CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

SECTION A. General description of project activity

A.1 Title of the project activity:

Berlin Binary Cycle power plant
Version 4. 25/10/2007

A.2. Description of the project activity:

Berlin Binary Cycle is a renewable energy project that will increase the power generation capacity in 9.2 MW at the Berlin Geothermal field, by means of the conversion of thermal energy of low pressures geothermal brine into electrical energy. The technology of binary cycle is used for first time in El Salvador in this new plant.

The developer and operator of the project is *LaGeo, S.A. de C.V.* that belongs to *Comisión Ejecutiva Hidroeléctrica del Río Lempa*[1] (CEL) and ENEL Latin America[2].

The goals of the Berlin Binary Cycle project are as follows:

1. To produce clean electric power, free of greenhouse effect emissions, to be injected to the electric network of El Salvador with the purpose of contributing to meet the electric power demand. It is estimated that the Berlin Binary Cycle shall produce an average of 63,700 MWh per year, which shall be sold at the spot market called System Regular Market, since it does not have a purchase power agreement.

2. To increase the efficient use of geothermal resources of Berlin field by means of a conversion facility able to transfer the residual heat from a geothermal fluid to an organic fluid (isopentane) applying a thermodynamic binary cycle.

3. To contribute to the sustainable development at local and global levels, utilizing the renewable energetic resources, and strengthening the local synergies to foster the development of the communities in the influence area through the following measures[3]:

    - Environmental dimension

      It avoids the emission to the atmosphere of approximately 44,141 t CO_2 per year, through the utilization of renewable resources to generate electric power, thus contributing to the mitigation of the global climate change.

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[1] *Comisión Ejecutiva del Río Lempa* (Hydroelectric Executive Comision of the Lempa River) is the state company that majority owns LaGeo, S.A. LaGeo is the owner and operator of two geothermal plants in El Salvador in the geothermal fields of *Ahuachapán* and *Berlín since* 1999.

[2] Enel Latin America is a minorty shareholder in LaGeo, holding 8.5% of the company´s shares since 2002.

[3] See Environmental and socio-economic impacts of the project in annex 5.

It reduces the emission of NOx, SOx and other pollutants to the atmosphere, avoiding the combustion of fuels by existing thermal plants to generate electricity in the El Salvador.

It contributes to preservation of natural resources through the establishment of a wildlife protection park in the area of Berlin geothermal field.

- Economic dimension

  It transfers new technology from Iceland geothermal utilities to LaGeo, S.A. de C.V., developing skills in isopentane handling.

  The project contributes to reduce poverty through job generation, since there is a commitment to create 80 positions of non-qualified labour during the power plant construction, which shall be occupied by the inhabitants of the influence area, through a rotary plan.

  Besides contributes to local economic growth fostering different activities. The operation of the wildlife protection park will require of personnel and ecotourism services which it will give rise to the creation of new jobs, in the same way, the fostering of development community projects in productive areas as an organic coffee plantation will promote communities sustainable development.

- Social dimension

  Improves quality of life through the opportunities offered in the wildlife protection park through environmental education and recreation activities.

From its conception, the project developers considered the reduction of emissions of CO_2 and their sale to overcome the barriers faced by the project. If it does not have the financing of the Clean Development Mechanism, the decision to carry out the project would have not been made; therefore, the project activity is additional to the baseline. Likewise, the income obtained from the sale of CERs shall be a part of the funds that allow the support of initiatives contributing the sustainable development of the communities in the area of action of the project.

A.3. Project participants:

Name of party involved	Private and/or public entity(ies)	The party involved wishes to be a project participant
El Salvador (host)	Private entity: LaGeo S.A. de C.V.	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

El Salvador

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

Usulután

A.4.1.3. City/Town/Community etc:

Alegría

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

Binary Cycle Berlin is located at 75 km to the south-east of San Salvador city. It lays on the north slope of the Berlin -Tecapa volcanic system.

The Binary Cycle Berlin facility is located at the platform TR-9[4] at the Berlin geothermal field, in the coordinates: North 266,689.543 East 266,689.543 Elevation 668.128

To arrive to the site project, the distance by car is 100 km from San Salvador City by the Panamerican Road and then by the Mercedes Umaña-Berlin road.

Fig. 1. Geographic location of the Berlin Binary Cycle.

The generation plant is connected to the grid through an electric substation in Berlin bus of the 115 kV transmission system.

[4] See annex 7.A.

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

Sectorial scope: Energy industries (renewable resources)

Category: Renewable based grid connected electricity generation

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

Currently, the geothermal wells at Berlin Phase One Plant produce a two-phase mixture of steam and liquid aqueous brine. The steam is used to produce electricity and the brine is re-injected into the wells for this purpose. The waste brine has a temperature of 180º C, which internal energy is wasted.

The conversion facility called Binary Cycle Berlin is designed to extract energy from the waste brine of Berlin Phase One plant, wells TR4/5 and TR2/9, and transforms the thermal energy into electricity, through a technology based on Carnot cycle[5]. The capacity installed of the power plant is of 9.2 MW with a capacity factor of 0.7904. The capacity factor depends on the availability of the resource, the plant design, and includes the primary reserve and a discount by the energy consumed in the plant for auxiliary services. Therefore, the capacity factor of 0.7904 is an indicator of the net energy available to be injected to the grid at maximum capacity.

During the process of energy conversion, the brine is fed to a heat exchanger, where evaporates the working fluid isopentane and then is pulled to a turbine where is expanded, transforming the geothermal energy into mechanical energy. The turbine is coupled to a generator to produce electricity.

The working fluid is driven to the cooling tower where it is condensed; afterwards at the exit of the condenser it is taken by a pump to repeat the cycle. The working fluid shall be maintained within a closed-circuit during plant operation, with replacements of 108 kg/year, during the programmed maintenance works.

The geothermal brine used shall have a descent of approximately 40 degrees Celsius and shall be again integrated to the re-injection line, thus maintaining its nature as renewable resource.

The technology to be used by the project is implemented for the first time at El Salvador, by this reason LaGeo, S.A. de C.V. is in charge of construction and operation of the plant under the supervising of Enex hf in order to achieve a successful transference of technology. Enex hf provides engineering, equipments, construction management, assembly and personnel training under an EPCM contract. LaGeo personnel have visited Enex facilities in Iceland and three operators will have training for the maintenance and operation of the plant, mainly in isopentane handling, for three weeks.

Even though there is no previous experience regarding the same, environmentally it is foreseen as safe, since during the generation of power no fuels are burned, no emissions are generated and no wastes are dumped to the environment.

[5] See annex 7.B.

A.4.4 Estimated amount of emission reductions over the chosen crediting period:

Table 1. Annual estimation of emission reductions.

		Annual estimation of emission reductions (t CO_2)
Year 1	2007	14,754
Year 2	2008	44,141
Year 3	2009	44,141
Year 4	2010	44,141
Year 5	2011	44,141
Year 6	2012	44,141
Year 7	2013	44,141
Year 8	2014	29,387
Total estimated reductions (t CO_2)		308,984
Total number of crediting years		7
Annual average over the first crediting period of estimated reductions (t CO_2)		44,141

A.4.5. Public funding of the project activity:

No public funds are available.

SECTION B. Application of a baseline and monitoring methodology

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

Berlin Binary Cycle power plant uses: "Consolidated Baseline Methodology for Grid-connected Electricity from Renewable Sources" (Version 06 of ACM0002).

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

- The project activity implies electricity capacity additions from geothermal resources.
- The project activity will not switch fossil fuels to renewable resources at Berlin geothermal field.
- The geographic borders and boundaries of the grid system are clearly identified, and the data from the Salvadorian electric system is available.

B.3. Description of the sources and gases included in the project boundary

Table 2 indicates the sources and gases included in the project boundary. The project boundary includes the physical site of the plant and the spatial extend of the project boundary includes all power plants connected to the electricity system and form part of the wholesale electricity market.

Table 2. Sources and gases included in the project boundary.

	Source	Gas	Included?	Justification/explanation
Baseline	Power plants connected to the grid	CO_2	Yes	GHG in the baseline are due thermal plants
		CH_4	No	Power plants do not produce CH_4
		N_2O	No	Power plants do not produce N_2O emissions or are negligible
Project activity	Construction	CO_2	No	The emissions produced during construction due vehicles and machinery are negligible in relation to the emission reductions that the power plant will produce
		CH_4	No	CH_4 is not produced
		N_2O	No	N_2O is not produced
	Operation	CO_2	No	There will not be auxiliary plants and fuel consumption for electricity production
		CH_4	No	CH_4 is not produced
		N_2O	No	N_2O is not produced

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

- **National policies and circumstances:**

The becoming effective of the General Electricity Law during 1996 allowed the development of a wholesale electricity market in El Salvador to promote competitiveness of the electric power generation, transmission, distribution, and marketing enterprises, with the purpose of fostering the access to the electric power supply for all sectors of the population[6].

The Wholesale Market is managed by the Transactions Unit, UT[7], and is formed by the Contract Market and the System Regulator Market (MRS) or Opportunity Market. To manage the Wholesale Market, the UT bases the programmed dispatch in the purchase-sale transactions of electric power agreed between the particular parties that participate in the Contract Market, while the MRS uses the same to balance the power supply and demand.

That is to say, the UT first dispatches the obliged contracts, and then the economic dispatch is made until the demand is satisfied. Likewise, the MRS works on the basis of bids and prices corresponding to increases or decreases of the amounts of electric power established in the programmed dispatch. The MRS prices are defined by the last plant dispatched.

Deviations of each participant regarding the programmed dispatch shall be evaluated at the prices resulting from the MRS operation. Thus, the generator agent which plant generates more than that programmed, the excess shall be valued at the MRS prices, and if it generates below the program, it shall be charged based on the cost of the energy required to replace the amount not delivered.

- **Scenario of the baseline**

The demand of the power required for the wholesale electricity market has had an average increment of 3.1 % per year during the last five year, as indicates table 3.

Table 3. Maximum demand.

Year	2001	2002	2003	2004	2005	Average
Demand (MWh)	734	752	785	809	829	
Increment (%)		**2.5%**	**4.4%**	**3.1%**	**2.5%**	**3.1%**

In order to cover the incremental demand, the system losses, the reserve and the future opportunities for exporting, new plants have been developing in El Salvador. Since effect of General Electricity Law in 1996, the investments in generation have been principally in fossil fuel fired power plants by generation private companies, and in a minor scale, state-owned CEL has added capacity to the system through the

[6] http://www.siget.gob.sv/documentos/electricidad/legislacion/ley_general_de_electricidad_ref42.pdf

[7] http://168.243.84.62/utweb/introduccion.htm

repowering of the existing hydro plants and LaGeo, S.A. de C.V. has developed geothermal plants, as a consequence of this situation, thermal generation predominates in the Salvadorian generation mix as is illustrated in figure 3.

The recent and new inversions in thermal plants are significant, continuing the business as usual scenario and the CDM incentive is obvious as of 2005, balancing in this way the energy matrix.

