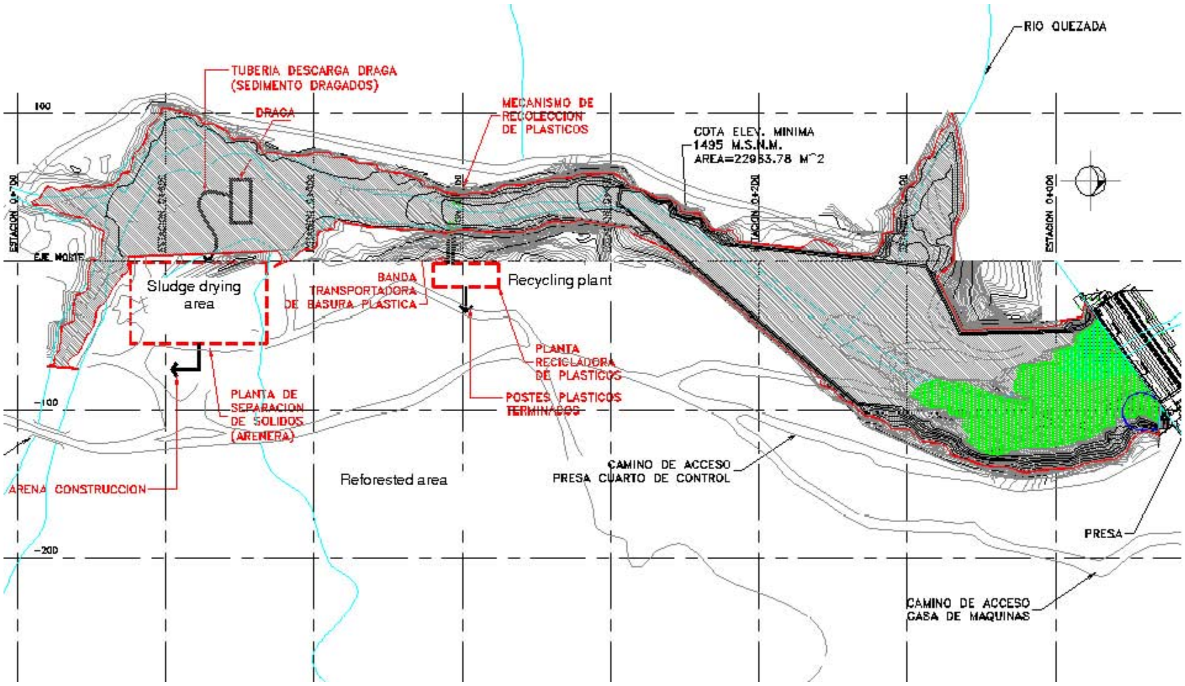

Figure 3: Location of the recycling plant, the sludge storage area and the reforested area.

In addition to these specific initiatives, the construction of the Las Vacas hydroelectric project created 700 temporary jobs, most of which were filled by local residents from San Antonio Las Flores. Being a region with high unemployment, low incomes levels and low education levels, these jobs have had a very positive impact on the local people and local economy, and have also led to the creation of indirect jobs and to increased income for local businesses. Now that the plant is in operation, 76 long-term jobs have been established at the plant, 90% of which are occupied by residents of San Antonio Las Flores. These jobs therefore directly benefit local families, improving income levels and injecting income into the local economy over the life of the project. All positions at the Las Vacas plant include a benefits package for employees that includes medical and life insurance, on-site medical services (such as vaccinations and blood tests), literacy programs, and scholarship programs for the children of employees.

Included as part of the ongoing improvements that HRLV strives to undertake in all of its activities, the Annual Training Plan is designed to reinforce basic principles for the correct operation and maintenance of plant equipments and facilities.

This Plan consists of a number of courses that are coordinated by the Plant Manager that help to advance the training of plant operators and update their knowledge. As a result, HRLV then has on staff technically qualified personnel with decision making capabilities.

The courses last approximately 2 days for each group of operators and are structured in such a way that theory and practice go hand by hand, and that the level is appropriate to the academic level of the group. This way the comprehension and assimilation of the subject matter are optimised. In addition, a document is distributed that summarizes subjects addressed and includes diagrams and technical specifications of the equipments used in the plant which will be of use interest for future reference.
Among the topics that are addressed in this training program are the following:

- Electronic Speed Regulators. Operation and functioning.
- Hydraulic Systems. Operation and functioning.
- Welding and repair of solders. Inspection of solders, type of materials used, Manipulation and application of materials, thermal treatments.
- etc.

In addition to reducing greenhouse gas emissions, the plant reduces emissions of local pollutants (CO, NOx, SO_2, particulates) from power generation by using a clean energy source to displace electricity generated by fossil fuel, and reduces the need for importing fossil fuels.

A.3. Project participants:

- **HIDROELÉCTRICA RÍO LAS VACAS**

A private sector Guatemalan company established to operate the Las Vacas Hydroelectric Plant. HRLV is recognized under Guatemalan legislation as a Company whose main shareholders are:

CEMENTOS PROGRESO

Cementos Progreso is part of a strategic alliance of the multinational group HOLCIM of Switzerland. Its main business activity is the production of industrial cement. Cementos Progreso is one of the two project partners that have developed the HRLV project.

FABRIGAS

Fabrigas, S.A. is a Guatemalan firm whose main area of business is in the production, commercialization, transformation, import and export of industrial and agricultural products. Fabrigas is one of the two project partners that have developed the HRLV project

- **COMEGSA**

Comegsa, a member of the Iberdrola group, has agreed to the purchase 100% of the energy generated by the Las Vacas plant. COMEGSA's primary shareholder is INVELCA (Inversiones Eléctricas Centroamericanas S.A.). COMEGSA legally represents the operation of the Las Vacas Hydroelectric Plant in the Guatemalan Wholesale Market.

IBERDROLA

Iberdrola is a Spanish utility whose primary business is electricity generation and distribution in Spain. Iberdrola's international business focuses on Latin America, primarily Brazil and Mexico, although it owns businesses in Guatemala, Bolivia and Chile. In Guatemala, Iberdrola operates through EEEGSA (Empresa Eléctrica de Guatemala S.A.) in the distribution of electricity, and through INVELCA (Inversiones Eléctricas Centroamericanas S.A.) in other activities of the deregulated electricity market. Iberdrola will share the ownership of the certified emission reductions obtained by the project through its holdings in COMEGSA.

- **KINGDOM OF SPAIN**

The Kingdom of Spain acts as an Annex I party of the Kyoto Protocol thus this project has been presented for its assessment and, if suitable, to issue the corresponding written approval of voluntary participation .

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Guatemala

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

Department of Guatemala

A.4.1.3. City/Town/Community etc:

San Antonio Las Flores, Chinautla

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

The Project is built on the Las Vacas River, 18 kilometers northeast of Guatemala City, the capital and the largest city in the country. The Las Vacas River lies northeast of the Guatemala City valley and passes through various municipalities of the department of Guatemala eventually flowing into the Motagua river basin.

The property on which the plant is built borders on the south with the Villalobos river basin and on the north with the Chinautla River basin. The following map identifies the exact location of the Project.

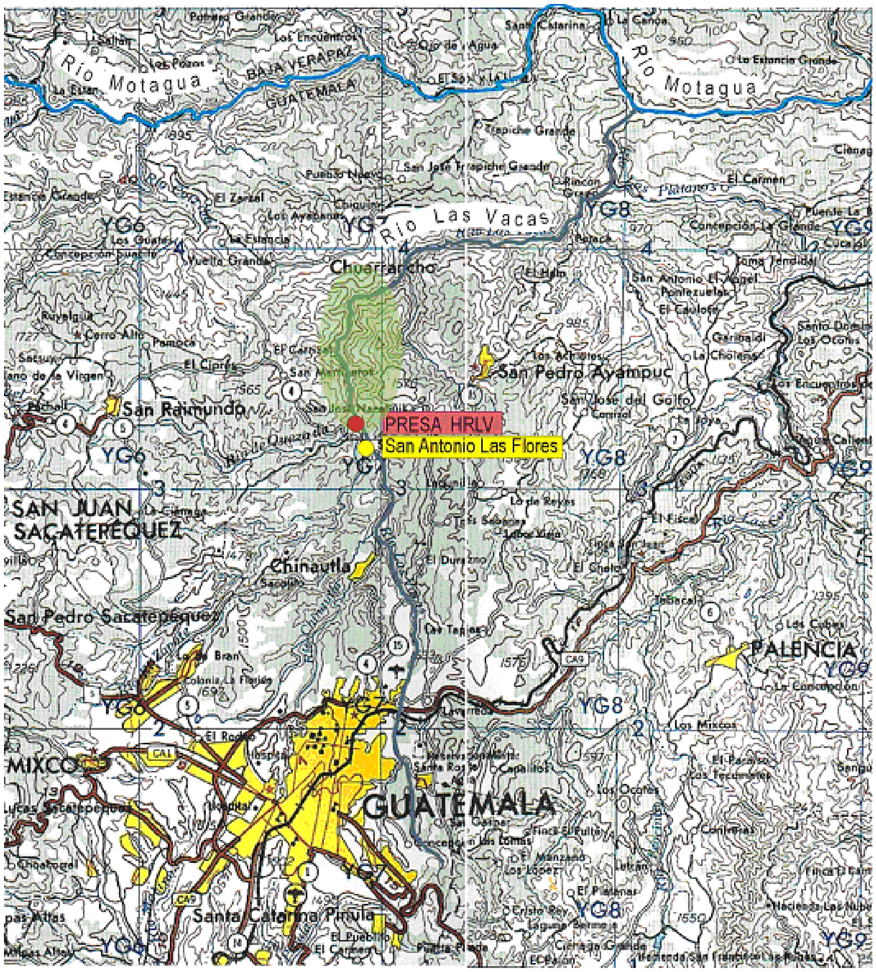

Figure 4: Location of the Project.

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

Small grid-connected renewable electricity generation

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

A concrete gravity dam was built for the project with a length of 136 metres which allows for a freefall head of 17 m with a rated capacity flow of 395 m^3 per second. The structure allows for a dynamic volume of water of 258,969.78m^3, which is used to generate electricity in peak hours.

The dam features a structure known as an antechamber, where a series of filtering bars have been installed to prevent the entry of garbage from the river. The antechamber connects with the tunnel through which the water flows to the high-pressure shafts.

Figure 5: Dredging System

A key feature of the dam is its dredging system that removes solid wastes that accumulate at the bottom of the river and deposits them to the sorting area. The technology used for the dredge is an Ellicot 370, an electric dredge whose source of power is electricity from the hydro plant. In all, six different mechanical systems are in place at the dam for filtering and redirecting wastes from the reservoir including non-organic wastes such as plastics and rubber.

Figure 6: Plastic Reservoir and Conveyor Belt

The intake tunnel is built of reinforced concrete with a length of 4,530 metres and an internal diameter of 2.65 metres. A steel door is installed at the end of the tunnel for emergency shutdowns and following this steel door the water flow is divided into two parallel steel penstocks 750 metres long with diameters varying from 76 inch to 120 inches. These high pressure shafts carry the water to the powerhouse in which five Pelton turbines are installed, four horizontal axis and one vertical axis, through which the water flows to generate electricity with a total maximum capacity of 45 MW. The water is then redirected through exit channels back to the Las Vacas River.

The 45 MW output is achieved through three generator sets, two of 20 MW, and one 5 MW. The 5 MW generator is set up so that it will power the auxiliary power systems of the entire project. These auxiliary systems include all equipment that is needed to start up and run the power generating units. Under normal operating conditions, the 5 MW generator operates continuously (depending on the available flow of water from Río Las Vacas) and all auxiliary systems are powered up with this electricity. This is achieved through a 4,160 volt power line that runs through the entire property of HRLV, and is used to power the plastics recycling plant, the dredge, all auxiliary equipment from the dam control house, and the housing facilities. All auxiliary systems for these subsystems are also powered by this line. All the facilities, including the plastics recycling plant and the dredge use power that comes from the 4,160 volt auxiliary line.

In the event of an electrical black out, HRLV must be ready to start up without using any external source of supply. For this purpose HRLV has a battery source capable of doing such thing. In order to back up the battery rack, HRLV has also an electrical generator set powered by a diesel engine. This gen set is capable of delivering the necessary power to start up all auxiliary equipment, and consists of a diesel gen set and diesel oil engine that are used only in the unlike event of black out. Note that because the potential use of these facilities is highly unlikely and their potential emissions minimal and relatively insignificant, so they are not included as project emissions.

A substation built next to the powerhouse converts the output voltage level from 13.8 a 69.0 kV, and the electricity is then transmitted 18 km via a transmission line to the Ciudad Quetzal substation where it is delivered to the national grid.

The following picture shows a general diagram of the plant:

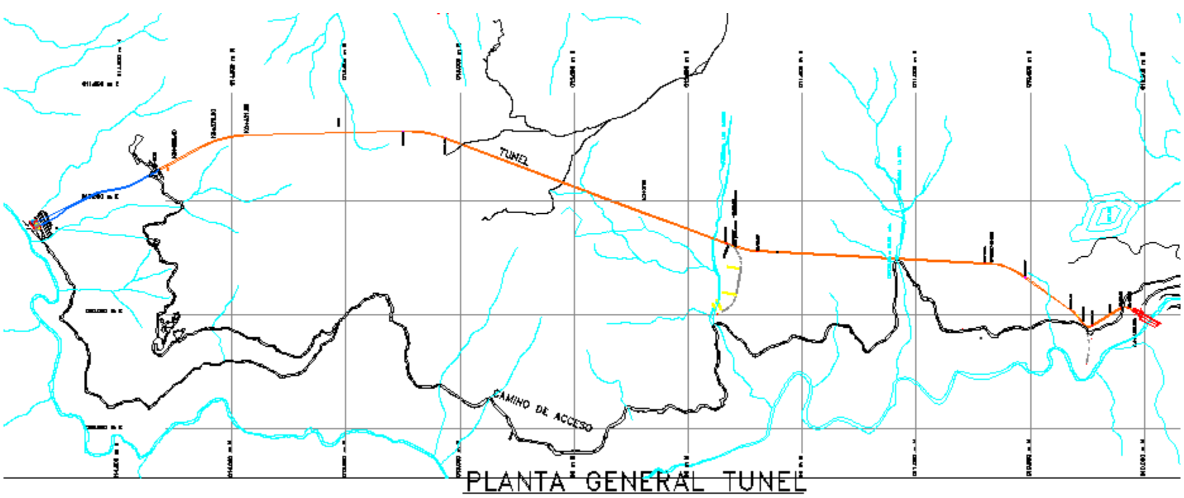

Figure 7: Diagram of the plant.

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

(a) Reductions of emissions through displaced fossil fuel generation: The Project employs a non-GHG emitting technology (hydropower). In the absence of the Las Vacas Project, the same level of demand for electricity would be met by fossil fuel thermal power generation with associated GHG emissions of an estimated 0.753 tCO_2/MWh. Due to their high fuel and operating costs, thermal plants, especially older less efficient ones, are generally dispatched as marginal producers of electricity in the Guatemalan system. Their output therefore is partly replaced by the Project activity. The average annual emission reductions to be achieved by the Project is 90,363 tonnes of CO_2e/year.

(b) Reductions of transmission losses Because the plant is located only 18 kilometers from Guatemala City where the highest electricity demand is concentrated, the project also reduces transmission losses by 0.86 MW. Note that emissions reduced because of these decrease in transmission losses are not included in the calculations of project emissions reductions in order that the calculations are conservative.

(c) National and sectoral circumstances: The 1996 General Electricity Law provided for decentralization of the Guatemalan electricity sector, and stipulated that all new electricity generation would be undertaken by private investors. As a consequence, no national power expansion plan exist, although a list of prospective power projects is available in the Plan Indicativo del Subsector Electrico[2]. Dispatch in the Guatemalan National Interconnected System (NIS) is by strict economic order, considering the need to supply demand, the opportunity cost of water, and the operational cost of the thermal units.

(d) Baseline scenario: Included in section B.2

(e) Additionality: Included in section B.3

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

It is estimated the project will reduce emissions by 1.897.620 tCO_2 during the chosen crediting period (3 crediting periods of 7 years).

A.4.5. Public funding of the project activity:

No public funding has been provided for this Project.

SECTION B. Application of a baseline methodology

[2]http://www.mem.gob.gt/documentos/Plan%20Indicativo%20del%20Subsector%20El%C3%A9ctrico%202020 01.pdf

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

Approved baseline methodology AM0005: Baseline methodology (barrier analysis, baseline scenario development and baseline emission rate, using combined margin) for small grid-connected zero-emissions renewable electricity generation.

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

Methodology AM0005 is applicable to grid-connected zero-emission renewable power generation project activities under the following conditions:

- *There is sufficient publicly available information to document in a transparent and conservative manner the nature of the prohibitive barriers to which the proposed project activity is subject, and the nature of the means by which its registration as a CDM activity would enable the project to overcome those barriers (and thus be successfully undertaken).*

  There is sufficient publicly available information to document in a transparent and conservative manner the nature of the prohibitive barriers faced by the proposed project activity. The sources of information are the Guatemala Wholesale Market Administrator (Administrador del Mercado Mayorista (AMM)), COMEGSA (Guatemala's largest commercialization company), the Ministry of Environment and Natural Resources (Ministerio de Medio Ambiente y Recursos Naturales), the Ministry of Energy and Mines (Ministerio de Energía y Minas) and Las Vacas project documents.

  The power purchase agreement between the seller and COMEGSA includes an article that specifically refers to the allocation of CERs from the CDM once the Kyoto Protocol enters into force.[3]

- *There is sufficient publicly available information to document in a transparent and conservative manner that the proposed project is occurring in a sector and investment context that does not feature the type of proposed activity as a common practice.*

  In 2003, approximately 70% of Guatemala's electricity was produced by thermal plants which indicates that hydroelectric generation is not the norm in this country. Furthermore, few or none of the country's hydro plants have had to face the technical difficulties that were faced by HRLV brought about by the extremely high level of pollution in the Rio Las Vacas.

- *The project will provide electricity to the electric grid, displacing power that would otherwise be provided by other generating sources through the operation and expansion of the electric sector. The geographic and system boundaries for the relevant electricity grid can be clearly identified and information on the characteristics of the grid is available.*

[3] A copy of this contract, dated 11th July 2001 is available for review as required.

Las Vacas supplies electricity to Guatemala's national grid. The system boundaries are the national grid, taking electricity exports into account. Source of data on the grid is the Guatemalan Wholesale Market Administrator (Administrador del Mercado Mayorista (AMM)).

- *The project is in an electric sector that is not dominated by generating sources with zero- or low-operating costs such as hydro, geothermal, wind, solar, nuclear, and low-cost biomass, and this fuel mix is expected to persist for the duration of the crediting period.*

  The grid is not dominated by zero or low-operating cost generating sources, and this fuel mix is expected to persist for the duration of the crediting period. For the year 2003 non-thermal generating sources only represented approximately 30% of electricity generation of the grid (source: AMM 2003). This percentage is expected to decrease as more thermal plants are built.

- *Electricity exports are included in electricity generation data used for calculating and monitoring the baseline emission rate to avoid potential leakage.*

  Electricity exports are included in the calculation of the baseline.

- *Applies only to small electricity capacity additions, i.e. less than or equal to 60 MW and using a 50:50 default weighting of the build and operating margins.*

  The Las Vacas project has a maximum capacity of 45 MW and thus satisfies this condition. A 50:50 weighting of the build and operating margins is used to determine the baseline.

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

Project Emissions

Since the project consist of a renewable power generation project activity, it does not generate any direct GHG emissions. The dredging system and recycling plant that are part of the project use electricity from the hydro plant as their only energy source. Any emissions from the reforestation program (i.e. transportation of seedlings and young plants) are minimal and considered to be insignificant. Thus no formula are provided for calculating project emissions.
As mentioned above, emissions from the battery rack backup system are not considered due to the unlikely use of this equipment (only intended to work under a blackout situation)

Project Emissions = Zero

Leakage

Methodology AM0005 specifies three main sources of potential leakage for renewable energy projects. These are addressed below:

i) Plant Construction

Some indirect emissions would have been generated during the construction of the project, however since these would have been less than or equal to those that would have been emitted during the construction of the plants (thermal or hydro) in the baseline, they are not included in these calculations.

ii) Land Inundation

Although many hydro projects lead to increased methane emissions from the decomposition of biomass on flooded lands, Las Vacas does not increase methane emissions because of the sandy soil of its shorelines, which are not suitable for the development of vegetation. Consequently, when the river rises it does not flood any vegetated areas, where anaerobic decomposition of organic matter normally takes place. Furthermore, the dam constructed for the project is a daily-regulated dam such that water is not stored on a long-term basis and therefore no increase in methane emissions is to be expected. In addition the project developers have taken steps that favour the oxygenation of the water, for example, by removing organic and inorganic matter from the river and by facilitating the water movement, thus reducing methane emissions.

iii) Fuel Handling

Since the project involves no fuel combustion, there is no leakage due to fuel handling (extraction, processing or transport)

Note: The project does not claim any credit for reducing these emissions below the level of the baseline scenario. Emissions associated with electricity import/export are dealt with by adjusting the baseline emission factor (as specified in AM0005).

$$Leakage = Zero$$

Project Activity Emissions

Total emissions for the project activity are assumed to be zero.

$$Project\ Activity\ Emissions = Zero$$

In the event of an electrical black out, HRLV must be ready to start up without using any external source of supply. For this purpose HRLV has a battery source capable of doing such thing. In order to back up the battery rack, HRLV has also an electrical generator set powered by a diesel engine. This gen set is capable of delivering the necessary power to start up all auxiliary equipment, and consists of a diesel gen set and diesel oil engine that are used only in the unlike event of black out. Note that because the potential use of these facilities is highly unlikely and their potential emissions minimal and relatively insignificant, so they are not included as project emissions.

Baseline Emissions

The baseline for the Las Vacas Project is determined following the method and formulae given in the approved methodology AM0005. The baseline methodology calculates an emission factor for Guatemala's national grid using a weighted average of the operating margin emission factor for the grid (thus reflecting emissions that the plant will displace on the margin) and the build margin emission factor (reflecting the impact the plant will have on the construction of new plants). Baseline emissions will be recalculated on an annual basis using actual monitored data, as is described in the monitoring plan.

Any potential risks to the baseline, for example, the shutdown of one or more power plants, or the increased use of lower carbon-intensity fuels due to changes in fuel prices, future interconnections among Central American countries, rises in imports/exports, etc., are minimized or eliminated, through the use of *ex post* monitoring of baseline data as well as conservative assumptions for the determination of emissions factors. In other words, any unforeseen changes in the baseline scenario will be accommodated for under this baseline methodology.

The estimation of the baseline emissions can be summarized as follows:

$$Annual\ Baseline\ Emissions = Annual\ Electricity\ Generation\ of\ the\ Project\ (GWh) \times$$
$$Emission\ Factor\ of\ the\ Grid\ (tCO_2\ /\ GWh)$$

where:

- *Annual Electricity Generation of the Project* is the amount of electricity delivered by the Las Vacas project to the grid, in GWh. This is currently estimated to be 120 GWh but emissions reductions will be calculated based on the actual generation of electricity by the plant each year.

- *Emission Factor of the Grid (*EF_g) is calculated using the Combined Margin method prescribed in methodology AM0005, using a 50/50 weighting factor, and is summarized below:

- $Emission\ Factor\ of\ the\ Grid = Combined\ Margin + Import\ Adjustement$

  and the

  $$Combined\ Margin = \frac{Operating\ Margin + Build\ Margin}{2}$$

- *Operating Margin* = Weighted Average of all generating sources on the grid excluding zero-emission, low-cost sources such as hydro and geothermal.

- The operating margin has been calculated for Guatemala's grid using 2003 generation data provided by AMM and IPCC default emission coefficients for the fuels used at each plant. As neither the AMM nor the individual plants make publicly available plant efficiency factors or fuel use it was necessary to use average plant efficiency factors that have been published by the IEA for non-Annex 1 countries[4] are used to calculate total fuel use for each technology and fuel used on the grid. These efficiency factors

[4] These IEA efficiency factors are obtained from the IEA publication: *An Initial View on Methodologies for Emissions Baselines: Electricity Generation Case Studies,* Martina Bosi, June 2000. This document provides efficiency factors for three non-annex 1 countries, Brasil, Morroco and India. The factors given for Brazil and Morocco are identical and those for India only slightly lower, and therefore it was assumed that these would be applicable to many non-annex 1 countries. To be conservative the factors given for Brazil and Morroco (ie. the higher values) were used in the baseline calculations. These values have been confirmed as being appropriate for Guatemala by several plant operators who sell electricity to COMEGSA.

have been confirmed to be appropriate by several power plant operators in Guatemala who sell electricity to COMEGSA. Note that it is expected that in future years individual plant data will be available and therefore during project monitoring individual plant data will be used.

Table 1 lists the plants on Guatemala's grid that are used to calculate the operating margin, along with technology, fuel type and generation for 2003. Table 2 gives the details of the operating margin calculations.

Name	Technology	Fuel Type	GWh
San José	Steam Turbine	Coal	892,06
Esc. Vapor 2	Steam Turbine	Bunker	0,08
Lag.Vapor No. 3	Steam Turbine	Bunker	2,81
Lag. Vapor No. 4	Steam Turbine	Bunker	0,01
Arizona	IC Motor	Bunker	561,40
La Esperanza	IC Motor	Bunker	739,98
PQPLLC	IC Motor	Bunker	444,78
Las Palmas 1	IC Motor	Bunker	104,20
Las Palmas 2	IC Motor	Bunker	100,44
Las Palmas 3	IC Motor	Bunker	113,25
Las Palmas 4	IC Motor	Bunker	108,69
Las Palmas 5	IC Motor	Bunker	34,33
Genor	IC Motor	Bunker	156,33
Sidegua	IC Motor	Bunker	86,93
Lagotex	IC Motor	Bunker	96,61
Amatex	IC Motor	Bunker	20,25
Electrogeneración	IC Motor	Bunker	3,89
Generadora Progreso	IC Motor	Bunker	34,11
Tampa	Gas Turbine	Diesel	15,25
Lag.Gas No. 1	Gas Turbine	Diesel	2,72
Lag.Gas No. 2	Gas Turbine	Diesel	22,52
Lag.Gas No. 4	Gas Turbine	Diesel	16,03
GGG Stewart + Stevenson	Gas Turbine	Diesel	12,85
Esc. Gas 4	Gas Turbine	Diesel	0,00
Esc. Gas 2	Gas Turbine	Diesel	0,00
Esc. Gas 3	Gas Turbine	Diesel	8,99
Esc. Gas 5	Gas Turbine	Diesel	6,41

Table 1: Plants Included in the Calculation of the Operating Margin
(Sources: "Despacho de Carga Ejecutado del Sistema Nacional Interconectado, año 2003, AMM; IPCC Inventory Workbook, 1996)

Fuel Type	Anual Generation [GWh/year]	Average Plant Efficiency [%]	Fuel Consumption [TJ/year]	Carbon Content [tC/TJ]	Emissions [tCO_2/year]	CEF [tCO_2/MWh]
Bunker	2,608.08	33.00	28,451.76	21.10	2,201,217.98	-
Diesel	84.78	35.00	872.03	20.20	64,588.55	-
Coal	892.1	35.00	9,175.51	25.80	868,003.49	-
TOTAL	3,584.92	-	-	-	3,133,810.03	**0.874**

Table 2: Calculation of the Operating Margin
(Sources: "Despacho de Carga Ejecutado del Sistema Nacional Interconectado", año 2003, AMM; IPCC Inventory Workbook, 1996)

$$\textit{Operating Margin} = 0.874\ tCO_2/MWh$$

The build margin is approximated by a mix of plants that reasonably represents recent trends in electric sector expansion. The methodology specifies two options for the build margin mix: the five power plants most recently commissioned or the most recently built 20% of the system generating sources. Since the first option leads to a mix of plants that only represents 9.5% of the total generating capacity, the second option of the most recently built 20% is chosen here for the build margin calculation.

The build margin emissions (BM) rate is approximated as the weighted average emission factor for the identified mix of recent plants. Table 3 shows the plants included in the build margin for Guatemala's grid. The electrical generation of La Esperanza is only considered until the 20% of the annual generation of the country is reached.