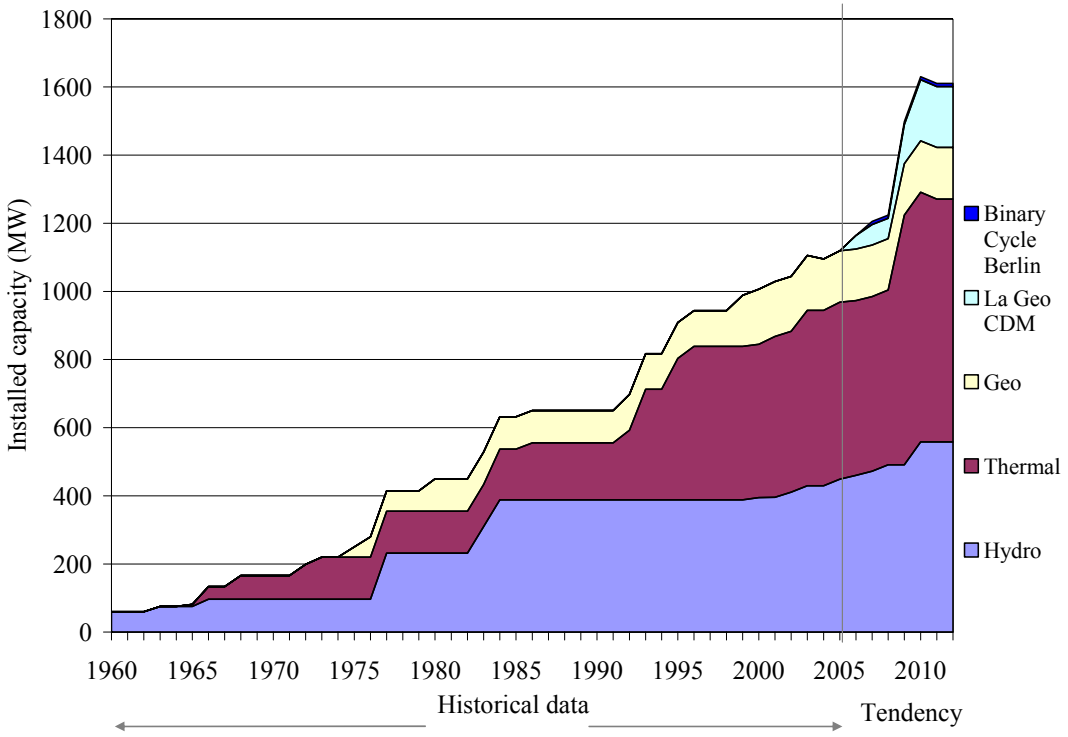

Fig.2 Capacity installed: historical and tendency

The graph of the capacity installed was been constructed considering the following information:

The historical information is obtained from chart 7, page 53, of the *Boletín de Estadísticas Eléctricas 2005* (Electric Statistic 2005) published by *Superintendencia de Electricidad y Telecomunicaciones* (SIGET).

At present, a new 50 MW thermal plant was constructed in La Libertad in order to meet the electricity demand and cover the present electricity short-age. The Comisión Ejecutiva *Hidroeléctrica del Río Lempa* (CEL) awarded to Wärtsila the construction of this plant, which is financed by Central America Bank of Economic Integration (CABEI)[8, 9].

[8]Boletín Estadísticas 2005, SIGET, page 4.

[9] See *La Prensa Gráfica*, May 15, 2006, http://www.laprensa.com.sv/economia/436731.asp

AES informed in a press release that will invest in a 220 MW carbon plant. This plant will be in commercial operation as of 2009[10].

According to CEL planning, El Chaparral hydroelectric plant of 67.4 MW will start operation in 2010. This plant is considered as a CDM project in the present analysis.

Additionally, LaGeo, S.A. de C.V. is developing and planning 3 geothermal that will be developed as CDM projects in order to overcome the barriers prevailing to renewable projects

- **Scenario of the project's activity**

In absence of Binary Cycle Power Plant, the Transactions Unit (*Unidad de Transaciones* , UT) would be required to dispatch a unit generation equivalent in power and energy to Binary Cycle Berlin, in order to supply the demand and grid losses of the electric system.

Considering the present conditions of demand and installed power prevailing in the crediting period, the energy and power which will replace Binary Cycle Berlin shall originate mainly from thermal plants, since the Opportunity Market ties the supply and demand offers in an economic manner, so the last plant dispatched is the plant with the highest price. Generally, the thermal plants have a high price due to fuel costs, as compared with plants of renewable power, and this way are marginal plants.

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

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

The additionality of the project activity is demonstrated by taking in to consideration the barriers the project faces. The demonstration and assessment of additionality uses the Tool for the Demonstration and Assessment of Additionality (version 3).

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

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

The General Electricity Law of El Salvador allows an open and competitive electricity market, and the investment in new electricity generation plants is free.

Therefore, the credible and plausible alternatives to be considered available to project participants or similar types of project developers that provide outputs or services comparable to the proposed CDM project activity are:

[10] *El Diario de Hoy*, August 2, 2005, http://www.elsalvador.com/noticias/2005/08/22/negocios

Alternative A:

LaGeo, S.A. could decide not to make the investment, thus the electricity sector in El Salvador would continue with the business as usual scenario. Under these conditions, the utilization factor of the fuel fired plants connected to the grid would increase or new fuel fired plants additions would occur in order to meet the electricity demand.

The prevailing practice in El Salvador is the investment in thermal plants because these technologies requires a less initial inversion, have shorter front-up times, additionally they do not imply technological risks due to penetration grade observed in the country. At present, several generation projects of fuel based technologies are being developed in El Salvador: Cutuco Energy develops a natural gas plant of 525 MW and AES develops a carbon plant of 300 MW, both have presented the Environmental Impact Assessment to Ministry of the Environment and Natural Resources[11]. Talñique a 50 MW fuel based plant started operations in January 2006[12], which was developed by CEL (*Comisión Ejecutiva del Río Lempa)*.

To consider the lack of incentives for renewable projects as a barrier for the activity project, it is a conservative approach because the trend on power plants inversion indicates that is necessary to promote renewable technologies in order to reverting the present situation and increase the share for renewable energies in the country[13].

Alternative B:

Develop the proposed project activity without being registered as a CDM project activity, is certainly an alternative to be considered.

Sub-step 1.b. Consistency with mandatory laws and regulations:

The identified alternatives are in compliance with all applicable laws and regulations for power plants development in El Salvador, therefore the project passes Step 1 of the additionality test.

Step 2. Investment analysis.

Not applicable.

Step 3. Barrier Analysis.

Sub-step 3a. Identification of barriers that would prevent the implementation of the proposed CDM project activity

[11] http://www.elsalvador.com/mwedh/nota/nota_completa.asp?idCat=2926&idart=1140198

[12] http://www.laprensa.com.sv/lodeldia/6619.asp

[13] See La Prensa Gráfica, May 15, 2006, http://www.laprensa.com.sv/economia/486994.asp

- **Barriers identification**

Technological barrier

The project faces technological barriers since this is the first time a binary-cycle system is applied to generate electric power in El Salvador[14], which implies risks due to the uncertainty in its operation.

The amount of power that could be generated, it will depend on how much heat can be extracted from the brine before silica scaling becomes a problem. Silica poses a serious operational constraint in geothermal field operations due to the formation of scales in surface pipework and the injection wells as the brine cools and ages, which could affect the operation of the binary plant and/or the downstream injection system.

Thermal projects do not face these types of technical barriers given the degree of experience found in El Salvador on technologies based on fossil fuels therefore the operation costs can be foreseen in an almost certain manner.

Cycle Binary Power Plant is the first plant of its type constructed in El Salvador, and to consider this situation as a barrier, is conservative approach because the mathematical model that describe brine availability and effectiveness of the silica management procedures could be proved and adjusted until the operation of the plant. Thus, electricity production may have fluctuations due brine availability and the amount of heat extracted from it, and this situation could be compensated with CERs sale.

In the other hand, there was not available trained labour to operate and maintain cycle binary technologies in El Salvador, by this reason several engineers of LaGeo were trained in the different systems of the technology (including isopentane system), risk management, environmental management, operation and maintenance.

Investment barrier

The project faces investment barriers due to the fact that El Salvador does not acknowledge fiscal incentives to renewable energies projects as is done in Guatemala and other Latin American countries, and which places Binary Cycle Berlin in a competitive disadvantage regarding a thermal project that is more profitable because requires smaller up-front investments and it has less risks during operation.
The sale of CERs was considered from the inception of the project in order to overcome investment barrier, having made different approaches with the World Bank since April 2000 and with Finnish

[14] Currently, in El Salvador there are two geothermal fields, Berlin and Aguachapan, exploited both by *LaGeo, S.A. de C.V.* In Aguachapan plant, the waste brine was transported via a 5 km pipeline to sea until 2003 and now is sent directly to injection wells located in the same geothermal and is not used for a binary cycle plant. *LaGeo, S.A. de C.V.* will analyze the feasibility to implement a binary cycle system in Aguachapan plant afterwards the evaluation of Binary Cycle Berlin experience.

In Berlin field, there are two plants, Phase one and Phase two. The waste brine associated to Berlin Phase One will be used for a binary cycle plant (present project) and in the case of Berlin Phase Two, plant starts operations in 2006 and it is necessary to develop a feasibility study previously to implement this system.

CDM/JI Pilote Programme since March 2003 in order to negotiate an Emissions Reduction Purchase Agreement. Project Input Notes have been submitted to both entities[15].

The financial analysis of the project results in an internal rate of return of 13.7% on an optimistic scenario, without barriers. This IRR correspond to the initial financial model presented during the validation on site, which does not include risks of the electricity market, technical risks and the investment required to support the wildlife protection park.

Barrier due to prevailing practice

The project faces a barrier due to prevailing practice due the Salvadorian electricity market conditions existing. At El Salvador there are no long-term contracts and the energy of Binary Cycle Berlin will be sold at the Opportunity Market, MRS, which implies uncertainty in the cash flow for power sales. The MRS is a volatile market whose prices are in function of several factors as petroleum international prices, generating units available, transmission system restrictions and hydraulic conditions, etc. In 2004, it had a 4.6 % decrease respect 2003, according to UT[16]. In contrast, 2006 shows an upward tendency, but in the long term RMS prices are totally unpredictable.

The uncertainty to operate in the Opportunity Market is intensified in the case of this project, given the fluctuating nature of the geothermal resource, which does not happen with a thermal plant that has a foreseen fuel amount.

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

Step 1 of the application of the Tool for Demonstration and Assessment of Additionality (version 03), presented before concluded that there were two credible alternatives to be considered: continuation of the current situation and development of the proposed project activity without being registered under the CDM.

Clearly, the second alternative would have been equally affected by the identified barrier and therefore is not a valid alternative under the CDM.

In the business as usual scenario, the fuel fired plants installed at present or the new thermal projects do not face the barriers that have to overcome the renewable projects, because they do not require licenses for the exploitation of resources and are well known technologies. In El Salvador, the last inversions in generation have been in power plants based in internal combustion engines that are modular plants. Pre-engineered and pre-tested modules minimize erection time and maximize reliability, doing a thermal project more feasible than a geothermal project.

Therefore, there is one viable alternative that is not prevented by the barriers identified and the project passes Step 3 of the additionality test.

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[15] Documents have been available to the Assigned Operational Entity during validation process.

[16] See *Boletín Estadísticas Siget 2004*, page 38.

Step 4. Analysis of common practice.

Sub-step 4a. Other activities similar to the proposed Project activity
There are not other options technologically similar to Berlin Binary Cycle power plant; this is the first project of this nature developed in El Salvador. Please refer to footnote 12.

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

There are not other projects that have implemented cycle binary technologies in El Salvador. LaGeo analyzed a similar project to be implemented in Ahuachapán field, but did not result technically feasible in the first assessment.

It is concluded that there are no similar activities to the proposed project activity and project passes step 4 of the additionality test, then the project activity is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

The calculation of the reduced emissions is done following the procedures established in the approved consolidated baseline methodology ACM0002, version 06.

Step 1. Operating Margin emission factor

The first option to calculate the Operating Margin should be the Dispatch Data Analysis, which is not used because the post-dispatch information available is not enough to complete the calculation.

The electric energy produced by the low-cost and must run plants during the last fiver represent more than 50% of the generation of the plants connected to the grid, therefore the Simple OM method is no applicable and the suitable option is the **Simple Adjusted OM method**.

For Operating Margin emission factor calculation, the emission factor of imports is considered equal to 0 t CO_2 per MWh because the electricity imported comes from connected electricity systems in other countries of Central America.

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

The Operating Margin emission factor, EF_{OM}, is calculated using simple adjusted method as is indicated in equation 1. The detailed formula is shown in equation 6.

$$EF_{OM} = \lambda \text{ (Low cost and must-run plants emission factor)} + (1-\lambda) \text{ (Other plants of the system emission factor)} \quad \text{Eq. 1}$$

Where λ is equal to number of hours per year for which low cost and must-run plants are on the margin divided by the total hours per year. The low-cost plants are the hydroelectric, geothermal plants and cogenerators connected to the grid.

Lambda is calculated graphically. The number of days that low cost and must-run plants are on the margin is calculated as the intersection of the value of equivalent power of these plants and the load duration curve.

For lambda calculation, is considered the amount of energy supplied to the grid by each cogeneration plant, not the gross production.

The following chart illustrates the calculation of lambda and the load duration curve, according wholesale market demand data from *Unidad de Transacciones*, UT.

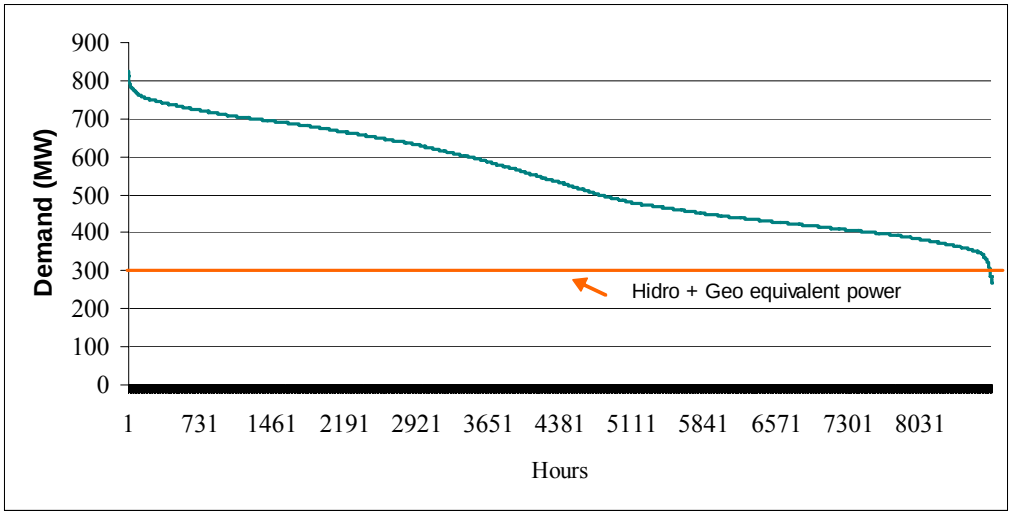

Fig. 3 Lambda factor calculation

Step 2. Build Margin emission factor

The Build Margin emission factor represents the tendency of the mix of generation and is calculated for the five most recent capacity additions and for the most recent capacity additions that represent the 20% of the power of the system. Project participants will use from the two options the group that comprises the larger annual generation of electricity.

CDM projects are excluded from calculation. Additionally imports are excluded because at the moment of submit the PDD is not clear the interchange of electricity through the *Sistema de Interconexión Eléctrica de los Paises de América Central* (SIEPAC).

Step 3. Base line emission factor

The baseline emission factor is calculated as the weighted average of the OM emission factor and the BM emission factor, where the weight factor for both is the default value equal to 0.5, for the first crediting period. Weight factor will be revised at the renewal of the crediting period.

Data vintages

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

Definition of boundaries

For determining the Operating Margin emission factor and the Build Margin emission factor, the spatial extent of the project boundary includes the project site and is limited to the project electricity system. The project electricity system is the spatial extent of the power plants connected to the Salvadorian electric grid and dispatched without significant transmission constraints. See annex 3.1 for more details of the project site and project electricity system.

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

Data / Parameter:	**Electricity by generating units**
Data unit:	MWh
Description:	Annual energy produced by the plants connected to the grid and form part of the wholesale and minorist market
Source of data used:	*Unidad de Transacciones* ,UT (Unit transactions) and generators
Value applied:	Please see table A1, annex 3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Electricity generated by the plants data is used to calculate the Operating Margin and Build Margin. Electricity is measured through measurement equipment installed in each plant according to Wholesales Electricity Market and Transmission System Operation Regulation.
Any comment:	

Data / Parameter:	**Fuel consumption of each generating unit**
Data unit:	gal
Description:	Fuel consumption of each generating unit connected to the grid and form part of the wholesale market
Source of data used:	Agents generators
Value applied:	This information is confidential, but is available to Operational Entity designated
Justification of the choice of data or description of measurement methods and procedures actually applied :	Fuel consumed by the plants data is used to calculate the CO2 emissions produced per plant and the Operating and Build Margin. This information is requested by MARN to each generator.
Any comment:	

Data / Parameter:	**Heat content**

Data unit:	BTU/gal
Description:	Heat content of the fuel used by each generating unit connected to the grid
Source of data used:	DOE, http://www.eia.doe.gov/oiaf/aeo/pdf/apph.pdf
Value applied:	For fuel oil No.6 is used 149,690 and for diesel 138,690
Justification of the choice of data or description of measurement methods and procedures actually applied :	Heat content is used to calculate the carbon emission per fuel used
Any comment:	This information is from small scale baseline calculation by MARN

Data / Parameter:	**Fuel CO_2 content**
Data unit:	Kg CO_2/MMBTU
Description:	Fuel consumption of each generating unit connected to the grid and form part of the wholesale market
Source of data used:	EIA
Value applied:	For fuel oil No.6 is used 78.0 and for diesel 72.4
Justification of the choice of data or description of measurement methods and procedures actually applied :	Fuel CO_2 content is used to calculate the CO2 emissions produced per plant and the Operating and Build Margin.
Any comment:	This information is from small scale baseline calculation by MARN

B.6.3 Ex-ante calculation of emission reductions:

1. Calculation of emissions reductions

Emissions reductions due project activity are calculated according to equation 1.

$$ER_y = BE_y - \text{GHG emissions by sources} - \text{leakages} \quad \text{Eq.1}$$

Where:

ER_y = Emissions reductions (t CO_2)

BE_y = Baseline emissions reductions (t CO_2)

The baseline emissions reductions per year are calculated using the following equation:

$$BE_y\ (t\ CO_2) = EG_y\ (MWh) \bullet EF_y\ (t\ CO_2/MWh) \qquad \text{Eq. 2}$$

Where:

BE_y = Emissions in the baseline setting (t CO_2)

EG_y = Energy produced by the Binary Cycle Berlin during the year *y* (MWh)

EF_y = Emissions factor (t CO_2/MWh)

y = year

2. Estimate of GHG emissions by sources

It is not applicable because Binary Cycle Power Plant does not generate any emissions during electricity production. The plant will not use the steam produced by wells, therefore there are not fugitive emissions of carbon dioxide and methane due to release of non-condensable gases from steam.

3. Estimated leakage:

The project activity does not have any leakage because CO_2 emissions resulting from fuel consumed by machinery and vehicles during construction are negligible. In order to assure that they are negligible, CO_2 emissions are calculated as follow:

$$LE_{machinery} = [F_{i,\ machinery} \bullet CEF_i \bullet 44/12] + [F_{i,\ vehicles} \bullet CEF_i \bullet 44/12] \qquad \text{Eq. 3}$$

Where:

$LE_{machinery}$ = CO_2 emissions due to fuel *i*, consumed by machinery required during construction (t CO_2).

$F_{i,\ machinery}$ = Amount equivalent of fuel *i* used[17] during construction by machinery (TJ).

$F_{i,\ vehicles}$ = Amount equivalent of fuel *i* used[18] during construction by vehicles (TJ).

CEF_i = Carbon emission factor of fuel *i*[19] (t C/TJ).

The amount of fuel equivalent *i*, in TJ, is calculated as:

[17] Data reported by contractor to LaGeo, S.A. de C.V.

[18] Data reported by contractor to LaGeo, S.A. de C.V.

[19] Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories Workbook.

F_i = Volume (gal) • Density fuel (10^3 tonnes/gal) • NCV_i	Eq. 4

Where:

Volume = Fuel volume (gal)

Density = Density fuel (10^3 tonnes/gal)

NCV = Net Calorific Values of fuel *i* according to IPCC data (($TJ/10^3$ tonnes).

From equations 1 and 2, the total amount of CO_2 produced during construction until May 2006 is 33.3 t CO_2. If we assume that construction is concluded in December 2006, the total amount of CO_2 is approximately equal to 44.4 t CO_2, which is negligible.

Table 4. Fuel consumption and CO_2 emissions released during Binary Cycle Power Plant construction.

	Volumen	Density	Mass	IPCC NCV	Fuel consumption	IPCC CEF	CO_2 emissions
Construction machinery (generators, excavators, compactors, cranes and concrete machines)							
	gal	10^3 tonnes/gal	10^3 tonnes	$TJ/10^3$ tonnes	TJ	(t C/TJ)	T CO_2
Diesel	2,495.24	3.26E-06	0.00812	43.33	0.35201	20.20	26.07
Gasoline	181.17	3.26E-06	0.00059	44.80	0.02643	18.90	1.83
Transportation vehicles							
Pick-ups, trucks and cars	534.00	3.26E-06	0.00174	44.80	0.07789	18.90	5.40
Total	3,210.41						33.30

Likewise, emissions during operation are negligible because it does not use fossil fuels in auxiliary power units for black starting or as back-up and energy generating equipment is not transferred from or to another activity.

Therefore, the project activity has not leakage.

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

The estimated anthropogenic emissions by sources of greenhouse gases of the baseline are given by emissions factor of the Interconnected National System. This value is calculated conservatively as the average of the emission factors of both Operating Margin and Building Margin, according to equation 5.

$$EF_y \text{ (t } CO_2\text{/MWh)} = 0.5 \bullet EF_{OM\,y} + 0.5 \bullet EF_{BM,y} \quad \text{Eq. 5}$$

Where:

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

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

Operating Margin emission factor

The Operating Margin emission factor represents the CO_2 emissions of the plants in operation from the generation mix that operates in the wholesale market. This factor separates the low-cost and must-run plants (k), which in El Salvador, is the total energy produced by the hydroelectric, geothermal plants and cogenerators, and the other power sources (j).

The Operating Margin emission factor is calculated *ex-ante* using Equation 6. The data vintages include the full generation-weighted average for the 2003, 2004 and 2005 for an *ex-ante* calculation of this factor.

$$EF_{OM,y} = (\lambda - 1) \bullet \frac{\sum_{i,j} F_{i,j,y} \bullet COEF_{i,j}}{\sum_{j} GEN_{j,y}} \oplus \lambda \bullet \frac{\sum_{i,k} F_{i,k,y} \bullet COEF_{i,k}}{\sum_{k} GEN_{k,y}} \quad \text{Eq.6}$$

Where:

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

λ_y = Lambda factor for year y

y = 2003, 2004 and 2005

$F_{i,j,y}$ = The amount of fuel i, for each relevant power source j of the electric system, expressed in gal/year[20].

[20] This data is given by generation plants.

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

$\sum_j GEN_{j,y}$ = The sumatory of the generation from each relevant source power j (MWh), during the years *y*.

The calculation of the terms defined previously is as follow:

The $COEF_{i,j}$, per unit generating *j* is calculated using Equation 7. The calculation is executed for the last three years in order to consider any variation in the energy produced by each unit generating.

$$COEF_{i,j} = \text{heat content}_{i,j}(\text{BTU/gal}) \bullet \text{fuel } CO_2 \text{ content (kg } CO_2\text{/MMBTU)}/1x10^6 \quad \text{Eq. 7}$$

Where:

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

Heat $content_{i,j}$ = Heat content of each fuel in (BTU/gal) taken from MARN Baseline Study.