Name	Technology	Fuel Type	Date of Installation	GWh	Accumulate	%of Capacity
El Canada	Hydro	RE	nov-03	13.02	13.02	0.2%
Electrogeneración	IC Motor	Bunker	nov-03	3.89	16.91	0.3%
Amatex	IC Motor	Bunker	2003	20.25	37.16	0.6%
Arizona	IC Motor	Bunker	apr-03	561.40	598.56	9.1%
Calderas	Geothermal	RE	dec-02	32.69	631.25	9.6%
Matanzas+ San Isidro	Hydro	RE	jul-02	62.40	693.65	10.6%
Magdalena	Cogeneration	Biomass	dec-01	64.51	758.16	11.6%
Tulula	Cogeneration	Biomass	jan-01	9.56	767.72	11.7%
La Esperanza	IC Motor	Bunker	may-00	739.98	1,507.70	23.0%

Table 3: Plants Included in the Calculation of the Build Margin (Source: "Capacidad Instalada en el Sistema Electrico Nacional", Nov-2003, AMM)

Type	Annual Generation [GWh/year]	Average Plant Efficiency [%]	Fuel Consumption [TJ/year]	Carbon Content [tC/TJ]	Emissions [tCO_2/year]	CEF [tCO_2/MWh]
Bunker	1,229.56	33.00	13,413.39	21.10	1,037,749.39	-
Biomass	74.07	-	-	-	-	-
RE	108.11	-	-	-	-	-
TOTAL	1,411.74	-	-	-	1,037,749.39	**0.735**

Table 4: Calculation of the Build Margin
(Source: "Despacho de Carga Ejecutado del Sistema Nacional Interconectado", año 2003, AMM; IPCC Inventory Workbook, 1996)

$$\textit{Build Margin} = 0.735\ tCO_2/MWh$$

Using a default weighting of 50:50, the combined margin (excluding import/export adjustment) is therefore calculated to be:

$$\textit{Combined Margin} = \frac{0.874 + 0.735}{2} = 0.805\ tCO_2/MWh$$

Electricity Imports/Exports: AM0005 specifies that if the grid imports or exports electricity from/to other grids, a correction is needed unless the correction is negligible. The following formula is provided for the correction:

$$EF_y \rightarrow EF_y + \frac{EL^{in}}{TGEN_y} \times EF_y^{in} - \frac{EL^{out}}{TGEN_y} \times EF_y^{out}$$

where EL^{in} and EL^{out} are electricity coming in and going out of the grid (and EF their associate emission factors); and TGENy is the electricity generated in the grid. The arrow means replacement of the EFy by the right-hand-side of the above formula.

In Table 6, electricity imports are shown to be insignificant for Guatemala, as only 23.52 GWh was imported in 2003, out of a total production 6,561 GWh. The effect on the calculation of the emission factor for Guatemala is less than 0.5% and therefore is not included in the final calculations. (See table 6 for analysis of impact of electricity imports).

Exports from the Guatemalan grid in 2003 were 420.75 GWh. This leakage factor is taken into account according to the formula provided, using a factor for EFout that is equivalent to the grid's combined factor, ie. 0.805 tCO_2/MWh:

The following tables provide the details of the calculation of the emission factor adjustment for the grid's exports and imports.

Input data	Value	Unit
Combined factor	0.805	tCO_2/MWh
EL^{in}	23.52	GWh
TGEN	6,560.9	GWh
EF^{in}	unknown	tCO_2/MWh
EL^{out}	420.75	GWh
EF^{out}	0.805	tCO_2/MWh

Table 5: Input data to calculate the emission factor for Guatemala
(Source: "Despacho de Carga Ejecutado del Sistema Nacional Interconectado", año 2003,AMM)

Impact of Imports	Value	Unit
Using a low EF^{in} (0,001)	0.805	tCO_2/MWh
Using a high EF^{in} (0,999)	0.808	tCO_2/MWh
Max range impact on Combined factor*	0.004	tCO_2/MWh
	0.44%	%

*Thus imports are negligible

Table 6: Adjustment factors for imports and exports
(Source: own calculations)

Thus, applying the adjustment formula:

$$\textbf{\textit{Grid Emission Factor}} = \textbf{\textit{Combined Margin}} + \textbf{\textit{Import Adjustement - Export Adjustement}} =$$

$$0.805 - \frac{420.75}{6{,}560.9} \times 0.805 = 0.753\, tCO_2 \,/\, MWh$$

Therefore,

$$\textit{Annual Baseline Emission} = 120{,}000\ MWh \times 0.753\ tCO_2\ /\ MWh = 90{,}363\ tCO_2$$

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

Additionality: The additionality of the project is assessed using the stepwise procedure described in methodology AM0005:

Step 1: Analyze prohibitive barriers to the proposed project

Step 1-a Identify the relevant barriers to the proposed project activity.

Technological Barriers:

Las Vacas hydroelectric project is not based on conventional fossil fuel technology, which immediately raises the level of risk as perceived by prospective financers and consumers. Guatemala's electricity sector does not include a substantial amount of renewable sources.

The construction of the Las Vacas hydroelectric plant faced many additional technological difficulties, mainly derived from the highly polluted water.

For several decades the Las Vacas river has been extremely polluted with high levels of micro-organisms, faecal matter, chemical compounds, plastics, industrial waste, etc. Approximately 60% to 70% of wastewater from Guatemala City ends up in the Las Vacas River, and all of it untreated. Raw sewage from surrounding municipalities and industrial sites is also dumped into this river. Decades of dumping untreated waste water into this river has left it seriously polluted and unfit for domestic, agricultural or even recreational use.

The treatment of solid wastes has not been a priority in the last years, even though it is well-known that polluted water is an important health and environmental hazard. No long-term strategy exists for improving water quality or for preventative health, and there is a lack of education and capacity-building in these areas. Water quality in the river is tested and analysed by government bodies, but no further steps are taken, likely due to a lack of resources.

Any hydro project that plans to use highly-polluted water as its energy source has to take additional measures to ensure that substances in the water do not jam, damage or corrode their facilities and equipment. A polluted water resource increases the difficulty of operation and maintenance of a project and significantly increases construction and operating costs.

In spite of these challenges, the Las Vacas Project has invested in technology that prevents waste from entering its dam, and instead of simply extracting the waste and dumping it further downstream, it actually collects the majority of wastes and either processes them (plastics, sediments etc.) or disposes of them in an appropriate designated area, thus preventing these waste products from entering the Motagua river. In addition, the water used in the project is oxygenated after it has passed through the project's turbines, which finally improves Las Vacas river water quality. These are unusual steps for a private enterprise to take in a country such as Guatemala. The measures taken on by the Las Vacas project developers led to significantly increased project costs as they necessitated the acquisition of additional property, the construction of new installations and the purchase of specialized waste treatment equipment. The waste treatment activities also increased the operating and maintenance costs of the plant. The economic value of the CER's that the project is expected to generate would help to mitigate the additional costs that have been taken on by the promoters of the Las Vacas for retaining, sorting and processing solid wastes.

Investment Barriers

Guatemala's domestic financial market has for a number of years been characterized by high interest rates and short loan terms[5]. Difficulty in obtaining domestic financing at reasonable rates has forced project developers to look toward international financial markets, which offer more attractive rates and longer payback terms, but are also more difficult to access. International lenders generally only finance projects that have reliable, creditworthy and firm sources of annual revenue with the necessary guarantees. In order to obtain funding from any financial institution, the company must be profitable and have a growth potential that requires medium/long term funding in order to materialize.

The Las Vacas plant faced numerous financial problems before getting off the ground. In an initial attempt order to obtain funding, HRLV turned to the Corporación Interamericana de Inversiones (CII). In the case of the CII, the profitability and financial viability of a project are essential prerequisites demanded even before they consider the possibility of financing a project. Hidroeléctrica Río Las Vacas (HRLV) presented all the documents required by the CII as well as a financial model that included the benefits that would be obtained from the sale of CERs generated by the Project[6]. The value of the CER's increased the rate of return on the Project from 9.84% to 10.76%. It is important to point out that the Republic of Guatemala issues bonds with a 8.125% rate of return[7].

In May 2000, HRLV received the approval for the project financing, which would have been difficult to obtain without the inclusion of the CER's as an annual revenue stream. The disbursement of the approved quantity was foreseen in the course of a few weeks.

Although the project had indeed been granted a provisional authorization, CII did not made the foreseen disbursements by the expected dates, due to the lack of a definitive authorization for the utilization of public goods (which was finally issued on May 2001 AG-076-2001). Nevertheless commissions accrued from the approval of the loan were paid by HRLV, up to overcoming 600,000 US$ in July 2001. This amount was never refunded.

At this moment technical difficulties were encountered in the construction of the tunnel which led to significant increases in the investment costs.

The important delay in the disbursement of CII funding together with the increase in the project construction costs made the project economically non-viable, forcing the promoters to look for funding from other sources.

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[5] World Trade Organization: *Trade Policy Review, 2002*

[6] Financial model of the Project.

[7] See http://www.banguat.gob.gt/publica/prensa/bgpre010.pdf

After several further attempts to obtain financing, HRLV turned to the Banco Agrícola de El Salvador with the same financial model mentioned above. Following a new financial analysis the Banco Agrícola de El Salvador financed the construction of the plant.

The Power Purchase Agreement (PPA) established between Comegsa and HRLV was included as a guarantee to the project in the funding contract with the Banco Agrícola de El Salvador and constituted a fundamental support to the incomes of the project as considered by the bank. This agreement included in the 21st clause the possibility to obtain CERs.

Comegsa is the leading company in electricity commercialization in the deregulated Central American market and the first one to commercialize renewable energy in Guatemalan market. In addition, it is a company committed to the development of renewable energy and sustainable development policies, which is supported by the fact that nearly 60% of its suppliers produce energy generated from renewable sources. This is the reason why Comegsa was highly interested in the Las Vacas project despite its low profitability.

The implementation of the environmental initiatives that are integral to this project are in part supported by the anticipated CDM revenue. According to the socioeconomic and environmental guidelines of the Project, parallel programs are to be developed to support general education needs, improve local infrastructure, and promote environmental education in the local area[8]. Additionally, the company has developed a recycling plant, a sediment processing plant and reforestation programs that will recuperate a large area in the sustainable buffer zone. These activities are important to the project's success, and would be very difficult to support without CDM revenues, as traditional banks do not generally support such initiatives.

Step 1-b Explain how only the approval and registration of the proposed project as a CDM activity would enable the project to overcome the identified barriers and thus be undertaken. This step helps to prove that the barriers identified in [Step 1-a] are indeed prohibitive barriers. If the proposed project were able to overcome the identified barriers without registration as a CDM project, then the barriers would be surmountable, and they would not be sufficient proof of additionality.

The revenues from the sale of CERs from the CDM have been considered as an integral part of the financial package of the Las Vacas Project. Indeed, the business plans given to and analyzed by the Banks included revenues from CERs as part of the projected cash flows. When development of the Las Vacas project began, the project developers contacted the director of the OGIC (Oficina Guatemalteca de Implementación Conjunta) regarding their intent to develop the project as a CDM project and include CERs as a component of the financial structure and an important source of revenue. The developers made inquiries to OGIC as to the requirements of a CDM project and how to ensure that their project was eligible. Several letters are available to document these early communications[9]. From the early stages the HRLV project was developed as a CDM[10] project and

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[8] This information is contained in the Environmental Impact Assessments of the Project.

[9] Communication with Las Vacas project developers.

[10] There is publicly available information to document that Las Vacas project was developed as a CDM project from the early stages on the web site of Corporación Interamericana de Inversiones published the 18th October 1.999. http://www.iadb.org/iic/espanol/projects/1999_gu1040a_environ.htm

has counted on the revenues from the CER's to make the project viable. In addition, the power purchase agreement between the seller and COMEGSA was modified in 2001 to include an article that specifically refers to the allocation of CERs from the CDM once the Kyoto Protocol enters into force.

The implementation of environmental projects parallel to the hydro plant, such as the plastics recycling plant, the local reforestation program and the sediment processing plant were initiated because the project was developed as a CDM project and the project developers wanted to be sure that the project met all objectives of a CDM project, ie. that it not only reduces greenhouse gases but also contributes to the sustainable development of the region and of the country. Once CER revenues have started to accrue, these initiatives will be expanded.

As well, the problems and delays encountered during the construction of the tunnel significantly diminished the viability of the Project, and its planned registration as a CDM Project was taken into account by the Banco Agricola de El Salvador. The intended registration of the Las Vacas project as a CDM activity and the PPA guaranteed by Comegsa has helped to mitigate risk and establish the credibility and creditworthiness of the developers in the view of prospective financers that have been approached, many of whom were immediately deterred by the perceived level of risk. Perceived risks primarily include the technological risk of hydro plants in general, and in this specific case the additional challenge of the contaminated water, and financial risks due to the setbacks in the construction phase and the risks associated with investments in Guatemala. The inclusion of revenue from emissions reductions from the registration of the project as a CDM project activity and the support given by a PPA where carbon credits are incorporated was needed to make these risks and financial barriers surmountable.

Step 2 Analyse other activities similar to the proposed project

In order to test whether a credible claim can be made that there are real prohibitive barriers to private development of a project such as Las Vacas Project, it is necessary to investigate the current state of private sector hydroelectric activity in Guatemala. Despite the barriers to hydropower in the country four hydropower plants were developed in Guatemala in the ten years previous to the implementation of Las Vacas in May 2002 (see table 6).

Name of Hydro Plant	Installed Capacity (MW)	Year Online
Rio Bobos	10	1995
Secacao	15.5	1998
Pasabien	12	2000
Poza Verde	8.1	2000
Las Vacas	45	2002

Table 7: Hydropower plants developed in the decade previous to Las Vacas construction (Source: "Capacidad Instalada en el Sistema Electrico Nacional", Nov-2003, AMM)[11]

[11] There is a mistake in the table "Capacidad Instalada en el Sistema Electrico Nacional," of the AMM (included in Annex 3) in the commercial operation dates of Pasabien and Poza Verde plants. The correct dates are given in the "Plan Indicativo del Subsector Electrico of the Ministerio de Energia y Minas". http://www.mem.gob.gt/documentos/Plan%20Indicativo%20del%20Subsector%20El%C3%A9ctrico%202001.pdf

From the above table it can be seen that in the 10 years previous to the start-up date of Las Vacas only four hydro-electric projects were developed in Guatemala. The total installed capacity of these four projects is only 45.6 MW, which is practically the same as the installed capacity of Las Vacas alone. Therefore, it is fairly reasonable to conclude that given the number and the size of hydroelectric plants developed in the previous decade that the Las Vacas project cannot be considered Business-as-Usual in Guatemala. Rather, the majority of power plants that have been built in Guatemala in recent years use bunker fuel and internal combustion technology. (See Table 3). Note that Las Vacas project faced unusual technical difficulties brought about by the use of a severely contaminated water resource (Las Vacas river receives between 60-70% of the untreated waste water of Guatemala city).

Furthermore the parallel sustainable development initiatives that are being carried out as part of the Las Vacas project such as the reforestation programs, recycling plant, and sludge drying and stabilisation can also not be considered to be of common practice in this country or region, as discussed previously.

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

As is specified in AM0005 the project boundary is defined as the project site (the Las Vacas project site, including the dam, tunnel, the penstocks, equipment house and generator) and the electricity grid system connected to it (Guatemala's national electrical grid, the NIS). The emissions associated with electricity import/export are dealt with by adjusting the calculation of the emissions baseline as outlined above.

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

The baseline study was completed on the 31st of March, 2005 and was carried out by:

Garrigues Medio Ambiente Consultora Técnica y de Gestión Integrada del Medio Ambiente,
José Abascal 45,
28015 Madrid
SPAIN

And,

Solea Consulting
Santiago, 15, 2D
18009 Granada,
SPAIN

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

The starting date of the project is the 18th April 2000 which is the date that project construction began[12].

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

25 years.

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

C.2.1. Renewable crediting period

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

The starting date of the first crediting period is 01/01/2004

C.2.1.2. Length of the first crediting period:

The project will select a renewable crediting period of 7 years .

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

N/A

C.2.2.2. Length:

N/A

SECTION D. Application of a monitoring methodology and plan

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

The monitoring plan has been designed according to the EB-approved monitoring methodology AM0005: *Monitoring methodology for small grid-connected zero-emissions renewable electricity generation.*

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[12] This start date is documented on the Construction Licence that was granted to the project by the Municipality of Chinautla.

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

The AM0005 methodology is applicable to the Las Vacas project because it is a renewable power generation project that displaces grid electricity, and meets the conditions required for using this methodology, specifically:

- *The grid, which the project activity is connected, is clearly identifiable*. The Las Vacas project is connected to Guatemala's national electricity grid via a secondary transmission network.
- *The grid is not dominated by zero or low-operating cost generating sources, and this fuel mix is expected to persist for the duration of the crediting period.* For the year 2003, renewable generating sources represented approximately 30% of electricity generation of the grid. This percentage is expected to decrease as more thermal plants are built.

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

The following data will be monitored throughout the crediting life of the Las Vacas project:

- Monthly/annual electricity generated by the Las Vacas project and sold to the grid
- Annual determination of the emission factor (operating margin) of Guatemala's electricity grid (weighted average excluding zero-and low cost sources) to recalculate the operating margin with monitored data,
- Annual determination of the emission factor (build margin) of Guatemala's grid (weighted average of recently built plants the most 20% of the generating units built) to recalculate the build margin with monitored data,
- Annual determination of the combined margin,
- Correction of emission factors due to import/export of electricity (as needed),
- At the renewal of each crediting period, confirmation that the project meets applicability requirements especially with regards to additionality.

As there are no project emissions, no data will be collected for the project emissions.

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

ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

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

As there are no project emissions, no formula are given for project emissions.

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :

The methodology AM0005 involves monitoring the following data for calculating the baseline emissions

- **Electricity generation from the proposed project activity**.
Total electricity generation energy will be monitored by HRLV, at the end of every month. An annual report of total generation for each year will be produced by HRLV. Data will be obtained from the power meters located at the HRLV substation. These meters comply with "Norma de coordinación comercial No.14" (NCC 14) of the local "Administrador del Mercado Mayorista", the entity that defines the local standards and parameters to be followed in the electricity generation sector. NCC 14 defines how the meters are set up and what kind accuracy is used. Since these meters are already installed on the project site and are already used for measuring electricity sold by HRLV, they will be also used for monitoring.

Responsibility:	*Lic. Cesar Guzmán*
Title:	*Financial Manager of HRLV*
Reporting Frequency:	*Yearly*
Quality Control:	*Comegsa will compare their own meters readings to those measured at the Substation where the secondary power line connects to the Utility grid.*

- **Annual determination of the operating margin emission factor of the grid using actual monitored data to calculate the weighted average of all plants operating on the grid excluding zero-and low cost sources to recalculate the operating margin with monitored data.** The annual reporting of the operating margin emission factor will be carried out using data available from the Administrador del Mercado Mayorista (AMM - /www.amm.org.gt/). As the information for the previous year is not available in the first month of the following year, this report will be done once the data is available from the AMM, which is usually March of the following year. The same assumptions and methodologies that were used for the initial calculations will be used for annual monitoring, unless more data is available from AMM, for example, fuel use at each plant, plant-specific efficiency factors or emissions factors. Otherwise default IPCC and IEA values will continue to be used.

Responsibility:	*Ing. Germán Juárez*
Title:	*Renewable Sources Engineer, Comegsa*
Report Frequency:	*Yearly*
Quality Control:	*HRLV will double check the calculations by following the same procedures a second time using data from the Administrador del Mercado Mayorista (AMM) . (Responsibility: Ing. Felino Milián, Geological and Environmental Engineer, HRLV)*

- **Annual determination of the build margin emission factor of the grid using actual data from most recent 20% of existing plants of that specific year.** The annual reporting of the operating margin emission factor will be carried out using data available from the Administrador del Mercado Mayorista (AMM - /www.amm.org.gt/). As the information for the previous year is not available in the first month of the following year, this report will be done once the data is available from the AMM, which is usually March of the following year. The same assumptions and methodologies that were used for the initial calculations will be used for annual monitoring, unless more data is available from AMM, for example, fuel use at each plant, plant-specific efficiency factors or emissions factors. Otherwise default IPCC and IEA values will continue to be used.

Responsibility: *Ing. Germán Juárez*
Title: *Renewable Sources Engineer, Comegsa*
Report Frequency: *Yearly*
Quality Control: *HRLV will double check the calculations by following the same procedures a second time using data from the Administrador del Mercado Mayorista (AMM) . (Responsibility: Ing. Felino Milián, Geological and Environmental Engineer, HRLV)*

• **Annual determination of the combined margin** (calculated as an average of the build and operating margins)

• **Correction of emission factors due to import/export of electricity**. The annual reporting of the correction of emission factors due to import/export of electricity will be carried out using data available from the Administrador del Mercado Mayorista (AMM - /www.amm.org.gt/). As the information for the previous year is not available in the first month of the following year, this report will be done once the data is available from the AMM, which is usually March of the following year. The same assumptions and methodologies that were used for the initial calculations will be used for annual monitoring, unless more data is available from AMM.

Responsibility: *Ing. Germán Juárez*
Title: *Renewable Sources Engineer, Comegsa*
Report Frequency: *Yearly*
Quality Control: *HRLV will double check the calculations by following the same procedures a second time using data from the Administrador del Mercado Mayorista (AMM) . (Responsibility: Ing. Felino Milián, Geological and Environmental Engineer, HRLV)*

• **Confirmation of applicability and eligibility of the project at the renewal of the crediting period.** Following the first crediting period, a joint team will be composed of the following members: Delegate from National Designed Authority, HRLV and Comegsa. This team will review current information and reassess applicability of the baseline and monitoring methodology and project additionality.

Responsibility: *Ing. Hugo Martinez*
Title: *Plant Manager, HRLV*
Reporting Frequency: *End of every crediting period*
Team Members: *-Delegate from National Designed Authority*

- *Delegate from Comegsa*
- *Delegate from HRLV*

Specific data to be monitored are provided in the following tables, along with how this data will be collected, recording frequency and length of time data will be archived. Note that the details for data to be monitored are all specified in the monitoring methodology (AM0005).

Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :								
ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1. EGy	Electricity supplied to the grid by the Las Vacas project	Project participants, metering on project site,	KWh/year	m	Hourly measurement and monthly recording	100%	electronic	Electricity supplied by Las Vacas to the national grid. To be double checked by sales receipts.
2. EFy	Emission factor of national grid	AMM. IPCC, IEA default values where local values aren't available.	tCO_2eq/kWh	c	yearly	100%	electronic	Calculated as a weighted sum of emission factors of the Operating Margin and Build Margin
3. EF_OMy	Emission factor of grid, operating margin	AMM. IPCC, IEA default values where local values aren't available	tCO_2eq/kWh	c	yearly	100%	electronic	Calculated as TEMy divided by TGENy
4. EF_BMy	Emission factor of national grid (Build Margin)	AMM.IPCC, IEA default values if local values not availablep[0-6	tCO_2eq/kWh	c	yearly	100%	electronic	Calculated as [∑i Fi,y*COEFi] / [∑k GENk,y] over 20% recently built power plants as defined in the baseline methodology
5. TEMy	Total emissions of the national grid	AMM	$tCO_2eq/year$	c	yearly	100%	electronic	Calculated as the sum of GHG emissions of each plant on the grid

6. TGENy	Total electricity generation of the national grid excluding hydro, geothermal and biomass	AMM	kWh/year	c	yearly	100%	electronic	Calculated as the sum of electricity generated on the grid excluding zero- or low-operating cost sources, ie. Excluding hydro, geothermal and biomass
7-i. Fiy	Amount of each fossil fuel consumed in the grid	AMM and plant efficiency factors from AMM or IEA default values.	TJ/year	m	yearly	100%	electronic	Obtained from Administrador del Mercado Mayorista (AMM)
8-i COEFi	GHG emission coefficient of fuel i	Local data or IPCC if no local data is available	tCO_2eq/TJ	m	yearly	100%	electronic	Obtained from the latest local statistics or IEA statistics if local statistics are not available.
9-j GEN	Electicity generation of plant j	AMM	kWh/year	m	yearly	100%	electronic	Obtained from AMM
10.	Identification of plants to be used for OM	AMM	-	m	yearly	100%	electronic	Identification of plants (j) to calculate Operating Margin emission factor; does not include zero-emission plants
11.	Identification of plants to be used for BM	AMM	-	m	yearly	100%	electronic	Identification of plants (k) to calculate Build Margin Emission factor, most recent 20% of existing plants
12. W_{OM} and W_{BM}	Weighting factor for OM:BM		-		Yearly or fixed	100%	electronic	Default weighting factor of 0.5 will be used.
13.	Documented Evidence of the prohibitive barriers of the proposed project activity.	Evidence documents	-		Once at the renewal time of the crediting period	100%		A team will be formed to review up-to-date data and assess ongoing eligibility and additionality of the project.

14.	Documented information related to the alternative to the project, especially diffusion data.	Evidence documents	-		Once at the renewal time of the crediting period	100%		A team will be formed to review up-to-date data and assess ongoing eligibility and additionality of the project.

Sustainable Development Indicators:

In addition to the monitoring data for the determination of the baseline as established in methodology AM0005, the contribution of the project to sustainable development will be monitored using the following indicators, from 2005 onwards (once the ordinary production regime is achieved):

- **Water Oxygenation.** Monthly, HRLV will measure the amount of oxygen diluted in the water at the locations “Puente Bailey” and “Desfogue de casa de máquinas” and will ellaborate a report describing the results. The data will be measured directly in situ using a portable oxygen monitor.

  Responsibility: Ing. Felino Milián
  Title: Environmental and Geological Engineer HRLV
  Frequency of data measurements : Monthly
  Reporting Frequency :Yearly.
  Quality Control: The data sampling procedure will include a previous calibration of the measuring equipment and at least 3 different measurements will be taken.

- **Dredged Material.** The daily quantity of sand extracted from the dam and the amount used for construction materials in cubic metres, will be monitored on a daily basis. A monthly a report will outline the quantities of extracted and utilized sand.

  Responsibility: Ing. Oscar Medina
  Title: Plant supervisor of HRLV
  Frequency of data measurements: Daily
  Reporting Frequency :Monthly
  Quality Control: HRLV will confirm the data contained in the report comparing it with data obtained from the receipts from the aggregates company (Responsibility: Cesar Guzmán, Financial Manager of HRLV)

- **Plastic Waste.** HRLV, will monitor the weight, in kilograms, of the plastic waste extracted from the riverbed once it has been crushed and prepared for the extruder.

Responsibility: Turn operator
Title: Plastic Plant Operator
Frequency of data measurements: Daily
Quality Control: HRLV will verify weekly the coherence of the information registered by the operator (Responsibility Ing. Felino Milián)

- **Reforested Area.** The number of hectares of land reforested will be monitored annually according to the data in the report emitted by the Instituto Nacional de Bosques (INAB) for the company in charge of the reforestation.

Responsibility: Ing. Oscar Medina
Title: Supervisor de Planta HRLV
Frequency of data measurements: Daily
Reporting Frequency: Anual
Quality Control: The INAB will verify in situ the area effectively reforested by the company in charge.

- **Social Responsibility.** HRLV will dedicate an annual budget item to socially responsible activities where concepts such as literacy plans, campaigns for deparasitation and environmental awareness programs will be included as well as other activities that due to their nature fall whithin this budget item.

Responsibility: César Guzmán
Title: Financial Manager HRLV

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

Baseline emissions will be estimated using the formulae provided in the monitoring methodology (AM0005) and listed below. In order to facilitate monitoring, spreadsheets will be created (similar to that used to calculate emissions reductions using 2003 data) where annual data can be entered and calculations carried out automatically**.**

Baseline emissions are equal to $EG_y * EF_y$

where EG_y is the electricity supplied to the grid, EF_y is the GHG emission factor of the grid as calculated below.

The emission factor EF_y of the grid is represented as a combination of the Operating Margin and the Build Margin. If we set the emission factor of associated method as EF_OM_y and EF_BM_y, the EF_y is given by:

$$EF_y = w_{OM} * EF\_OM_y + w_{BM} * EF\_BM_y$$

with respective weight factors w_{OM} and w_{BM} (where $w_{OM} + w_{BM} = 1$), and by default, are weighted equally ($w_{OM} = w_{BM} = 0.5$).

The Operating Margin emission factor EF_OM_y is defined as the generation-weighted average emissions per electricity unit (tCO_2 / MWh) of all generating sources serving the system, excluding zero- or low-operating cost power plants (hydro, geothermal, wind, low-cost biomass, nuclear and solar generation), based on the latest year statistics data and are derived from the following equation:

$$EF\_OM_y = TEM_y / TGEN_y = [_i \sum F_{i,y} * COEF_i] / [\sum_j GEN_{j,y}]$$

Where TEM_y and $TGEN_y$ is the total GHG emissions and electricity generation supplied to the grid by the power plants connected to the grid excluding zero- or low-operating cost sources. $F_{i,y}$ and $COEF_i$ are the fuel consumption and associated carbon coefficient of the fossil fuel *i* consumed in the grid. $GEN_{j,y}$ is the electricity generation at the plant *j* connected to the grid excluding zero- or low-operating cost sources.