Fuel CO_2 content = CO_2 content for each fuel *i* and plant *j* in (kg CO_2/MMBTU) taken from MARN Baseline Study

According to MARN Baseline Study:

Table 5. Heat content of fuels[21].

Fuel Oil No.6	Diesel
BTU/gal	BTU/gal
149,690	138,690

Fuel CO_2 content = $CEF_{ij} \bullet 44/12$

Where:

CEF_i = Carbon adjusted emission factor of fuel *i* expressed in (kg C/MMBTU) These values consider oxidation factors[22].

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

[21] http://www.eia.doe.gov/oiaf/aeo/pdf/apph.pdf

[22] Energy Information Administration, Emission of Greenhouse Gases in the United States 1998, http://www.eia.doe.gov/oiaf/archive/aeo00/assumption/tbl2.html

Table 6. Fuel CO_2 content.

Fuel Oil No.6	Diesel
kg CO_2/MMBTU	kg CO_2/MMBTU
78.00	72.4

Finally, the denominator of the Operating Margin Equation is:

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

The annual energy (MWh/year) of each generating unit j, delivered to the grid during the year *y*, according to recorded data by the Transactions Unit, UT. These data are the result of the commercial measurement, whose breakdown per generating unit does not appear in the statistics reports, and therefore, they have to be obtained directly from the UT.

The calculation is executed for the last three years in order to consider any variation in the energy produced by each unit generating. The years considered are 2003, 2004, 2005.

Building Margin emission factor

The Building Margin emission factor represents the trend of the generation mix. It is calculated for both the five most recent plants and for the most recent plants representing 20% of the energy of the system, taking the value that comprises the larger annual generation, as indicates the following equation:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \bullet COEF_{i,m}}{\sum_m GEN_{m,y}} \quad \text{Eq. 8}$$

Where:

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

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

y = 2005 for an ex-ante calculation

$COEF_{i,m}$ = The CO_2 emissions coefficient of most recent plants connected to the grid that use fuel *i* (tCO_2/gal). It is determined using Equation 7 considering the plants shown in table 3 of annex 3.

$\sum_j GEN_{m,y}$ = The sumatory of the generation of each relevant source power *m*, during 2005, expressed in MWh.

It is considered the emission factor with the highest value, between the calculation for the 5 most recent plants and calculation for the plants that represents 20% of the system generation. For the present case, the emission factor corresponds to the group of plants whose electricity production is 20% total generation.

Emission factor

The estimation of the emissions factor for the baseline, calculated *ex-ante,* is as follow:

$EF_{OM,y}$ (t CO_2/MWh) = 0.734

$EF_{BM,y}$ (t CO_2/MWh) = 0.652

EF_y (t CO_2/MWh) = $0.5 \bullet 0.734 + 0.5 \bullet 0.652$

= 0.693 t CO_2/MWh

(See Annex 3, Tables A2, A3 and A4)

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

In conclusion, the emission reductions due Binary Cycle Berlin power plant is equal to the energy supplied by the plant to the grid multiplied by the emissions coefficient of the baseline, as indicated in equation 2 and described in table 7, because the activity of the project does not produce GHG emissions and there is not leakages

Table 7. Estimation of project activity emission reductions

	Estimation of project activity emission reductions	Estimation of baseline emission reductions	Estimation of leakage	Estimation of GHG emissions
	(t CO_2e)	(t CO_2e)	(t CO_2e)	(t CO_2e)
	A	B	C	D

	B – C – D	$BE_y = EF_y * EG_y$ = 0.693*63,700		
2007	14,754	14,754	0	0
2008	44,141	44,141	0	0
2009	44,141	44,141	0	0
2010	44,141	44,141	0	0
2011	44,141	44,141	0	0
2012	44,141	44,141	0	0
2013	44,141	44,141	0	0
2014	29,387	29,387	0	0
Total (tCO2)	**308,984**	**308,984**	**0**	**0**

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

B.7.1 Data and parameters monitored:

Data / Parameter:	Electricity produced
Data unit:	MWh
Description:	Electricity produced by Binary Cycle Berlin Power Plant and supplied to the grid.
Source of data to be used:	The electricity meter of the Binary Cycle Berlin power plant.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	63,700
Description of measurement methods and procedures to be applied:	Electricity produced will be registered by the metering equipment validated by *Unidad de Transacciones*, UT (Transactions Unit). The meter and a measurement process comply with the Wholesales Electricity Market and Transmission System Operation Regulation: Metering annex. See Monitoring Plan in Annex 4.
QA/QC procedures to be applied:	The information downloaded by the personnel of the power plant is compared monthly with the information downloaded by the UT.
Any comment:	The meter used by Binary Cycle Berlin Power Plant is independent of the meters used by the other facilities in Berlin field.

B.7.2 Description of the monitoring plan:

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

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

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

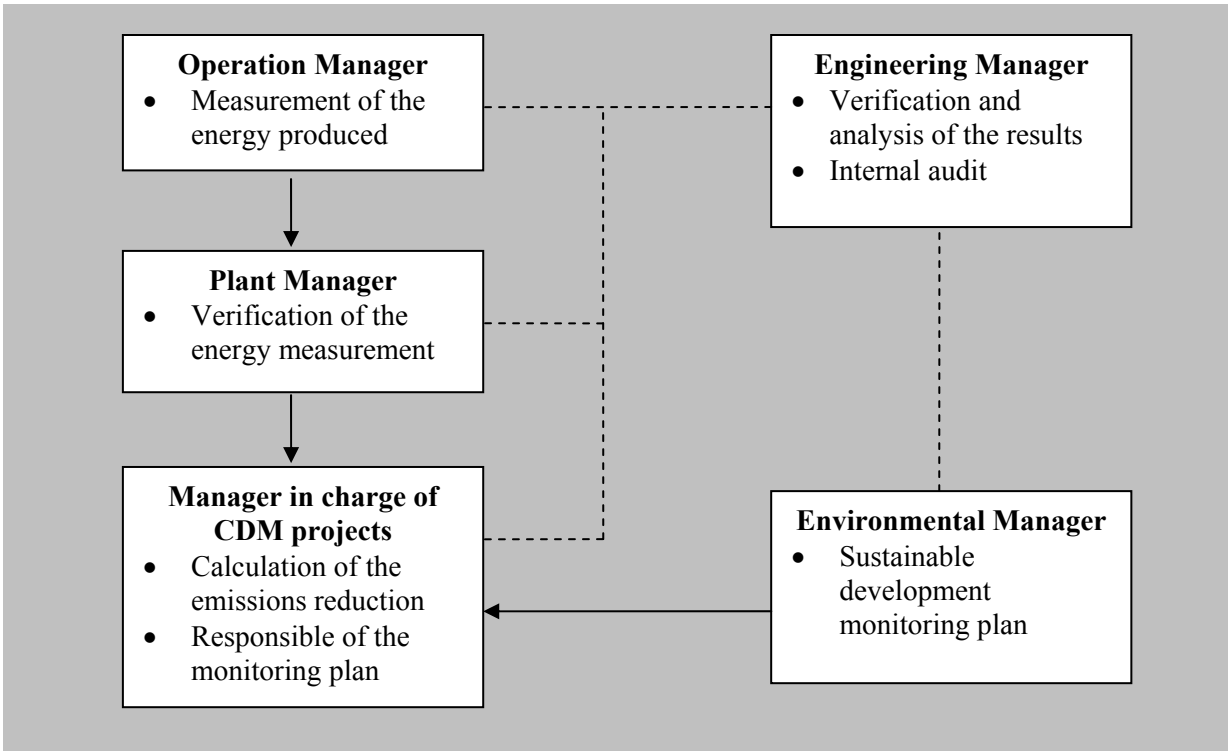

Fig. 4 Operational structure of the monitoring plan.

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

- Use of electric energy meters with accuracy according to Unit Transactions (UT) norms.
- Verification of the measurement of the plant used for calculating the emissions reductions against the commercial measurement used by the UT for the payment of operations in the electricity market.
- Development of clear and defined procedures for data recording.
- The monitoring plan includes an internal audit procedure and a nonconformance and corrective/prevention actions procedure.

Please see the monitoring plan in annex 4.

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

Date of completing the final draft of this baseline section:
21/09/2006

Name of person determining the baseline methodology:
Alaide González Leche
Energía y Medio Ambiente, alaidegl@itelgua.com

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:

3/5/2005

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

30 y

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:

01/09/2007

C.2.1.2. Length of the first crediting period:

7 y

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

It does not apply

C.2.2.2. Length:

It does not apply

SECTION D. Environmental impacts

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

In compliance with Article 22 of the Law of the Environment, LaGeo, S.A. de C.V. submitted an environment form to the General Bureau of Environmental Management of the Ministry of the Environment and Natural Resources (*Ministerio de Ambiente y Recurso Naturales*, MARN) with the purpose of initiating the environmental evaluation process for Binary Cycle Berlin system assembly.

The Ministry of the Environment and Natural Resources evaluated the project, and on February 15, 2005, in accordance with Article 18 of the Environmental Law, resolves that it does not require of an Environmental Impact Assessment, since it will not show any negative impacts to the environment.

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

Environmental impacts are not considered significant by the project participants or El Salvador, by this reason, the MARN granted an environmental permit to LaGeo, S.A. de C.V.

The environmental permit granted by the MARN forces LaGeo, S.A. de C.V. to comply with the following measures:

- To carry out an integral and adequate management of: solid waste, domestic and industrial waste water and emissions to the atmosphere if any were generated during the process.

- Comply with the environmental legislation related to this type of project, as determined by the different laws and regulations.

It is considered that the project has positive impacts on the environment, because it takes advantage of the brine's heat which was not used, and typified as high risk for human health due to its high temperature. As a result of the project, the temperature of the brine goes down approximately 40^{o}C.

Not significant negative impacts will be taken into consideration during construction, as the increase of suspended particles and noise, which will be mitigated through the Environmental Management Plan.

Routine not significant impact activities will be carried out during operation. These activities imply the annual maintenance of the system and handling of solid and liquid waste, both domestic and industrial.

SECTION E. Stakeholders' comments

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

Since Berlin Binary Cycle Project implies positive benefits to the environment and is carried out within Berlin geothermal field, it did not require an Environmental Impact Study; by this reason the public consultation required by Ministry of the Environment and Natural Resources (*Ministerio de Ambiente y Recurso Naturales*, MARN) as part of the EIA was not done.

Even though a direct consultation is not required, LaGeo maintains constant communication with the communities neighbouring the site of the project. In its role as "responsible neighbour" promotes and contributes to the implementation of development programs through the municipal government and/or other institutions, by means of the opening of communication spaces with community leaders.

LaGeo's social staff is in charge of these activities through the Social Unit (*Area de Proyección Social*, APS) that is coordinated by the Development Management with the participation of the Human Resources Management, Production Management and others units.

The communication with the stakeholders could be summarized as follow:

1. Meetings with communities

- A monthly meeting is realized, or when is required by local stakeholders or LaGeo, in order to inform about LaGeo projects and the activities developed jointly with the communities, and to know the opinion and requirements of the communities. LaGeo sends a monthly letter to invite the stakeholders to the meetings and a minute is signed by the participants after each meeting[23].

  Berlin Binary Cycle Project was discussed in the following meetings:
  - August 11, 2005, Canton El Zapotillo
    LaGeo informed to the communities of Guallinac, San Jose Montañita, Las Crucitas, San Juan Loma Alta, Canton Concepcion y Apastepeque about the beginning of construction of Berlin Cycle Binary project in 2006, and the planning for hiring of personnel had to done by both, LaGeo and the communities.
  - January 17 and 19, 2006, Berlín community
    The communities of Concepcion, Crucitas, Coyolar y Bob Graham were informed about the Berlin Cycle Binary project and the programmed date to start hiring the necessary personnel.