The Build Margin emission factor EF_BM_y is given as the generation-weighted average emission factor of the selected representative set of recent power plants represented by the most 20% of the generating units built (summation is over such plants specified by *k*):

$$EF\_BM_y = [\sum_i F_{i,y} * COEF_i] / [\sum_k GEN_{k,y}]$$

as the default method. The summation over *i* and *k* is for the fuels and electricity generation of the plants mentioned above.

If the grid imports or exports electricity from/to other grids, the associated correction

$$EF_y \rightarrow EF_y + \frac{EL^{in}}{TGEN_y} \times EF_y^{in} - \frac{EL^{out}}{TGEN_y} \times EF_y^{out}$$

is needed unless such correction is demonstrated to be conservative or negligible, where EL^{in} (EF_y^{in}) and EL^{out} (EF_y^{out}) are electricity coming in and going out of the grid (and their associated emission factors); and $TGEN_y$ is the electricity generated in the grid. The arrow means replacement of the EF_y by the right-hand-side of the above formula.

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

N/A

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

ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

N/A

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

N/A

D.2.3. Treatment of leakage in the monitoring plan

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

ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
15. EL^{in}_{y}	electricity	AMM	kWh	c	yearly	100%	electronic	Obtained from latest local statistics, primarily from AMM.
16. EL^{out}_{y}	electricity	AMM	kWh	c	yearly	100%	electronic	Obtained from latest local statistics, primarily from AMM.
17. EF^{in}_{y}	Emission factor of imported electricity	AMM, and data from source country	tCO_2eq/kWh	c	yearly	100%	electronic	Obtained from latest local statistics, eg from AMM and from data from source country, for example El Salvador. When the effect of imports on the calculation of the emission factor for Guatemala overcomes 0.5%, the imports will not be considered negligibles.
18. EF^{out}_{y}	Emission factor	AMM	tCO_2eq/kWh	c	yearly	100%	electronic	Obtained from latest local statistics, for example AMM.

Leakage will be treated by adjusting the baseline emission factor for imported and exported electricity using the formula above. The amount of electricity imported into the Guatemalan grid and the amount exported each year will be collected, and emission factors for imported and exported electricity will be calculated.

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

The formula for estimating leakage are given in D.2.1.4, as part of the formulae for estimating baseline emissions.

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

The emission reductions ER_y by the project activity during a given year y are equal to the baseline emissions for which the formula are given above.

$$ER_y = EG_y * EF_y$$

where EG_y is the electricity supplied to the grid, EF_y is the GHG emission factor of the grid as calculated below (CO_2 emission factor can be used if effects of other GHGs are demonstrated to be negligible).

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored		
Data	Uncertainty level of data (High/Medium/Low)	
1	Low	This item will be directly used for calculation of emission reductions. Sales records to the grid and other records will be used to ensure consistency.
13,14	Low	These data are used to check whether the applicability conditions are met.
Others	Low	Default data (for emission factors) and IEA statistics (for energy data) will be used to check local data.

All variables used to calculate project and baseline emissions are directly measured or use publicly –available official data. To ensure the quality of the data, in particular those that are measured, the data are double-checked against commercial data. The quality control and quality assurance measures planned for the Project are outlined in the above table.

HRLV is currently working towards achieving an ISO 14001 certification. Within this process all internal audits and conflict resolution will be taken into account. First steps are being taken once the initial phase of the ISO 14001 Project has been implemented. Identification of environmental aspects related to the operation of HRLV have been carried out and data required to follow-up emission reductions as well as other sustainable development indicators will be monitored and verified under this scheme. Special care will be taken to have such procedures ready as soon as possible, considering the fact that they will probably be ready much sooner than ISO 14001 Certification is achieved. Current Maintenance Program and activities will also be reviewed under this scheme.

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

The financial division of HRLV 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. César Guzman of this division will be directly responsible for monitoring activities for the first crediting period.

Ing. Germán Juárez a Renewable Energy Sources Engineer at Comegsa will be responsible for monitoring data and carry out the calculations for the emissions factors including the operating margin emission factor, build margin emission factor, combined margin emission factor and import/export adjustment.

Following the first crediting period, a joint team will be formed composed of the following members: HRLV, Comegsa and a representative from the purchaser of CERs. This team will review current information and reassess applicability of the baseline and monitoring methodology, and project additionality.

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

Garrigues Medio Ambiente
José Abascal 45,
28015 Madrid
SPAIN;

and

Solea Consulting
Calle Santiago, 15, 2D
18009 Granada
SPAIN

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

The project activity does not generated any GHG emissions.

E.2. Estimated leakage:

Leakage calculations are included in the determination of baseline emissions and therefore are not referred here.

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

The project activity emissions are zero.

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

Baseline emissions are estimated to be 90,363 tonnes of CO_2/year.

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

Emissions reduction are estimated to be 90,363 tonnes of CO_2/year.

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

See Annex 3.

SECTION F. Environmental impacts

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

According to Guatemalan law, proposals for electricity generation must undertake an environmental impact study and submit it to the General Directorate of Environmental Management and Natural Resources of the Ministry of Environment and Natural Resources (Dirección General de Gestión Ambiental y Recursos Naturales del Ministerio de Ambiente y Recursos Naturales de Guatemala). The Las Vacas project has undergone three environmental impact studies, one for the initial project design of 20MW, dated February 1999, a second one in December 2001 when it was determined that the project would be expanded to 40MW, and a third one completed in June 2003 for the additional 5 MW[13]. These studies were all carried out by *Asesoría en Geología, Petróleo y Medio Ambiente,* a local environmental consulting firm in Guatemala, and have been approved by the General Directorate of Environmental Management and Natural Resources [14]

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[13] Although the 45 MW were in operation in may 2003, there was a delay in the submission of the environmental impact assessment report.

[14] These studies are all available for review as required.

The first EIA made a number of recommendations for activities to be included in the project's Environmental Management Plan, including an environmental education program, mapping of the environmental sensitivity of the zone affected by the project, ongoing monitoring and observation of flora and fauna of the zone and monitoring of water quality of the river. These activities have all been included in the expanded Environmental Management Plan of the Las Vacas project. The additional EIA's built upon the first one, but did not identify any significant environmental impacts of the project.

The project developers have made special efforts to compensate for any potential environmental impacts the project may have by reforesting the zone that was directly affected by the project and has taken the extraordinary steps of implementing a tree nursery, carrying out reforestation projects of the Las Vacas river basin, and by collecting and recycling plastics and sediments that end up at the dam. Because of these efforts, the environmental benefits of the project are much greater than any impact it may have.

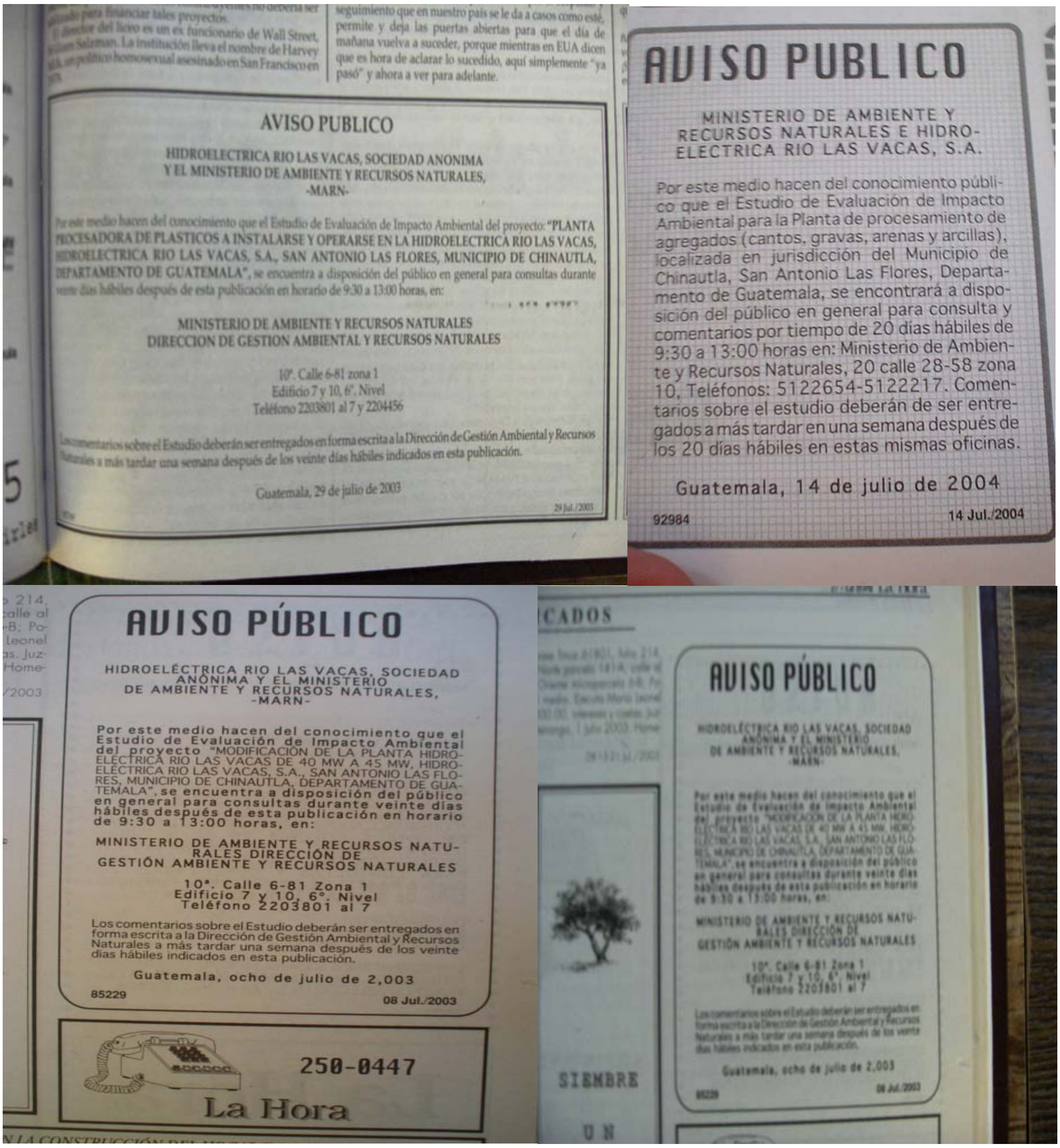
F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

N/A

SECTION G. Stakeholders' comments

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

a) Following national regulations for public consultations on this type of project the project developers published several public announcements in Guatemala's national newspapers describing the project and soliciting comments from the public. The following images show these these announcements and include the dates that were published.



AVISO PUBLICO

HIDROELECTRICA RIO LAS VACAS, SOCIEDAD ANONIMA
Y EL MINISTERIO DE AMBIENTE Y RECURSOS NATURALES,
-MARN-

Por este medio hacen del conocimiento que el Estudio de Evaluación de Impacto Ambiental del proyecto: "PLANTA PROCESADORA DE PLASTICOS A INSTALARSE Y OPERARSE EN LA HIDROELECTRICA RIO LAS VACAS, HIDROELECTRICA RIO LAS VACAS, S.A., SAN ANTONIO LAS FLORES, MUNICIPIO DE CHINAUTLA, DEPARTAMENTO DE GUATEMALA", se encuentra a disposición del público en general para consultas durante veinte días hábiles después de esta publicación en horario de 9:30 a 13:00 horas, en:

MINISTERIO DE AMBIENTE Y RECURSOS NATURALES
DIRECCION DE GESTION AMBIENTAL Y RECURSOS NATURALES

10ª. Calle 6-81 zona 1
Edificio 7 y 10, 6º. Nivel
Teléfono 2203801 al 7 y 2204456

Los comentarios sobre el Estudio deberán ser entregados en forma escrita a la Dirección de Gestión Ambiental y Recursos Naturales a más tardar una semana después de los veinte días hábiles indicados en esta publicación.

Guatemala, 29 de julio de 2003

29 Jul./2003

AVISO PUBLICO

MINISTERIO DE AMBIENTE Y
RECURSOS NATURALES E HIDRO-
ELECTRICA RIO LAS VACAS, S.A.

Por este medio hacen del conocimiento público que el Estudio de Evaluación de Impacto Ambiental para la Planta de procesamiento de agregados (cantos, gravas, arenas y arcillas), localizada en jurisdicción del Municipio de Chinautla, San Antonio Las Flores, Departamento de Guatemala, se encontrará a disposición del público en general para consulta y comentarios por tiempo de 20 días hábiles de 9:30 a 13:00 horas en: Ministerio de Ambiente y Recursos Naturales, 20 calle 28-58 zona 10, Teléfonos: 5122654-5122217. Comentarios sobre el estudio deberán de ser entregados a más tardar en una semana después de los 20 días hábiles en estas mismas oficinas.

Guatemala, 14 de julio de 2004

92984 14 Jul./2004

AVISO PÚBLICO

HIDROELÉCTRICA RIO LAS VACAS, SOCIEDAD ANÓNIMA Y EL MINISTERIO DE AMBIENTE Y RECURSOS NATURALES,
-MARN-

Por este medio hacen del conocimiento que el Estudio de Evaluación de Impacto Ambiental del proyecto "MODIFICACIÓN DE LA PLANTA HIDROELÉCTRICA RIO LAS VACAS DE 40 MW A 45 MW, HIDROELÉCTRICA RIO LAS VACAS, S.A., SAN ANTONIO LAS FLORES, MUNICIPIO DE CHINAUTLA, DEPARTAMENTO DE GUATEMALA", se encuentra a disposición del público en general para consultas durante veinte días hábiles después de esta publicación en horario de 9:30 a 13:00 horas, en:

MINISTERIO DE AMBIENTE Y RECURSOS NATURALES DIRECCIÓN DE GESTIÓN AMBIENTE Y RECURSOS NATURALES

10ª. Calle 6-81 Zona 1
Edificio 7 y 10, 6º. Nivel
Teléfono 2203801 al 7

Los comentarios sobre el Estudio deberán ser entregados en forma escrita a la Dirección de Gestión Ambiental y Recursos Naturales a más tardar una semana después de los veinte días hábiles indicados en esta publicación.