- LaGeo invited to the communities in order to inform them about the implementation of a wildlife protection park to safeguard the wildlife in the areas close to the plant, additionally informed about the plan of Berlin Binary Cycle Project to contribute to the sustainable development by means of this environmental project. For this purpose, LaGeo organized the following meetings:

  - The communities of El Recreo, San Jose Montañita and Montañita de Mercedes Umaña were informed in June 6, 2006.

[23] The documents concerning to the stakeholders were presented to the Operational Entity Designated.

- The communities of El Centro, Guallinac, El Calvario, El Tronador and La Corriente were informed in June 7, 2006.
- The communities of Buena Vista, Concepcion, Las Crucitas, Bob Graham and Villa Rosa were informed in June 8, 2006.

After each meeting a minute was signed by the participants. The minute contents date and place of the meeting, the issues treated and the name of the participants.

Fig.5 Photograph of one of the meetings with the communities.

2. Communication with The Union of Electricity Sector Workers (*Sindicato de Trabajadores del Sector Eléctrico,* STSEI)

LaGeo, S.A. de C.V. has informed timely to The Union of Electricity Sector Workers (*Sindicato de Trabajadores del Sector Eléctrico,* STSEI) about the advance of the project and its benefits to the employees and the communities. In November 13, 2006, LaGeo informed to General Secretary of STSEI-LaGeo about the CDM project; and invited him to participate in the meeting celebrated to sign the ERPA and the social responsibility letter with Belgium in November 14, 2006.

The Union of Electricity Sector Workers, STSEI, issued a letter in December 28, 2006, confirming the statements above described.

3. Exposition of LaGeo projects

LaGeo, S.A. de C.V. organized an exposition to inform about the electricity generation of the existent plants and the projects in construction (Berlin Binary Cycle, Berlin Phase Two) at Berlin geothermal site, furthermore to inform about the productive and social projects that they sponsor. The exposition was carried out in 26–29 September, 2006 in the central park of Alegria community.

It was presented a summary of the activities executed by the Social Unit of LaGeo during 2005 and most stakeholders recognized the social and environmental responsibility of LaGeo, S.A. de C.V. The stakeholders gave their comments in writing in a register book available to the public.

4. National and international communications

LaGeo, S.A. de C.V. organizes and participates in workshops to inform about its activities and technological advances. One example of this initiative is the Workshop for Decision Makers on Geothermal Projects in Central America[24] carried out in November 27, 2006 in San Salvador. During this workshop, LaGeo informed about **Berlin Binary Cycle** and the **wildlife protection park,** between other topics.

E.2. Summary of the comments received:

LAGEO received comments from MARN and the inhabitants of the communities of the influenced area as follow:

- MARN´s comments
  MARN requires that the development and operation of the project occurs with good environmental practices and in compliance of El Salvador legislation.

- Communities' comments
  In general, the local stakeholders demands new opportunities of employment as a strategy to reduce poorness.
  In the other hand, they agree with the social and environmental projects that LaGeo will support to contribute to sustainable development.

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

- Comments issued by MARN regarding compliance with good environmental practices were taken into consideration through the execution of the Environmental Management Plan, which implies:
  - Rubble handling
  - Road safety plan
  - Industrial safety plan
  - Handling of industrial waste
  - Emergency plan

  Comments issued by MARN regarding compliance with the country's legislation have been considered complying with all the laws regulating the activities such as this project. The regulatory framework observed contemplates the Environment Law, Health Code, General Regulation on Safety and Hygiene at Work Centers, Municipal Code, Regulations to the Law of Urbanization and Construction.

[24] http://www.casapres.gob.sv/vicepresidenta/boletines/2006/11/vbol2701.html

- LaGeo considered communities' comments about employment, hiring personnel from local communities for the construction of Berlin Binary Cycle Project, who was selected in coordination with communities' representatives.

- LaGeo, S.A. de C.V., through LaGeo Workers Cooperative Society "Los Ausoles" (*La Cooperativa de Trabajadores de LaGeo "Los Ausoles*"), has developed several meetings with small entrepreneurs from Alegria and Berlin communities to planning the **wildlife protection park project** with the participation of the communities.

  FUNDES[25], an international ONG, was hired by Los Ausoles to organize the small enterprises that will participate in the Geo-environmental Tourist Park and have had the following activities:
  - Presentation the wildlife protection park as a component of The Geo-environmental Tourist Park "El Tronador", which will be developed by LaGeo.
  - To know the opinion of the small entrepreneurs.
  - Analysis of the tourist situation and the opportunities in the area.
  - Discussion of the importance of the constitution of a local tourism committee.
  - Enhancement of local capacities though courses in tourism services.
  - Presentation of the strategic plan of the park.
  - Identification of the inputs required to formulate the business plan of the park.

  Several meetings and workshops were carried out during 2006. In Alegria Community were carried out in August 25, September 14 and December 15. While in Berlin community were carried out in August 2, September 14 and December 14.

Fig 6. Photograph of the workshop held in Alegria community.

FUNDES has had meetings with Mr. Moises Funes, Major of Alegria Municipality with the purpose to inform about the The Geo-environmental Tourist Park "El Tronador" and how this project could create new jobs in the area. Alegría Municipality undertook to participate in the consultant process in order to coordinate the project with the local Government Plans.

[25] FUNDAPYME, http://elsalvador2.fundes.org/ , ph 503-22985353.

In the same way, FUNDES has had meetings with the local authorities of Berlin with the purpose to coordinate the activities of the project with the local Government Plans.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Postcode/ZIP:	
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Telephone:	(503) 2211-6700
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E-Mail:	info@lageo.com.sv
URL:	www.lageo.com.sv
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Middle Name:	Antonio
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Represented by:	
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Direct phone:	(503) 2211-6757
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funds are available.

Annex 3

BASELINE INFORMATION

Boundaries

The project site includes the area occupied by the components of the power plant in Berlin geothermal field. The components of the plant are:

- Heat exchanger
- Steam turbine
- Electrical generator
- Condensator
- Cooling tower
- Injection pump
- 600 m transmission line

The relation between Berlin Binary Cycle Plant and other power plants in Berlin geothermal field can be appreciated in the following figure:

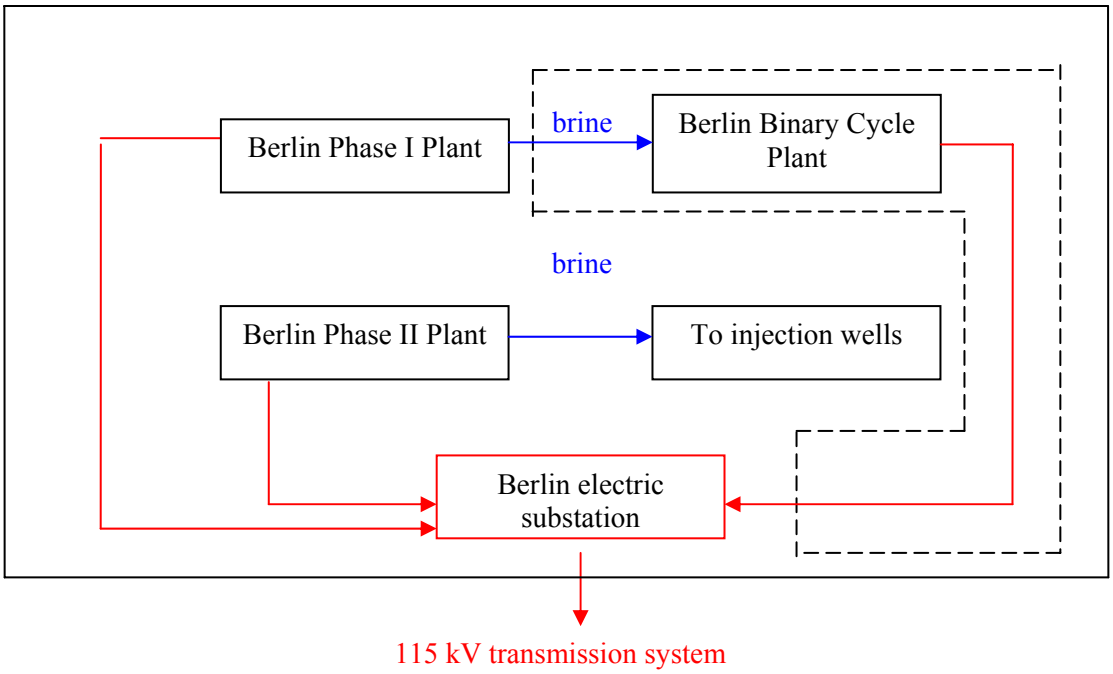

Figure III.1 Berlin Binary Cycle Plant boundaries related to the plants in Berlin geothermal field

The project electricity system is the spatial extent of the power plants connected to the Salvadorian electric grid and dispatched without significant transmission constraints.

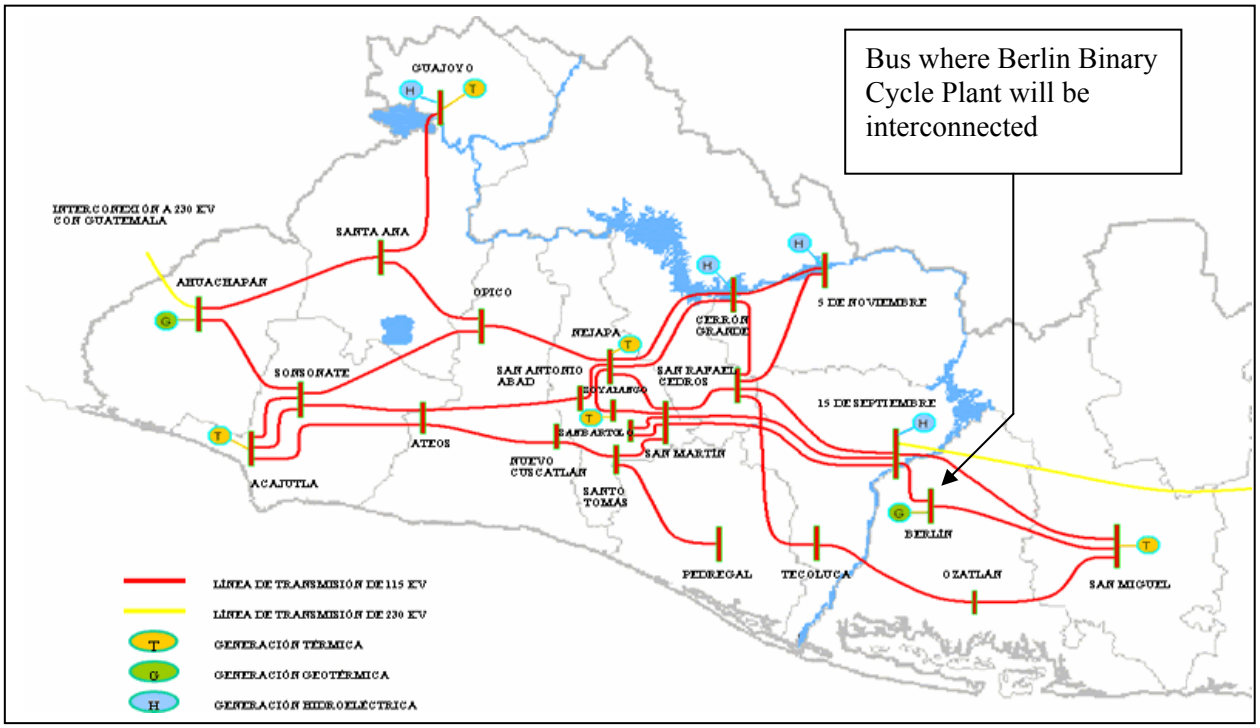

Fig. III.2 Project electricity system

Data baseline

Table A1								
Owner	**Unit**	**Technology**	**Starting Year**	**Installed capacity (MW)**	**Type of Fuel**	**3-year net generation (MWh)**	**3-year CO_2 emissions (tCO_2)**	**3-year average emission rate (tCO2/MWh)**
Duke Energy	Acajutla	Steam turbine	1967-1970	63	Fuel oil No. 6	210,149	229,234	1.091
Duke Energy	Acajutla	Gas turbine	1992-1994	72	Diesel	49,213	58,380	1.186
Duke Energy	Acajutla	Internal combustion	2000-2001	150	Fuel oil No. 6	2,223,971	1,511,156	0.679
Acajutla power plant				**285**		**2,483,333**	**1,798,769**	
Duke Energy	Soyapango	Gas turbine	1972-1974	15	Diesel	61,497	45,743	0.744
Soyapango Power Plant				**15**		**61,497**	**45,743**	
Nejapa Power	Nejapa ICE 2	Internal combustion	1995-1998	144.5	Fuel oil No. 6	2,467,979	1,867,783	0.757
Nejapa Power Plant				**144.5**		**2,467,979**	**1,867,783**	
CESSA	CESSA ICE 1&2	Internal combustion	2001	32.6	Fuel oil No. 6	580,818	416,994	0.718
CESSA Power Plant				**32.6**		**580,818**	**416,994**	
TEXTUFIL	TEXTUFIL ICE1	Internal combustion	2000	40	Fuel oil No. 6	723,698	518,021	0.716
Textufil Power plant				**40**		**723,698**	**518,021**	**-**
CASSA	CASSA	Internal combustion	2003	20	Bagasse	51,100	-	
CASSA power plant				**20**		**51,100**	**-**	**-**