Guatemala, ocho de julio de 2,003

85229 08 Jul./2003

250-0447

La Hora

AVISO PÚBLICO

HIDROELÉCTRICA RIO LAS VACAS, SOCIEDAD ANÓNIMA Y EL MINISTERIO DE AMBIENTE Y RECURSOS NATURALES,
-MARN-

Guatemala, ocho de julio de 2,003

SIEMBRE

UN

Figure 8: Public communications in national newspapers

b) In addition, as part of the Environmental Impact Assessments of the project, the local community was consulted regarding their views of the project. This consultation consisted of direct interviews of a sample of the local population who lived in the area of influence of the project, who were interviewed in their homes, work-places, and on the street. In total 150 people were interviewed in the communities of Chinautla, San Pedro Ayampuc, Chuarrancho, San Martineros, San Jose Nacahuil, San Antonio Las Flores and San Rafael Las Flores. Municipal authorities were also consulted. A summary of the results plus a copy of the interview that was carried out are included as part of the first EIA.

G.2. Summary of the comments received:

a) No stakeholders comments were received following the publications of the newspaper announcements.

b) Of those that were interviewed as part of the first EIA, 90% felt that the project would not have any impact on the environment. The majority of those consulted (98%) felt that the project would be beneficial to the community as it would generate employment. The main disadvantage that was mentioned was the risk of flooding (75% of the consulted). On the other hand, many respondents mentioned that the main environmental problems in the region were deforestation, pollution of the rivers, and garbage. They also mentioned that these issues were a result of a lack of interest on the part of municipal authorities and the national government.

The general population considered that the project would improve living conditions in the area through the creation of employment opportunities an increase in trade and consequently an increase in income levels. A high percentage considered that the project would not present any disadvantage. The neighbours felt that the project would support activities or programs that involve training on the construction site, coordination with the neighbours through committees of various types, direct economic assistance, and an improvement of the general infrastructure of the region.

The municipal authorities stated the new project would not only increase their funds via municipal fees, but also resolve the problems regarding insufficient and unstable electricity supply in the municipality.

As part of the two additional EIA's the local community was consulted once again regarding the expansion of the plant. The comments were mostly positive, many mentioning that the construction of the project was beneficial to their community, or had provided them with work opportunities or increased their business. They continued to mention that the main environmental problem in the area was the water quality of the river.

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

a) No stakeholders comments were received following the publications of the newspaper announcements. As no comments were received, no action was taken.

b) Since the only real concerns of the population were with regards to deforestation and water quality, the project addressed these concerns by initiating reforestation programs, collecting and recycling plastics that gather at the dam, and dredging and sorting sediments nearby the dam.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	*Hidroeléctrica Río Las Vacas (HRLV)*
Street/P.O.Box:	*Diagonal 6, 10-01 Zona 10*
Building:	*Centro Gerencial Las Margaritas, Torre I, Nivel 12,Oficina 12-01*
City:	*Guatemala City*
State/Region:	*Guatemala*
Postfix/ZIP:	*01010*
Country:	*Guatemala*
Telephone:	*Tel: (502) 2-331-7088* *(502) 2-331-7068* *(502) 2-331-7077*
FAX:	
E-Mail:	
URL:	
Represented by:	*Hugo Martínez* Siekavizza
Title:	
Salutation:	*Ing.*
Last Name:	*Martínez* Siekavizza
Middle Name:	
First Name:	*Hugo*
Department:	*Plant Management HRLV*
Mobile:	*59080403*
Direct FAX:	
Direct tel:	
Personal E-Mail:	hugom@fabrigas.com

Organization:	*COMEGSA*
Street/P.O.Box:	*Sexta Avenida 8-14 zona 1*
Building:	
City:	
State/Region:	
Postfix/ZIP:	01001
Country:	*Guatemala*
Telephone:	*(502) 24204200 / 24204277 ext. 2352*
FAX:	*(502) 22305618*
E-Mail:	
URL:	*www.comegsa.com.gt*
Represented by:	
Title:	*Ingeniero de Estudios*
Salutation:	
Last Name:	*Juárez Vidaurre*
Middle Name:	
First Name:	*German Antonio*

Department:	*Unidad de Estudios*
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City:	*Madrid*
State/Region:	*Madrid*
Postfix/ZIP:	*28033*
Country:	*España*
Telephone:	
FAX:	
E-Mail:	
URL:	*www.iberdrola.es*
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Personal E-Mail:	jsureda@iberdrola.es

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

N/A

Annex 3

BASELINE INFORMATION: DISPATCH DATA BY TECHNOLOGIES AND SOURCES (NATIONAL INTERCONNECTED SYSTEM, YEAR 2003)

DESPACHO DE CARGA EJECUTADO DEL SISTEMA NACIONAL INTERCONECTADO
AÑO 2,003

	ENE		FEB		MAR		ABR		MAY		JUN		SUBTOTAL
	ENERGIA GWH	POTENCIA MW	ENERGIA GWH	POTENCIA MW	ENERGIA GWH	POTENCIA MW	ENERGIA GWH	POTENCIA MW	ENERGIA GWH	POTENCIA MW	ENERGIA GWH	POTENCIA MW	ENERGIA GWH
PLANTAS HIDRÁULICAS	**158,384**		**147,544**		**155,917**		**154,701**		**140,102**		**196,265**		**952,9**
CHIXOY	103,355		100,319		104,469		105,469		78,468		99,188		591,3
AGUACAPA	13,274		11,669		12,839		12,325		15,147		25,108		90,4
JURUN	9,668		8,788		12,778		14,216		20,496		29,291		95,2
ESCLAVOS	0,737		1,115		1,278		1,105		2,887		8,283		15,4
PEQUEÑAS HIDRO*	4,435		3,572		3,976		3,779		3,783		3,044		22,6
RIO BOBOS	4,108		3,791		4,051		2,818		1,840		2,839		19,4
SECACAO	6,861		5,713		5,509		4,990		5,154		6,269		34,5
PASABIEN	4,464		2,563		2,053		1,835		1,568		4,073		16,6
POZA VERDE	1,586		1,316		1,414		1,283		1,986		3,799		11,4
LAS VACAS	2,472		4,127		4,501		4,386		6,080		8,414		30,0
MATANZAS + SAN ISIDRO	7,424		4,571		3,049		2,494		2,692		5,958		26,2
PLANTAS TÉRMICAS	**376,409**		**348,986**		**391,716**		**374,745**		**415,402**		**321,541**		**2228,8**
TURBINAS DE VAPOR	**88,620**		**85,293**		**94,311**		**67,308**		**92,577**		**92,480**		**520,6**
SAN JOSE	88,537		85,293		94,306		67,308		91,851		91,400		518,7
ESC VAPOR 2	0,082												0,1
LAG.VAPOR No. 3									0,721		1,080		1,8
LAG.VAPOR No. 4					0,006				0,005				0,0
GEOTÉRMICAS	**14,789**		**15,720**		**17,911**		**16,539**		**16,914**		**15,315**		**97,2**
ORZUNIL	14,628		13,507		14,842		13,918		13,759		12,103		82,8
CALDERAS	0,160		2,213		3,069		2,621		3,155		3,213		14,4
COGENERADORES(T.VAPOR INGENIOS AZUCAREROS)	**100,426**		**86,875**		**98,610**		**69,329**		**47,225**		**16,159**		**418,6**
CONCEPCION	15,902		15,670		15,603		13,600		7,569		5,029		73,4
PANTALEON	23,669		20,188		23,357		15,870		8,421		1,368		92,9
SANTA ANA	19,980		14,265		15,161		12,175		13,990		5,157		80,7
MAGDALENA	9,171		8,462		13,648		8,458		4,771		1,301		45,8
LA UNION	21,735		19,149		19,869		16,154		10,890		1,854		89,7
MADRE TIERRA	8,210		6,618		7,470		3,073		1,140		0,904		27,4
TULULA	1,759		2,523		3,501						0,006		7,8
DARSA									0,444		0,541		1,0
MOTORES RECIPROCANTES	**169,551**		**157,352**		**172,717**		**212,158**		**244,161**		**193,359**		**1149,3**
ARIZONA					4,553		47,625		54,085		49,294		155,6
LA ESPERANZA	60,301		55,074		56,627		61,040		65,900		54,971		353,9
PQPLLC	37,467		32,959		39,513		33,083		44,745		29,292		217,1
LAS PALMAS 1	10,189		9,350		9,384		9,425		9,476		9,126		57,0
LAS PALMAS 2	9,291		7,447		9,646		9,613		9,553		9,221		54,8
LAS PALMAS 3	10,442		8,591		9,946		9,902		8,697		9,825		57,4
LAS PALMAS 4	10,117		8,071		10,263		9,773		10,242		3,678		52,1
LAS PALMAS 5	3,507		2,796		3,547		3,388		2,873		1,486		17,6
GENOR	19,018		18,950		15,391		10,472		14,217		10,272		88,3
SIDEGUA	3,741		6,227		6,255		8,033		12,294		4,913		41,5
LAGOTEX(COMEGSA)	5,478		7,888		7,592		9,805		12,080		8,671		51,5
GENERADORA PROGRESO											2,611		2,6
TURBINAS DE GAS	**3,024**		**3,746**		**8,167**		**9,411**		**14,525**		**4,227**		**43,1**
TAMPA	1,258		0,380		1,112		2,048		4,705		0,619		10,1
LAG.GAS No. 1	0,371		0,401		1,180		0,627		0,137				2,7
LAG.GAS No. 2	0,721		1,418		2,392		1,647		3,849		2,078		12,1
LAG.GAS No. 4	0,172		0,000				1,751		1,950		0,829		4,7
STEWART & STEVENSON	0,302		0,760		2,035		1,358		0,011				4,5
ESC.GAS No. 3	0,154		0,475		0,811		1,114		1,996		0,608		5,2
ESC.GAS No. 5	0,046		0,312		0,638		0,866		1,876		0,092		3,8
AUTOPRODUCTORES	**16,368**		**14,784**		**16,368**		**15,840**		**16,368**		**7,200**		**89,5389405**
CEMENTOS PROGRESO	8,928		8,064		8,928		8,640		8,928				46,1
LAGOTEX	7,440		6,720		7,440		7,200		7,440		7,200		43,4
IMPORTACIONES (-)	1,3014		4,215		0,231		0,413		1,821		1,456		9,4
EXPORTACIONES (+)	33,2254		32,859		26,889		37,317		34,328		26,319		190,9
NETO	31,924		28,644		26,658		36,904		32,507		24,862		181,5
DEMANDA S.N.I.	**519,238**		**482,671**		**537,343**		**508,382**		**539,365**		**500,144**		**3087,1**
TOTAL GENERACION	**551,162**		**511,314**		**564,000**		**545,285**		**571,872**		**525,006**		**3271,3**
DEMANDA S.N.I. SIN AUTOCONSUMOS	**502,870**		**467,887**		**520,975**		**492,542**		**522,997**		**492,944**		**2997,6**

DESPACHO DE CARGA EJECUTADO DEL SISTEMA NACIONAL INTERCONECTADO
AÑO 2,003

	JUL		AGO		SEP		OCT		NOV		DIC		SUBTOTAL	TOTAL
	ENERGIA GWH	POTENCIA MW	ENERGIA GWH	POTENCIA MW	ENERGIA GWH	POTENCIA MW	ENERGIA GWH	POTENCIA MW	ENERGIA GWH	POTENCIA MW	ENERGIA GWH	POTENCIA MW	ENERGIA GWH	ENERGIA GWH
PLANTAS HIDRÁULICAS	**245.7**		**196.9**		**217.7**		**216.8**		**174.8**		**171.7**		**1223.7**	**2176.6**
CHIXOY	147.5		106.0		92.5		101.3		92.1		98.6		637.95	1229.22
AGUACAPA	28.11		27.58		44.23		34.78		22.03		13.71		170.44	260.80
JURUN	24.31		20.24		22.75		24.42		11.27		9.66		112.65	207.89
ESCLAVOS	7.48		5.39		9.75		8.83		2.57		1.69		35.70	51.11
PEQUEÑAS HIDRO	3.02		4.76		5.77		6.36		4.52		5.16		29.59	52.18
RIO BOBOS	2.83		2.93		2.24		3.19		5.49		7.45		24.13	43.58
SECACAO	9.56		10.56		10.71		11.74		10.96		9.27		62.80	97.30
PASABIEN	3.33		2.26		3.48		5.99		6.19		5.02		26.28	42.84
POZA VERDE	4.21		4.21		5.71		4.99		3.61		2.23		24.96	36.35
LAS VACAS	8.60		6.95		16.17		8.32		5.57		4.29		49.91	79.89
EL CANADÁ									3.09		9.94		13.02	13.02
MATANZAS + SAN ISIDRO	6.76		6.05		4.41		6.86		7.40		4.74		36.23	36.23 *
PLANTAS TÉRMICAS	**321.7**		**361.5**		**335.4**		**355.6**		**384.1**		**397.2**		**2155.5**	**4384.3**
TURBINAS DE VAPOR	**86.4**		**94.4**		**90.2**		**22.2**				**81.2**		**374.4**	**895.0**
SAN JOSE	86.43		94.37		90.18		21.16				81.23		373.37	892.06
ESC VAPOR 2														0.08
LAG.VAPOR No. 3							1.01						1.01	2.81
LAG.'VAPOR No. 4														0.01
GEOTÉRMICAS	**16.2**		**16.7**		**16.6**		**14.7**		**16.3**		**17.2**		**97.8**	**195.02**
ORZUNIL	12.84		13.48		13.87		11.71		13.45		14.23		79.57	162.33
CALDERAS	3.32		3.25		2.78		3.04		2.89		2.98		18.26	32.69
COGENERADORES(T.VAPOR INGENIOS AZUCAREROS)	**2.9**		**0.2**		**0.3**		**28.8**		**68.1**		**85.5**		**185.7**	**604.4**
CONCEPCION	1.94						6.41		13.81		12.19		34.35	107.72
PANTALEON			0.00				12.82		18.21		20.39		51.42	144.30
SANTA ANA			0.00						12.96		16.83		29.79	110.52
MAGDALENA							2.86		5.74		10.11		18.70	64.51
LA UNION					0.0042		3.85		11.07		17.86		32.79	122.45
MADRE TIERRA	0.51						2.57		6.11		6.01		15.20	42.62
TULULA							0.02		0.06		1.69		1.77	9.56
DEARSA	0.43		0.22		0.28		0.27		0.10		0.40		1.70	2.69
MOTORES RECIPROCANTES	**213.3**		**243.8**		**216.4**		**277.3**		**293.3**		**211.8**		**1455.9**	**2605.17**
ARIZONA	51.0		58.5		46.3		73.8		102.3		74.1		405.84	561.40
LA ESPERANZA	57.34		65.59		56.68		70.88		72.21		63.35		386.07	739.98
PQPLLC	37.68		42.64		40.97		48.47		41.85		16.11		227.72	444.78
LAS PALMAS 1	8.00		9.02		8.18		9.24		9.04		3.76		47.25	104.20
LAS PALMAS 2	9.23		5.71		3.96		9.23		8.70		8.84		45.67	100.44
LAS PALMAS 3	9.66		9.85		9.32		9.35		8.91		8.76		55.84	113.25
LAS PALMAS 4	9.37		9.29		9.59		9.49		9.58		9.23		56.54	108.69
LAS PALMAS 5	2.95		3.46		2.60		2.71		3.20		1.81		16.74	34.33
GENOR	9.38		13.52		12.22		13.18		11.66		8.05		68.02	156.33
SIDEGUA	4.35		9.71		9.17		11.75		8.56		1.92		45.46	86.93
LAGOTEX(COMEGSA)	8.01		9.52		9.41		3.44		8.42		6.31		45.10	96.61
AMATEX	1.83		2.02		2.36		8.89		3.08		2.06		20.25	20.25
ELECTROGENERACIÓN									0.11		3.78		3.89	3.89
GENERADORA PROGRESO	4.49		5.05		5.65		6.87		5.67		3.78		31.50	34.11
TURBINAS DE GAS	**3.0**		**6.4**		**11.8**		**12.6**		**6.4**		**1.4**		**41.7**	**84.78**
TAMPA	0.17		0.06		1.47		2.27		0.52		0.65		5.13	15.25
LAG.GAS No. 1											0.00		0.00	2.72
LAG.GAS No. 2	0.75		1.72		2.72		3.15		1.82		0.26		10.42	22.52
LAG.GAS No. 4	1.15		2.89		3.37		1.51		2.30		0.12		11.33	16.03
STEWART & STEVENSON	0.56		1.11		2.52		2.99		1.04		0.16		8.38	12.85
ESC.GAS No.3	0.22		0.38		1.10		1.70		0.30		0.13		3.84	8.99
ESC.GAS No.5	0.15		0.21		0.67		1.02		0.44		0.11		2.58	6.41
AUTOPRODUCTORES	**7.44**		**7.44**		**7.2**		**7.44**		**7.2**		**7.44**		**44.16**	**133.70**
CEMENTOS PROGRESO														46.10
LAGOTEX	7.44		7.44		7.20		7.44		7.20		7.44		44.16	87.60
IMPORTACIONES (-)	0.20		0.44		4.67		7.80		0.85		0.12		14.08	**23.52**
EXPORTACIONES (+)	44.99		34.87		41.16		40.16		33.70		34.94		229.82	**420.75**
NETO	44.78		34.43		36.50		32.36		32.84		34.82		215.74	**397.24**
DEMANDA S.N.I.	**530.1**		**531.5**		**523.8**		**547.5**		**533.3**		**541.5**		**3207.6**	**6294.7**
TOTAL GENERACION	**574.9**		**565.9**		**560.3**		**579.9**		**566.1**		**576.3**		**3423.3**	**6694.6**
DEMANDA S.N.I. SIN AUTOCONSUMOS	**522.7**		**524.03**		**516.6**		**540.1**		**526.1**		**534.0**		**3163.44**	**6161.04**