TABLE A2	**A**	**B**	**C**	**D**	**E**	**F**
Operating Margin	**Fuel Consumption (gal)**	**Energy Content (Btu/gal)**	**Fuel CO2 Content (kgCO2 / MMBtu)**	**3-year CO_2 emissions (tCO_2)**	**3-year net generation (MWh)**	**EF $_{2003-2005}$ (tCO_2 / MWh)**
	Generators plants	EIA	EIA	See Table A1	See Table A1	
Plant $_i$				Σ2003-2005 (A*B*C)	Σ3 year net generation	D*E
Total				4,647,310	6,317,325	D/E= 0.736
					Simple Adjusted factor	**0.997*0.736= 0.734**

TABLE A3							
Last additions to the grid	**Technology**	**Starting Year**	**Installed capacity (MW)**	**Type of Fuel**	**2005 net generation (MWh)**	**2005 CO_2 emissions (tCO_2)**	**2005 average emission rate (tCO_2/MWh)**
Cerrón Grande unit 2	Hydro	2005	18.9	Bunker	63,252	-	-
CESSA ICE 1 & 2	Internal combustion	2001	19	Bunker	179,292	130,031	0.725
CESSA ICE 2	Internal combustion	2001	13	Bunker	-	-	-
Acajutla ICE 2	Internal combustion	2001	99	Bunker	782,491	538,559	0.688
Acajutla ICE 1	Internal combustion	2000	51	Bunker	-	-	-
					1,025,034	668,590	0.652

TABLE A4		**units**	**equation or source**	
A	Estimated operating margin emission rate	tCO_2/MWh	Table A2	0.734
B	Estimated build margin emission rate	tCO_2/MWh	Table A4	0.652
C	Estimated baseline emission rate*	tCO_2/MWh	= ((A + B)/2)	**0.693**

TABLE A5 Emissions estimated		**Units**	**Equation or source**	
A	Binary Cycle Berlin	MW	project developers	9.2
B	Capacity factor	%	project developers	79.04%
C	Annual generation	MWh	(=A x B x 8760)	63,700
D	Baseline emission rate	tCO_2/MWh	See Table A4	0.693
E	annual emissions reductions	tCO_2	(= C x D)	44,141
F	First crediting period	years	project developers	Sept. 2007 – July 2014
G	Crediting lifetime	years	difference	21
H	Total emissions reductions over crediting lifetime	tCO_2	(= E x G)	926,953

Annex 4

MONITORING INFORMATION

The monitoring plan comprises two parts. The first one refers to the compilation and filling of all the relevant data needed to estimate the emissions reductions by the plant and the second part presents the sustainable development monitoring plan.

A. Monitoring of the emissions reductions

A.1 Objective:

The objective of the present plan is to assure the complete, consistent, clear, and accurate monitoring and calculation of the emissions reductions, within the Binary Cycle Berlin power plant boundaries, during the crediting period.

A.2 Methodology:

According to the "Consolidated monitoring methodology for zero-emissions grid-connected electricity generation from renewable sources".

A.3 Boundaries

The boundaries of the project activity will remain constant during the entire crediting period as defined in Item B.6.1.

A.4 Equipment to be used

According to Wholesales Electricity Market and Transmission System Operation Regulation, the electricity meter has to record energy in programmable intervals and store the data accumulatively. It has to store data at least for two months.

The electricity meter has to be multifunctional, three-phase, bidirectional and equipped with a modem[26].

The measuring transformers observe Norm ANSI/IEEE C57.13 and the meter ANSI C12.16 as follows:

Table 1. Equipment accuracy

	Accuracy type (%)
Meter	0.2
PT	0.3
CT	0.3

The measurement equipment will be audited by a third party, authorized by the Transaction Unit at least each two years (Metering Annex, item 7.7, page 117), according to Operation Norms of Transmission

[26] Metering Annex, page 111, http://168.243.84.62:8080/documentos/Anexos%20al%20Reglamento%20UT%20modificados.pdf

System and Wholesale Market in order to verify that the measurement equipment satisfies the standards (Metering annex, item 4, pages 115-116) . The first audit is executed before to fit out commercially the meter (Metering annex, item 14.3.2.1, page 122).

A.5 Installation Point of the Electric energy metering equipment

The meter is located in the substation that connects to the transmission system. Therefore, it measures the energy produced within the project site, and which is exported to electricity system.

A.6 Personnel responsible:

- The Manager in charge of the CDM projects is responsible of the monitoring plan and will carry out the following activities: verification of energy produced, calculation of the emissions reductions and data recording.

- Plant Manager is responsible of the electric energy measurement and reports the energy data to the Manager in charge of the CDM projects.

- Operation Engineer is responsible of discharging data from the meter.

- The Environmental Manager is in charge of the sustainable development monitoring plan.

- The Engineering Manager is in charge of the internal audits and quality control.

Personnel who carry out the monitoring function are trained according to the training procedure described in item A.8.3. New personnel have to follow up a training program and are formed in the specific skills required to carry out the monitoring plan.

A.7 Measuring and calculation procedure

A.7.1 Measuring

The Operation Engineer of the plant discharges the data from the principal and backing meters monthly, and stores electronically the data discharged from the meter. The meter reading and data discharge of the monitoring month takes place during the first week of the following month.

The Operation Engineer reports the energy measured to the Plant Manager monthly. Then the Plant Manager reports to the Manager in charge of the CDM projects the electric energy measured by the principal and the backing meter.

In order to assure the reliability of the measurement, the Plant Operator has to register day-to-day the energy produced and exported to the grid. The procedure followed is:

- The plant operator reads each hour the power produced by the plant, directly from the meter panel. This information is filed hardly.
- The Operation Engineer downloads the data of the energy produced through the SCADA system and reports it daily. The data reported are compared with the hourly readings. This information is filed in an electronic version.

- Each month, the Operation Engineer reports to Plant Manager the total of the energy produced. The data form part of the Monthly Operations Report, which is filed in hard and electronic version.

A.7.2 Verification of the energy produced

The manager in charge of the CDM projects will verify the accuracy of the recorded energy data. For this purpose, data of the principal and the backing meter will need to be compared against the information of the commercial measurements published by the Transactions Unit (*Unidad de Transacciones*, UT).

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

Table 2. Spreadsheet for measurement control.

Binary Cycle Berlin Power Plant				
Year				
Month	**Binary Cycle Berlin generation measurement: principal meter (MWh)**	**Binary Cycle Berlin generation measurement: backing meter (MWh)**	**UT commercial measurement (MWh)**	**Binary Cycle Berlin validated generation (MWh)**
A	**B**	**C**	**D**	**E**
				If B=C=D then measurement is validated
January				B
February				B
March				B
April				B
May				B
June				B
July				B
August				B
September				B
October				B
November				B
December				B
Annual total				B

Because it could be a difference between measurements due to accuracy type of the equipments, it will be considered acceptable a difference ≤ to 0.8% (Σ equipment accuracy type) between the principal and secondary meters. If there is a difference greater, the data and meters will be checked and the data will be corrected according to the Operation Norms of Transmission System and Wholesale Market of the Transaction Unit and the value approved by the Transaction Unit.

A.7.3 Registration of the energy data

For each crediting year, the energy is registered monthly in the spreadsheet shown in the following table. The data registered is obtained from the principal meter (column E of table 2).

Table 3. Spreadsheet for the registration of the energy produced.

Binary Cycle Berlin Power Plant	
Year:	
Month	**Monthly Generation (MWh)**
A	**B**
Month 1	
Month 2	
Month 3	
Month 4	
Month 5	
Month 6	
Month 7	
Month 8	
Month 9	
Month 10	
Month 11	
Month 12	
Total	**Σ B**

A.7.4 Calculation of emissions reductions

The manager in charge of CDM projects calculates the emissions reductions each year during the crediting period in a spreadsheet, where the emissions factor is determined *ex-ante* according to item B.6.3 of the PDD.

The spreadsheet used is as follow:

Table 4. Spreadsheet for the calculation of emissions reductions.

Binary Cycle Berlin Power Plant. First Crediting period.			
Year	**Annual validated generation (MWh)**	**Emission factor (ton CO_2/MWh)**	**Emissions reductions (ton CO_2)**
	A	**B**	**C**
		0.693	C = A * B
2007		0.693	
2008		0.693	
2009		0.693	
2010		0.693	
2011		0.693	
2012		0.693	
2013		0.693	
2014		0.693	

A.7.5 Records

Monitored data should be kept for two years after the end of the first crediting period. The Manager in charge of the CDM projects is the responsible to archive the relevant data for the Monitoring Plan.

A.8 Quality control and quality assurance procedures

An internal audit procedure and a Nonconformance and corrective/prevention actions procedure will be managed in order to reduce the remaining uncertainties of the emissions reductions monitored.

A.8.1 Procedure Nonconformance treatment and corrective and preventive actions

1. Purpose

   The purpose of this procedure is to describe the treatment for any non-conformity regarding the Monitoring Plan of the reduced emissions produced by of Binary Cycle Berlin Power Plant.

2. Responsibilities

   Engineering Manager is responsible:
   - To coordinate all activities related with the Non-Conformity Reports.
   - To analyze nonconformities along with the persons in charge of energy measuring and monitoring plan and identify appropriate corrective and preventive actions.
   - Planning corrective and preventive actions establishing their scope, responsibilities, methodology, implementation and controls considered convenient.
   - Verify the close-out and effectiveness of corrective and preventive actions.

   The CDM projects Manager:
   - Will be in charge of the procurement, from its opening to its closure, of the nonconformities arisen.
   - To analyze, together with the Environmental Manager and Engineering Manager, any non-conformity detected.
   - Registry of nonconformities.
   - Implement preventive and corrective actions

3. Methodology

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

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

The Engineering Manager after receiving the report, shall analyze the non-conformity, and together with the metering and/or monitoring officers shall determine the non-conformity treatment, mentioning in the report the corrective and preventive actions agreed to solve the same, the party responsible to carry them out, and the term estimated therefore.

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

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

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

- Corrective and Preventive Actions

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

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

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

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

4. Records

The monitoring officer shall be in charge of keeping a file of the Non-Conformity Reports where there is full detail of each nonconformity, from the moment of its appearance to its final closing. Table 5 contents the Nonconformance report.

Table 5. Nonconformance report and corrective/preventive actions.

Binary Cycle Berlin	Nonconformance Report and Corrective/preventive Actions	Nº.: Page 1 of __ Opening Date: Closure Date:
Non-conformance Identification Identifying person: Description: Causes analysis:		
Preventive action Description: Estimated implementation term:		
Responsible (signed)	Responsible: Date:	
Corrective action Description: Estimated implementation term:		
Responsible (signed)	Responsible: Date	
Evidence of the execution and resolution proof Verifications carried out:		
Responsible:	Engineering Manager: Closure Date:	

A.8.2 Internal audit procedure

1. Objective

This procedure has the purpose to describe the established system for the programming and execution of internal audits of the Monitoring Plan of Binary Cycle Berlin Power Plant.

2. Responsibilities

The Engineering Manager is responsible of:
- Drafting and planning the annual program of internal audits.
- Carrying out the audits in accordance with the approved plans.
- Drafting, issuing, and distributing the pertinent reports.
- Supervising the implementation and conformance of the corrective and preventive actions, if any.

3. Audit stages

3.1 Programming and Planning

- Determine if the Monitoring Plan is being properly documented.
- Regular verification of the proper implementation of the Monitoring Plan.
- Identify any deficiency, nonconformity or deviation, proving the application of appropriate corrective and preventive actions.

Every year, the Environmental Manager prepares the audit program so as to insure that at least all points of the Monitoring Plan are audited, which shall contemplate the scope of audits, dates projected for the inspections, and timely remarks, if any.

Said programming shall establish the audit, at least once a year or when it is necessary to check the execution of the corrective and preventive actions established.

3.2Notification

The Engineering Manager will submit an auditing plan to CDM project Manager, Environmental Manager, Plant Manager, at least 15 days in advance.

3.3 Previous meeting

The audit start with a previous meeting in which the auditor meets the Plant Manager, Environmental Manager and the person in charge of monitoring and confirms the scope of the audit, and:

- Explain the plan (sequence of operations).
- Request monitoring registries.
- Decide the date for the conclusion meeting.

3.4 Execution

The audit will be carried out by the Engineering Manager. The verification to be carried out will be mainly based in the following:
- The examination of procedures and instructions to determine if they are complete and appropriate, trying to obtain the confirmation of their well use and respect.
- In the cases in which for certain operations a special competency is needed, requirements related to the formation and competency of staff will be examined.

- The agreement between the real organization and the one described in the Monitoring Plan will be verified.
- The possession of the necessary documents will be verified.
- The maintenance or document updating will be verified.
- The correct treatment of disagreements and the appropriate description and application of amendment and preventive actions will be verified.
- The well file of documentation will be supervised.
- The well application of identification on documents, equipment, etc., will be checked.
- The well elaboration of reports, certificates, etc., will be verified.

3.5 Conclusion meeting

Once the audit execution phase is concluded, a new meeting with the auditor, the Environmental Manager and the party in charge of monitoring will be held, with the purpose of submitting results and clarify any doubts. During this meeting the corrective and preventive measures to be applied regarding the identified non-conformities will be resolved.

3.6 Report

The auditor will prepare an audit report at least with the following information and copy must be submitted to the Plan Manager and Environmental Manager and the person in charge of the monitoring process:

- Brief statement of the objective and scope of the audit.
- List of procedures and other documents used as reference base for the execution of the audit.
- Name and position of the auditor.
- Summary of the audit results, including an evaluation of the Monitoring Plan effectiveness at the audited environment, and the description of all deficiencies and non-conformities found, as well as Non-Conformity Reports open, giving the necessary corrective and preventive actions.
- Detailed list of the conclusions reached during the audit, based on hard objective criteria. It should include all details that allow to take the adequate corrective and preventive measures and to prepare the pertinent answer.
- Indications for the correction of non-conformities with the Monitoring Plan that allow the improvement thereof, and the closing of Non-Conformity Reports.

3.7Follow up and closure

When non conformances are identified, the person in charge of monitoring will agree and program along with the General Manager, the appropriate corrective and preventive measures as well as the application terms.

Once the term is completed, follow up audits can be carried out, if seriousness requires so, or take advantage of the audits of the following cycle to verify the result of the implementation of amendment and preventive actions, as well as their efficiency.

Follow up actions must be carried out until the complete elimination of the nonconformance, situation that will close audits in which said non-conformity were found.

4 Registries

All documents generated in the audit must be filed by the monitoring responsible during the crediting period plus two years. These documents must include programs, auditing plans, audit reports, response to the reports, and documentation on the implementation of corrective and preventive actions.

A.9 Training procedure

1. Objective

This procedure has the purpose to describe the system for the programming and execution of the training activities for the personnel in charge of the Monitoring Plan of Binary Cycle Berlin Power Plant.

2. Responsibilities

The CDM Projects Manager is responsible of:

- Drafting and planning the training activities.
- Carrying out the training activities in accordance with the approved plans.
- Hiring of experts if were necessary.
- Training of the new personnel.

The Engineering Manager, Plant Manager, Operation Engineer, Plant Operators, Environmental Manager and officer of the Geo-chemical laboratory are responsible to attendee the training activities according to the present procedure.

3. Training stages

3.1 Planning
The Manager in charge of the CDM projects will plan the training activities, considering contents of the training, participants and dates of execution. Additionally, he/she will prepare the material to support the workshops.

3.1 Workshop I.
The purpose of the workshop I is that the personnel in charge of the Monitoring Plan know theirs responsibilities and develop the skills necessaries to carry out the Plan. This workshop is held at the beginning of the operations of the plant and repeated when new personnel were incorporated into the functions related to the Monitoring Plan. The contents of the workshop are:

- Review of the PDD.
- Analysis of the Monitoring Plan and responsibilities.
- Review of procedures for energy measurement, data handling and data registration.
- Data quality assessment.
- Calculation of emissions reductions.
- Review of procedures for non-conformities and internal audit.
- Preparation of the spreadsheets.
- Monitoring of the contribution to sustainable development.

3.2 Workshop II.

The purpose of the workshop II is the personnel in charge of the Monitoring Plan knows theirs responsibilities and develop the skills necessaries to carry out the report of monitoring required for the verification process. The workshop will be held at the end of the first monitoring year.

- Review of Monitoring Plan fulfillment.
- Review of the data registered.
- Review of emissions reductions calculation.
- Review or sustainable development indicators.
- Guidelines to prepare a monitoring report.

3.2 Follow up

The CDM Projects Manager will hold meetings with the personnel in charge of the Monitoring Plan in order to review its fulfillment and to clarify situations or doubts about it. The personnel could request a clarification about the Monitoring Plan, in a written way, and the CDM Projects Manager will plan and execute as many meetings as be necessary.

3.3 Notification

The CDM Projects Manager will submit an invitation to the workshops to personnel in charge of the Monitoring Plan, at least 15 days in advance.

3.4 Report

After each workshop or training, the CDM Projects Manager will prepare a report including the following information:

- Date and place of the activity.
- Contents.
- Participants.
- Comments and recommendations for future training.

3.5 Registries

All documents generated in the training must be filed by the CDM Projects Manager during the crediting period plus two years.

B. Monitoring the contribution to the sustainable development

The contribution to the sustainable development of the MDL project activity "Berlin Binary Cycle power plant" will be periodically evaluated with the purpose of acknowledging the effort made by LaGeo, S.A. de C.V., even though this type of monitoring is not required by the MDL Executive Board.

The sustainable development monitoring plan is of a voluntary nature and the scope of each goal as defined by the indicators does not require any obligation regarding its compliance, since its execution and scope surpasses the requirements of the laws in effect, excepting the maintenance of the ecologic wealth.

B.1 Objective

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

B.2 Personnel responsible

The person responsible of monitoring the sustainable development indicators is the Environmental Manager. This person will be trained for this purpose according to the training procedure described in section A.8.3 of the monitoring plan.

B.3 Monitoring indicators

Berlin Binary Cycle power plant		
Year:		
Dimension	**Criteria**	**Indicators**
Environmental	1. Contribution to the mitigation of Global Climate Change 2. Biodiversity 3. Law fulfillment	1. Reduced emissions (ton CO_2) 2.1. Reforested area (m^2) 2.2. % indigenous species 2.3. % fruit trees 2.4. No. of animals protected in the park 2.5. No. of animals recently accepted 2.6. % of income contributed to environmental projects (Investment/Electricity sales) 3.1 Enviromental audits and reports submitted to MARN 3.2 No. of visits done by MARN to audit the park.

Economic	Employment	- No. fixed jobs /year - No. temporary jobs /year - % of income contributed to productive jobs - No. productive projects supported
Social	Human capacity , Improvement in life quality and communities empowerment	- No. of park visitors - No. of courses and workshops carried out for visitors -No. of courses and workshops carried out for inhabitants of communities surrounded.

Annex 5

Environmental and socio-economic impacts of the project

1. Background

LaGeo, S.A. de C.V. developed the project "Berlin Binary Cycle Power Plant" as a CDM project from the initial stage, with the purpose of generating electricity free of greenhouse emissions to be injected to the El Salvador electric system.

In addition, the Berlin Binary Cycle plant project activity due to its own nature and by the responsible manner -- both socially and environmentally -- as is being managed, allows the strengthening of local synergies to promote the local sustainable development.

That is to say, intrinsically contributes to the protection of the environment, and being developed jointly with flora and fauna species preservation projects and taking advantage of the areas it occupies, it may provide a space to preserve native species, and at the same time to develop actions of environmental education seeking to generate the protection consciousness and sustainable management of the natural wealth in the areas; thus contributing to preserve the natural wealth of the country and to foster options for tourist development with educational and study purposes.

Thus attaining the fulfillment of the Clean Development Mechanism as described in Article 12.2 of the Kyoto Protocol.

2. Interpretation of sustainable development

a) The Berlin Binary Cycle Power Plant will contribute to the sustainable development of El Salvador, understanding sustainable development as "the development that meets the needs for the present, without compromising the ability of future generations to meet their own needs" [27].

   Berlin Binary Cycle will contribute to satisfy the electric power demand required by the country, and to this end it will use the heat of the brine, which is re-injected to the soil after being used to generate electricity, preserving the resource for future generations. Thus it satisfies the demand of electric power required for the country's economic and social development, without exhausting the natural resources required by future generations for their own development.

b) The Berlin Binary Cycle Power Plant will allow the exploitation of the geo-thermal resources of El Salvador for the production of electric power, without contaminant emissions and waste, and without altering the local eco-system, thus contributing to the preservation of natural resources in compliance of the legislation and norms in effect.

   To attain this, LaGeo, S.A. de C.V. carries out plants of Environmental Management, Monitoring, and Contingency during all stages of the project.

[27] IUCN 1980 *World Conservation Strategy report*.

c) To safeguard the wildlife in the areas close to the plant, LaGeo works in the establishment of a wildlife protection park as an alternative to shelter the animal species that the Ministry of the Environment and Natural Resources of El Salvador (MARN in Spanish) seizes in bad captivity conditions and illegal ownership. The park initiative originated together with the construction of the Berlin Binary Cycle plant, having already some animals under protection, which were sent by the MARN.

The following figure shows a crocodile of a native species of El Salvador that was rescued and now he lives in the site were the park will be built.

Fig. V.1 Crocodile rescued by the MARN.

The animals rescued by the Ministry of the Environment and Natural Resources will be placed in naturalistic habitats into the wildlife protection park. Likewise, native fauna and flora will be protected through a reforesting and productive planting program in the park area and neighboring areas, which will allow enjoying better natural conditions.

The wildlife protection park is a component of the Geo-environmental Tourist Park, which is being developed by LaGeo, which purpose is contributes to environmental, social and economic development. The other components of the park will be sponsored by the generation projects of LaGeo.

The site of the wildlife protection park is located in a land that belongs to LaGeo, into the Berlin geothermal site. The following figures show a panoramic view of the site and a possible distribution of the species in the project's area.