*This value only refers to the second semester. For calculate the annual generation it should be added up with the generation of the first semester (so the annual generation is 62,4 GWh).

INSTALLED CAPACITY IN THE NATIONAL INTERCONNECTED SYSTEM

CAPACIDAD INSTALADA EN EL SISTEMA ELÉCTRICO NACIONAL

Nov-03

PLANTAS GENERADORAS	UNIDADES	POTENCIA DE PLACA MW	POTENCIA EFECTIVA AL SISTEMA MW	FECHA DE INSTALACIÓN	UBICACIÓN MUNICIPIO	UBICACIÓN DEPARTAMENTO
SISTEMA ELÉCTRICO NACIONAL		1,966.3	1,754.7			
HIDROELÉCTRICAS		621.9	569.9			
CHIXOY	5	300.0	275.0	27/11/83	San Cristóbal	Alta Verapaz
AGUACAPA	3	90.0	75.0	22/02/82	Pueblo Nuevo Viña	Santa Rosa
JURÚN MARINALÁ	3	60.0	60.0	12/02/70	Palín	Escuintla
EL CANADÁ	2	41.6	40.0	Nov-03		
LAS VACAS	1	40.0	38.0	May-02	Chinautla	Guatemala
SECACAO	1	15.5	13.5	Julio/1998	Senahú	Alta Verapaz
ESCLAVOS	2	14.0	13.5	17/08/66	Cuilapa	Santa Rosa
PASABIEN	2	12.0	12.0	Jun-05	Río Hondo	Zacapa
MATANZAS	1	12.0	12.0	Jul-02	San Jerónimo	Baja Verapaz
RIO BOBOS	1	10.0	10.0	10/08/95	Quebradas, Morale	Izabal
POZA VERDE	2	8.1	8.0	Jun-05	Pueblo Nuevo Viña	Santa Rosa
SISTEMA MICHATOYA	5	6.7	1.0	15/10/27	Escuintla	Escuintla
SANTA MARÍA	3	6.0	6.0	25/06/66	Zunil	Quezaltenango
SAN ISIDRO	2	3.5	3.4	Jul-02	San Jerónimo	Baja Verapaz
EL PORVENIR	1	2.0	2.0	Septiembre/1968	San Pablo	San Marcos
CHICHAIC	2	0.6	0.5	26/07/79	Cobán	Alta Verapaz
TERMOELÉCTRICAS		1344.3	1184.8			
TURBINAS DE VAPOR		221.0	174.9			
SAN JOSÉ	1	142.0	128.9	01 Enero 2000	Masagua	Escuintla
ESC.VAPOR 2	1	53.0	24.0	22/04/77	Escuintla	Escuintla
GGG VAPOR 3	1	13.0	11.0	1959	Amatitlán	Guatemala
GGG VAPOR 4	1	13.0	11.0	1961	Amatitlán	Guatemala
TURBINAS DE GAS		264.0	186.3			
TAMPA	2	80.0	79.3	1995	Escuintla	Escuintla
GGG STEWART & STEVENSON	1	51.0	23.0	24/12/92	Escuintla	Escuintla
ESC.GAS 5	1	41.0	15.0	Noviembre/1985	Escuintla	Escuintla
GGG GAS 4	1	33.0	27.0	1989	Amatitlán	Guatemala
ESC.GAS 3	1	25.0	17.0	09/08/76	Escuintla	Escuintla
ESC.GAS 4	1	"	"	09/08/76	Escuintla	Escuintla
GGG GAS 2	1	23.0	17.0	1976	Amatitlán	Guatemala
ESC.GAS 2	2	"	"	07/05/68	Escuintla	Escuintla
GGG GAS 1	1	11.0	8.0	1964	Amatitlán	Guatemala
MOTORES DE COMBUSTIÓN INTERNA		627.2	602.6			
ARIZONA	10	167.0	160.0	Abril/Mayo 2003	San José	Escuintla
LA ESPERANZA	7	126.0	124.0	Mayo de 2000	Puerto Quetzal	Escuintla
PQPC	20	114.0	110.0	1993	Puerto Quetzal	Escuintla
LAS PALMAS	5	66.8	65.0	Septiembre/1998	Escuintla	Escuintla
SIDEGUA	10	44.0	36.0	1995	Escuintla	Escuintla
GENOR	2	42.4	41.6	Octubre/1998	Puerto Barrios	Izabal
GENERADORA PROGRESO	1	22.0	21.0	1993	Sanarate	El Progreso
LAGOTEX	4	20.0	20.0	1996	Amatitlán	Guatemala
AMATEX	2	10.0	10.0	2003	Amatitlán	Guatemala
ELECTROGENERACIÓN	2	15.0	15.0	Nov-03	Amatitlán	Guatemala
INGENIOS AZUCAREROS		182.7	180.2	1992 - 1996	Varios	Escuintla
PANTALEÓN		38.5	38.5			Escuintla
SANTA ANA		33.8	33.8			Escuintla
LA UNIÓN		29.5	29.5			Escuintla
CONCEPCIÓN	1	27.5	27.5			Escuintla
MADRE TIERRA		19.0	19.0			Escuintla
MAGDALENA		15.4	15.4			Escuintla
TULULA		19	16.5			Suchitepequez
GEOTÉRMICA		29.0	26.5			
ZUNIL	1	24.0	22.0	04 Agosto 1999	Zunil	Quezaltenango
CALDERAS	1	5.0	4.5	01 Diciembre 2002	San Vicente Pacaya	Guatemala

Name	Technology	Fuel Type	GWh
San José	Steam Turbine	Coal	892,06
Esc. Vapor 2	Steam Turbine	Bunker	0,08
Lag.Vapor No. 3	Steam Turbine	Bunker	2,81
Lag. Vapor No. 4	Steam Turbine	Bunker	0,01
Arizona	IC Motor	Bunker	561,40
La Esperanza	IC Motor	Bunker	739,98
PQPLLC	IC Motor	Bunker	444,78
Las Palmas 1	IC Motor	Bunker	104,20
Las Palmas 2	IC Motor	Bunker	100,44
Las Palmas 3	IC Motor	Bunker	113,25
Las Palmas 4	IC Motor	Bunker	108,69
Las Palmas 5	IC Motor	Bunker	34,33
Genor	IC Motor	Bunker	156,33
Sidegua	IC Motor	Bunker	86,93
Lagotex	IC Motor	Bunker	96,61
Amatex	IC Motor	Bunker	20,25
Electrogeneración	IC Motor	Bunker	3,89
Generadora Progreso	IC Motor	Bunker	34,11
Tampa	Gas Turbine	Diesel	15,25
Lag.Gas No. 1	Gas Turbine	Diesel	2,72
Lag.Gas No. 2	Gas Turbine	Diesel	22,52
Lag.Gas No. 4	Gas Turbine	Diesel	16,03
GGG Stewart + Stevenson	Gas Turbine	Diesel	12,85
Esc. Gas 4	Gas Turbine	Diesel	0,00
Esc. Gas 2	Gas Turbine	Diesel	0,00
Esc. Gas 3	Gas Turbine	Diesel	8,99
Esc. Gas 5	Gas Turbine	Diesel	6,41

Fuel Type	Anual Generation [GWh/year]	Average Plant Efficiency [%]	Fuel Consumption [TJ/year]	Carbon Content [tC/TJ]	Emissions [tCO_2/year]	CEF [tCO_2/MWh]
Bunker	2,608.08	33.00	28,451.76	21.10	2,201,217.98	-
Diesel	84.78	35.00	872.03	20.20	64,588.55	-
Coal	892.1	35.00	9,175.51	25.80	868,003.49	-
TOTAL	3,584.92	-	-	-	3,133,810.03	**0.874**

Name	Technology	Fuel Type	Date of Installation	GWh	Accumulate	%of Capacity
El Canada	Hydro	RE	nov-03	13.02	13.02	0.2%
Electrogeneración	IC Motor	Bunker	nov-03	3.89	16.91	0.3%
Amatex	IC Motor	Bunker	2003	20.25	37.16	0.6%
Arizona	IC Motor	Bunker	apr-03	561.40	598.56	9.1%
Calderas	Geothermal	RE	dec-02	32.69	631.25	9.6%
Matanzas+ San Isidro	Hydro	RE	jul-02	62.40	693.65	10.6%
Magdalena	Cogeneration	Biomass	dec-01	64.51	758.16	11.6%
Tulula	Cogeneration	Biomass	jan-01	9.56	767.72	11.7%
La Esperanza	IC Motor	Bunker	may-00	739.98	1,507.70	23.0%

Type	Annual Generation [GWh/year]	Average Plant Efficiency [%]	Fuel Consumption [TJ/year]	Carbon Content [tC/TJ]	Emissions [tCO_2/year]	CEF [tCO_2/MWh]
Bunker	1,229.56	33.00	13,413.39	21.10	1,037,749.39	-
Biomass	74.07	-	-	-	-	-
RE	108.11	-	-	-	-	-
TOTAL	1,411.74	-	-	-	1,037,749.39	**0.735**

Input data	Value	Unit
Combined factor	0.805	tCO_2/MWh
EL^{in}	23.52	GWh
TGEN	6,560.9	GWh
EF^{in}	unknown	tCO_2/MWh
EL^{out}	420.75	GWh
EF^{out}	0.805	tCO_2/MWh

Impact of Imports	Value	Unit
Using a low EF^{in} (0,001)	0.805	tCO_2/MWh
Using a high EF^{in} (0,999)	0.808	tCO_2/MWh
Max range impact on Combined factor*	0.004	tCO_2/MWh
	0.44%	%

*Thus imports are negligible

Annex 4

MONITORING PLAN

1. Data to be Monitored

The following data will be monitored throughout the crediting life of the Las Vacas project:

- Monthly/annual electricity generated by the Las Vacas project and sold to the grid,
- Annual determination of the emission factor (operating margin) of Guatemala's electricity grid (weighted average excluding zero-and low cost sources) to recalculate the operating margin with monitored data,
- Annual determination of the emission factor (build margin) of Guatemala's grid (weighted average of recently built plants the most 20% of the generating units built) to recalculate the build margin with monitored data,
- Annual determination of the combined margin,
- Correction of emission factors due to import/export of electricity (as needed),
- At the renewal of each crediting period, confirmation that the project meets applicability requirements especially with regards to additionality.

As there are no project emissions, no data will be collected for the project emissions.

2. Procedures to be Followed for Data Monitoring and Calculations

Data will be monitored and calculated in the following manner:

- **Electricity generation from the proposed project activity**.
Total electricity generation energy will be monitored by HRLV, at the end of every month. An annual report of total generation for each year will be produced by HRLV. Data will be obtained from the power meters located at the HRLV substation. These meters comply with "Norma de coordinación comercial No.14" (NCC 14) of the local "Administrador del Mercado Mayorista", the entity that defines the local standards and parameters to be followed in the electricity generation sector. NCC 14 defines how the meters are set up and what kind accuracy is used. Since these meters are already installed on the project site and are already used for measuring electricity sold by HRLV, they will be also used for monitoring.

Responsibility:	*Lic. Cesar Guzmán*
Title:	*Financial Manager of HRLV*
Reporting Frequency:	*Yearly*
Quality Control:	*Comegsa will compare their own meters readings to those measured at the Substation where the secondary power line connects to the Utility grid.*

- **Annual determination of the operating margin emission factor of the grid using actual monitored data to calculate the weighted average of all plants operating on the grid excluding zero-and low cost sources to recalculate the operating margin with monitored data.**
The annual reporting of the operating margin emission factor will be carried out using data available from the Administrador del Mercado Mayorista (AMM - /www.amm.org.gt/). As the information for the previous year is not available in the first month of the following year, this report will be done once the data is available from the AMM, which is usually March of the

following year. The same assumptions and methodologies that were used for the initial calculations will be used for annual monitoring, unless more data is available from AMM, for example, fuel use at each plant, plant-specific efficiency factors or emissions factors. Otherwise default IPCC and IEA values will continue to be used. Note that the spreadsheets that were developed to calculate the baseline will be provided to HRLV and Comegsa for monitoring.

Responsibility:	Ing. Germán Juárez
Title:	Renewable Sources Engineer, Comegsa
Report Frequency:	Yearly
Quality Control:	HRLV will double check the calculations by following the same procedures a second time using data from the Administrador del Mercado Mayorista (AMM) . (Responsibility: Ing. Felino Milián, Geological and Environmental Engineer, HRLV)

• **Annual determination of the build margin emission factor of the grid using actual data from most recent 20% of existing plants of that specific year.**
The annual reporting of the operating margin emission factor will be carried out using data available from the Administrador del Mercado Mayorista (AMM - /www.amm.org.gt/). As the information for the previous year is not available in the first month of the following year, this report will be done once the data is available from the AMM, which is usually March of the following year. The same assumptions and methodologies that were used for the initial calculations will be used for annual monitoring, unless more data is available from AMM, for example, fuel use at each plant, plant-specific efficiency factors or emissions factors. Otherwise default IPCC and IEA values will continue to be used. Note that the spreadsheets that were developed to calculate the baseline will be provided to HRLV and Comegsa for monitoring.

Responsibility:	Ing. Germán Juárez
Title:	Renewable Sources Engineer, Comegsa
Report Frequency:	Yearly
Quality Control:	HRLV will double check the calculations by following the same procedures a second time using data from the Administrador del Mercado Mayorista (AMM) . (Responsibility: Ing. Felino Milián, Geological and Environmental Engineer, HRLV)

• **Annual determination of the combined margin** (calculated as an average of the build and operating margins)

Responsibility:	Ing. Germán Juárez
Title:	Renewable Sources Engineer, Comegsa
Report Frequency:	Yearly
Quality Control:	HRLV will double check the calculations by following the same procedures a second time using data from the Administrador del Mercado Mayorista (AMM). (Responsibility: Ing. Felino Milián, Geological and Environmental Engineer, HRLV)

• **Correction of emission factors due to import/export of electricity**. The annual reporting of the operating margin emission factor will be carried out using data available from the

Administrador del Mercado Mayorista (AMM - /www.amm.org.gt/). As the information for the previous year is not available in the first month of the following year, this report will be done once the data is available from the AMM, which is usually March of the following year. The same assumptions and methodologies that were used for the initial calculations will be used for annual monitoring, unless more data is available from AMM, for example, fuel use at each plant, plant-specific efficiency factors or emissions factors. Otherwise default IPCC and IEA values will continue to be used. Note that the spreadsheets that were developed to calculate the baseline will be provided to HRLV and Comegsa for monitoring.

Responsibility:	Ing. Germán Juárez
Title:	Renewable Sources Engineer, Comegsa
Report Frequency:	Yearly
Quality Control:	HRLV will double check the calculations by following the same procedures a second time using data from the Administrador del Mercado Mayorista (AMM) . (Responsibility: Ing. Felino Milián, Geological and Environmental Engineer, HRLV)

- **Confirmation of applicability and eligibility of the project at the renewal of the crediting period.** Following the first crediting period, a joint team will be formed composed of the following members: a delegate fron the Designed National Authority, HRLV and Comegsa. This team will review current information and reassess applicability of the baseline and monitoring methodology and project additionality.

Responsiblity:	Ing. Hugo Martinez
Title:	Plant Manager, HRLV
Reporting Frequency:	End of every crediting period
Team Members:	-Delegate from National Designed Authority - Delegate from Comegsa - Delegate from HRLV

Data necessary for determining the baseline and how such data will be collected and archived :								
ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1. EGy	Electricity supplied to the grid by the Las Vacas project	Project participants, metering on project site,	KWh/year	m	Hourly measurement and monthly recording	100%	electronic	Electricity supplied by Las Vacas to the national grid. To be double checked by sales receipts.
2. EFy	Emission factor of national grid	AMM. IPCC, IEA default values where local values aren’t available.	tCO_2eq/kWh	c	yearly	100%	electronic	Calculated as a weighted sum of emission factors of the Operating Margin and Build Margin
3. EF_OMy	Emission factor of grid, operating margin	AMM. IPCC, IEA default values where local values aren’t available	tCO_2eq/kWh	c	yearly	100%	electronic	Calculated as TEMy divided by TGENy
4. EF_BMy	Emission factor of national grid (Build Margin)	AMM.IPCC, IEA default values if local values not availablep[0-6	tCO_2eq/kWh	c	yearly	100%	electronic	Calculated as [∑i Fi,y*COEFi] / [∑k GENk,y] over 20% recently built power plants as defined in the baseline methodology
5. TEMy	Total emissions of the national grid	AMM	$tCO_2eq/year$	c	yearly	100%	electronic	Calculated as the sum of GHG emissions of each plant on the grid

6. TGENy	Total electricity generation of the national grid excluding hydro, geothermal and biomass	AMM	kWh/year	c	yearly	100%	electronic	Calculated as the sum of electricity generated on the grid excluding zero- or low-operating cost sources, ie. Excluding hydro, geothermal and biomass
7-i. Fiy	Amount of each fossil fuel consumed in the grid	AMM and plant efficiency factors from AMM or IEA default values.	TJ/year	m	yearly	100%	electronic	Obtained from Administrador del Mercado Mayorista (AMM)
8-i COEFi	GHG emission coefficient of fuel i	Local data or IPCC if no local data is available	tCO_2eq/TJ	m	yearly	100%	electronic	Obtained from the latest local statistics or IEA statistics if local statistics are not available.
9-j GEN	Electicity generation of plant j	AMM	kWh/yr	m	yearly	100%	electronic	Obtained from AMM
10.	Identification of plants to be used for OM	AMM	-	m	yearly	100%	electronic	Identification of plants (j) to calculate Operating Margin emission factor; does not include zero-emission plants
11.	Identification of plants to be used for BM	AMM	-	m	yearly	100%	electronic	Identification of plants (k) to calculate Build Margin Emission factor, most recent 20% of existing plants
12. W_{OM} and W_{BM}	Weighting factor for OM:BM		-		Yearly or fixed	100%	electronic	Default weighting factor of 0.5 will be used.
13.	Documented Evidence of the prohibitive barriers of the proposed project activity.	Evidence documents	-		Once at the renewal time of the crediting period	100%		A team will be formed to review up-to-date data and assess ongoing eligibility and additionality of the project.

14.	Documented information related to the alternative to the project, especially diffusion data.	Evidence documents	-		Once at the renewal time of the crediting period	100%		A team will be formed to review up-to-date data and assess ongoing eligibility and additionality of the project.

Sustainable Development Indicators:

In addition to the monitoring data for the determination of the baseline as established in methodology AM0005, the contribution of the project to sustainable development will be monitored using the following indicators, from 2005 (once the ordinary production regime is achieved):

- **Water Oxygenation.** Monthly, HRLV will measure the amount of oxygen diluted in the water at the locations “Puente Bailey” and “Desfogue de casa de máquinas” and will ellaborate a report describing the results. The data will be measured directly in situ using a portable oxygen monitor.

  Responsibility: Ing. Felino Milián
  Title: Environmental and Geological Engineer HRLV
  Frequency of data measurements : Monthly
  Reporting Frequency :Yearly.
  Quality Control: The data sampling procedure will include a previous calibration of the measuring equipment and at least 3 different measurements will be taken.

- **Dredged Material.** The daily quantity of sand extracted from the dam and the amount used for construction materials in cubic metres, will be monitored on a daily basis. A monthly a report will outline the quantities of extracted and utilized sand.

  Responsibility: Ing. Oscar Medina
  Title: Plant supervisor of HRLV
  Frequency of data measurements: Daily
  Reporting Frequency :Monthly
  Quality Control: HRLV will confirm the data contained in the report comparing it with data obtained from the receipts from the aggregates company (Responsibility: Cesar Guzmán, Financial Manager of HRLV)

- **Plastic Waste.** HRLV, will monitor the weight, in kilograms, of the plastic waste extracted from the riverbed once it has been crushed and prepared for the extruder.

  Responsibility: Turn operator
  Title: Plastic Plant Operator
  Frequency of data measurements: Daily
  Quality Control: HRLV will verify weekly the coherence of the information registered by the operator (Responsibility Ing. Felino Milián)

- **Reforested Area.** The number of hectares of land reforested will be monitored annually according to the data in the report emitted by the Instituto Nacional de Bosques (INAB) for the company in charge of the reforestation.

  Responsibility: Ing. Oscar Medina
  Title: Supervisor de Planta HRLV
  Frequency of data measurements: Daily
  Reporting Frequency: Anual
  Quality Control: The INAB will verify in situ the area effectively reforested by the company in charge.

- **Social Responsibility.** HRLV will dedicate an annual budget item to socially responsible activities where concepts such as literacy plans, campaigns for deparasitation and environmental awareness programs will be included as well as other activities that due to their nature fall whithin this budget item.

  Responsibility: César Guzmán
  Title: Financial Manager HRLV

3. Calculation of Leakage

Leakage will be treated by adjusting the baseline emission factor for imported and exported electricity using the formula above. The amount of electricity imported into the Guatemalan grid and the amount exported each year will be collected, and emission factors for imported and exported electricity will be calculated.

Data and information that will be collected in order to monitor leakage effects of the project activity								
ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
15. EL^{in}_y	electricity	AMM	kWh	c	yearly	100%	electronic	Obtained from latest local statistics, primarily from AMM.
16. EL^{out}_y	electricity	AMM	kWh	c	yearly	100%	electronic	Obtained from latest local statistics, primarily from AMM.
17. EF^{in}_y	Emission factor of imported electricity	AMM, and data from source country	tCO_2eq/kWh	c	yearly	100%	electronic	Obtained from latest local statistics, eg from AMM and from data from source country, for example El Salvador. When the effect of imports on the calculation of the emission factor for Guatemala overcomes 0.5%, the imports will not be considered negligibles.
18. EF^{out}_y	Emission factor	AMM	tCO_2eq/kWh	c	yearly	100%	electronic	Obtained from latest local statistics, for example AMM.

4. Formula used to Calculate Baseline Emissions and Leakage for Project Monitoring

Baseline emissions will be estimated using the formulae provided in the monitoring methodology (AM0005) and listed below. In order to facilitate monitoring, spreadsheets will be created (similar to that used to calculate emissions reductions using 2003 data) where annual data can be entered and calculations carried out automatically**.**

Baseline emissions are equal to $EG_y * EF_y$

where EG_y is the electricity supplied to the grid, EFy is the GHG emission factor of the grid as calculated below.

The emission factor EFy of the grid is represented as a combination of the Operating Margin and the Build Margin. If we set the emission factor of associated method as EF_OM_y and EF_BM_y, the EF_y is given by:

$EF_y = w_{OM} * EF\_OM_y + w_{BM} * EF\_BM_y$

with respective weight factors w_{OM} and w_{BM} (where $w_{OM} + w_{BM} = 1$), and by default, are weighted equally ($w_{OM} = w_{BM} = 0.5$).

The Operating Margin emission factor EF_OM_y is defined as the generation-weighted average emissions per electricity unit (tCO_2 / MWh) of all generating sources serving the system, excluding zero- or low-operating cost power plants (hydro, geothermal, wind, low-cost biomass, nuclear and solar generation), based on the latest year statistics data and are derived from the following equation:

$$EF\_OM_y = TEM_y / TGEN_y = [_i \sum F_{i,y} * COEF_i] / [\sum_j GEN_{j,y}]$$

Where TEM_y and $TGEN_y$ is the total GHG emissions and electricity generation supplied to the grid by the power plants connected to the grid excluding zero- or low-operating cost sources. $F_{i,y}$ and $COEF_i$ are the fuel consumption and associated carbon coefficient of the fossil fuel i consumed in the grid. $GEN_{j,y}$ is the electricity generation at the plant j connected to the grid excluding zero- or low-operating cost sources.

The Build Margin emission factor EF_BM_y is given as the generation-weighted average emission factor of the selected representative set of recent power plants represented by the most 20% of the generating units built (summation is over such plants
specified by k):

$$EF\_BM_y = [\sum_i F_{i,y} * COEF_i] / [\sum_k GEN_{k,y}]$$

as the default method. The summation over i and k is for the fuels and electricity generation of the plants mentioned above.

If the grid imports or exports electricity from/to other grids, the associated correction

$$EF_y \rightarrow EF_y + \frac{EL^{in}}{TGEN_y} \times EF_y^{in} - \frac{EL^{out}}{TGEN_y} \times EF_y^{out}$$

is needed unless such correction is demonstrated to be conservative or negligible, where EL^{in} (EF_y^{in}) and EL^{out} (EF_y^{out}) are electricity coming in and going out of the grid (and their associated emission factors); and $TGEN_y$ is the electricity generated in the grid. The arrow means replacement of the EF_y by the right-hand-side of the above formula.

5. Quality Control and Quality Assurance

All variables used to calculate project and baseline emissions are directly measured or use publicly –available official data. To ensure the quality of the data, in particular those that are measured, the data are double-checked against commercial data. The quality control and quality assurance measures planned for the Project are outlined in the table below:

Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored		
Data	Uncertainty level of data (High/Medium/Low)	
1	Low	This item will be directly used for calculation of emission reductions. Sales records to the grid and other records will be used to ensure consistency.
13,14	Low	These data are used to check whether the applicability conditions are met.
Others	Low	Default data (for emission factors) and IEA statistics (for energy data) will be used to check local data.

6. Operational and Management Structure Implemented by Project Operator

The financial division of HRLV 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. César Guzman of this division will be directly responsible for monitoring activities for the first crediting period.

Ing. Germán Juárez a Renewable Energy Sources Engineer at Comegsa will be responsible for monitoring data and carry out the calculations for the emissions factors including the operating margin emission factor, build margin emission factor, combined margin emission factor and import/export adjustment.

Following the first crediting period, a joint team will be formed composed of the following members: HRLV, Comegsa and a representative from the purchaser of CERs. This team will review current information and reassess applicability of the baseline and monitoring methodology, and project additionality.

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