Fig. V.2 Panoramic view of the site.

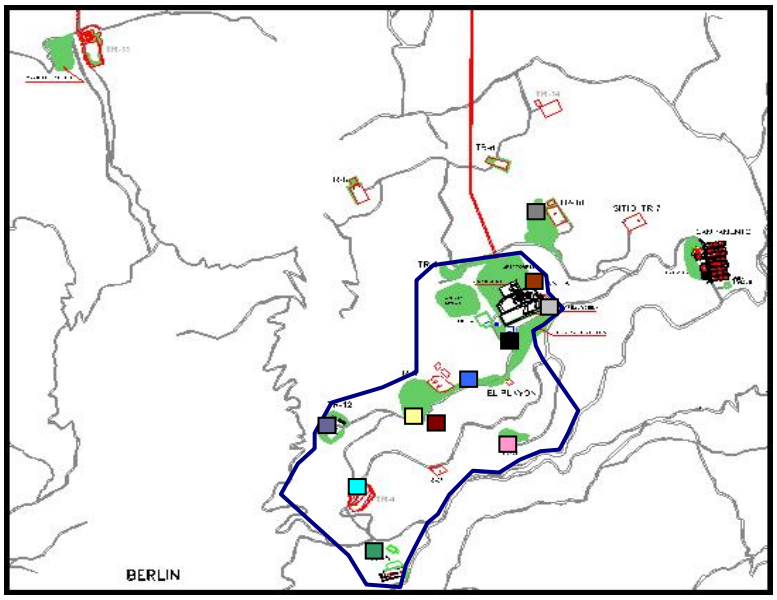

Fig. V.3 Biodiversity protection area.

- Deer
- Crocodile – alligator
- Raccoon and fox
- Aviary
- Monkeys
- Tepezcuintle
- Iguanas
- Tilapia (Fish)
- Snakes
- Rabbits
- Gopher
- Cuzucos
- Frogs and toads

d) To enhance the sustainable development of the communities close to Berlin Binary Cycle Power Plant, LaGeo will promote a productive project consisting in organic coffee plantation. Furthermore,

the shade grown coffee plantations are very important for biodiversity because the coffee forests support a great variety of birds and other animals.

3. Financing of sustainable development activities

A percentage of the income by electricity and CERs will be destined to the **wildlife protection park** to strengthen the effort made by local municipalities, community committees, OG and NGO in different initiatives for community development and preservation of local resources, with the purpose of contributing to the local sustainable development.

4. Operationalising SD at the project level

COMPONENTS Sustainable development criteria	**Score (-2 to + 2)**	**Comments on the score**	**Relevant criteria for the follow-up of the project (yes/no and why)**	**Relevant performance indicators (to be included in the Monitoring Plan *sensu lato*)**
Local/regional/global environment				
Water quality and quantity	0	The cycle binary system does not change water quality and quantity because work fluid does not have any contact with geothermal fluid.	No, because there is not a physical interaction between work fluid and geothermal fluid	
Air quality	2	It reduces the emission of NOx, SOx and other pollutants to the atmosphere, avoiding the combustion of fuels by existing thermal plants to generate electricity	No, because this benefit is real but can not be measured directly	
Soil condition	0	There are not impacts on soil because Berlin Binary Cycle power is constructed over an existent platform	No, because there is no any impact	
Contribution to the mitigation of Global	2	Reduction of approximately	Yes, because it is a direct	Emissions reduced (t CO_2)

Climate Change		44,141 t CO_2 per year, through the utilization of renewable resources for the generation of electric energy.	environmental benefit of the activity project	
Biodiversity	2	Contribution to the preservation of local natural resources through the establishment of a wildlife protection park in the plant's area.	Yes, because it is a direct environmental benefit of the activities realized simultaneously to the activity project	• Reforested area (m^2) % indigenous species % fruit trees • No. of animals protected in the park • No. of animals recently accepted • % of income contributed to environmental projects
B. Social sustainability and development				
Human capacity	2	Contribution to life quality providing recreation and education through the wildlife protection park.	Yes, because it is a direct environmental benefit of the activities realized parallel to the activity project	- No. of park visitors - No. of courses and workshops carried out
Livehood of the poor	2	Contribution to the local economic growth through the development of community projects developed under cooperation agreements with local municipalities.	Yes, because it is a direct environmental benefit of the activities realized parallel to the activity project	- No. productive projects
C. Economic and technological development				
Employment	2	Contribution to the reduction of poverty through the generation of employment for the operation of the plant, operation of the wildlife	Yes, because it has a direct impact in communities close to the plant	- No. fixed jobs /year - No. temporary jobs /year - % of income contributed to productive jobs

		protection park and organic coffee projects.		
Contribution to macroeconomic sustainability	1	Decreases the dependence on fossil origin fuel imports, avoiding the annual purchase of fuel derived from petroleum.	No, because fuel imports reductions can not be measured directly	
Technology transference	1	Due to this project is the first in El Salvador, the project engineers have visited Inex hf utility in Iceland and 3 technicians will be trained in isopentane handling.	No, because benefits training activities are temporal	

5. Qualitative analysis in the impact to sustainable development

	Energy access and affordability	Employment	Environmental impacts	Education	Income generation
Baseline case: Increase of thermal generation	Expensive electricity due to high prices of bunker or diesel	Employment related to: • Plant construction and operation	High local air pollution with associated health damages	No associated direct benefit	Increase of the country's economic growth through improved availability of electric power
CDM Project: Berlin Binary Cycle Power Plant	Electric power produced with geo-thermal resources is low-cost	Plant-related employment: • Construction and operation Employment related to the wildlife protection park: • Construction, maintenance, and management of the park • Reforestation of neighboring areas • Veterinary personnel and forest rangers • Environmental education program • Public services and products Employment related to organic coffee plantations.	• Greenhouse emissions abatement • Low local air pollution with associated health benefits • Contribution to biodiversity (flora and fauna) of the country through the wildlife protection park and reforestation projects	Creation of an educational window where visitors may watch how an industrial project may be associated to environmental projects, attaining the harmonization with the environment and contributing to its preservation through the population's educational processes	• Increase of economic growth of the country through higher availability of electric power • Creation of small businesses to provide services and products at the park
Net impact of replacing baseline case with CDM project	Prices of electric power for final users at lowest prices	Increase in employment at long term	• Lower air pollution with associated health benefits • Less risks of extinction of threatened species	• Increase of environmental education opportunities and options at El Salvador	More income generated

Annex 6
Letter of Approval by the Designated National Authority of El Salvador

MINISTERIO DE MEDIO AMBIENTE Y RECURSOS NATURALES

MARN-DGGA-84/2006

San Salvador, March 24, 2006

Reference: Letter of approval of the project "Berlin Binary Cycle Power Plant"

Mr. José Antonio Rodríguez
General Manager
LaGeo S.A. de C.V.

Dear Mister Rodríguez:

We wish to refer to the project "Berlin Binary Cycle Power Plant" (the Project), submitted for our approval. As authorized representative of the Designated National Authority (DNA) for the Clean Development Mechanism (CDM) of the Republic of El Salvador, we hereby confirm:

i) The Republic of El Salvador ratified the Kyoto Protocol on September 17, 1998.
ii) The Republic of El Salvador and the project participants, voluntary participate in the CDM.
iii) The Republic of El Salvador recognizes the Project Participant's rights to all Certified Emission Reductions (CERs) generated by the Project, and accepts the transfer of all CERs during the crediting period of the Project.
iv) The Project assists the Republic of El Salvador in achieving sustainable development.

This letter of approval is valid, only if the Project Design Document (PDD) had been validated by a Designated Operational Entity (DOE).

Sincerely,

Hugo Barrera
Minister

Kilómetro 5 ½ Carretera a Santa Tecla, Calle y Colonia Las Mercedes, Edificio MARN (Instalaciones ISTA), San Salvador, El Salvador. Tel: (503) 2267-9343, Fax: (503) 2267-9339
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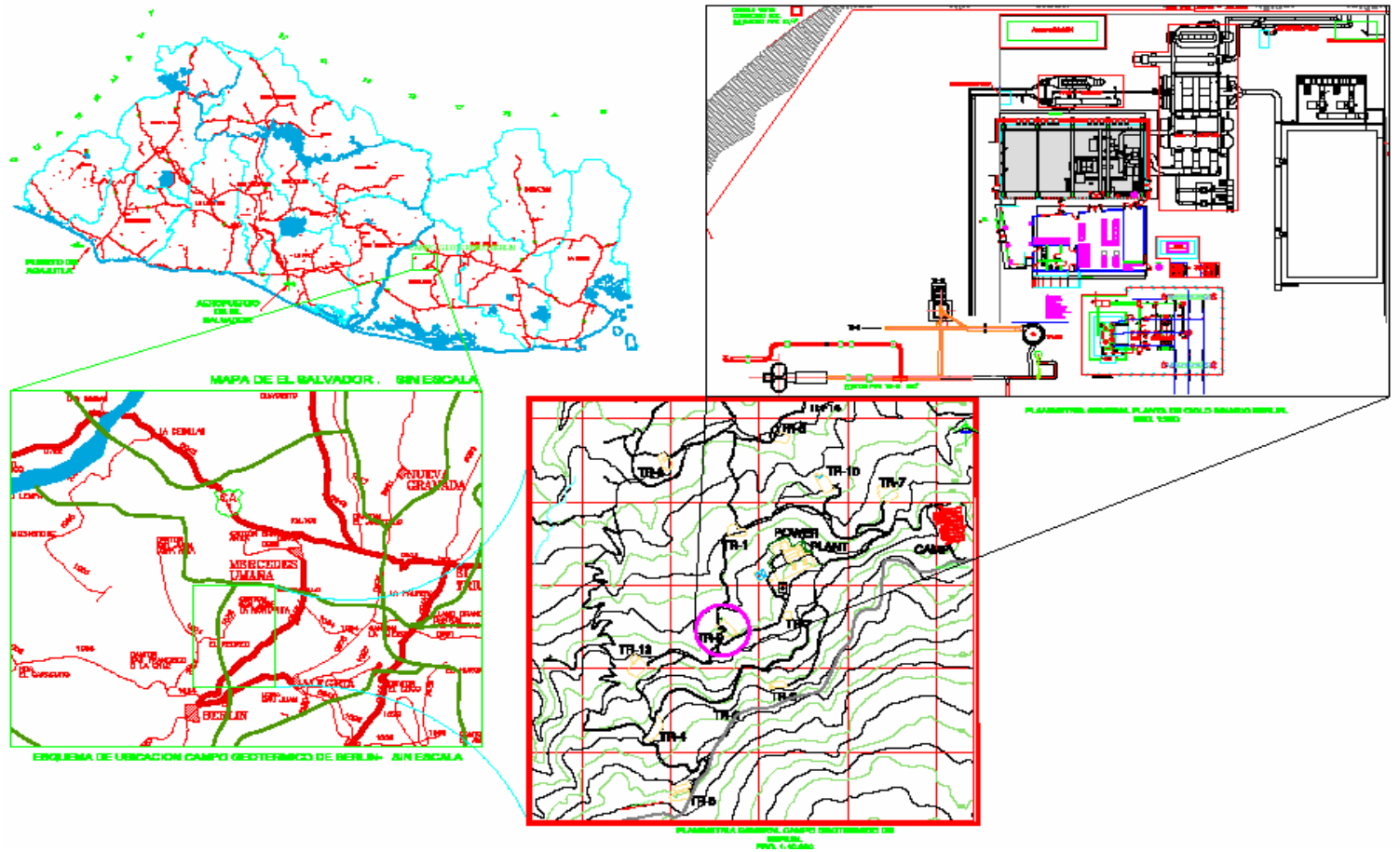
Annex 7
Technical information

A. Berlin Binary Cycle power plant location and plant scheme



B. Simplified Binary Cycle diagram

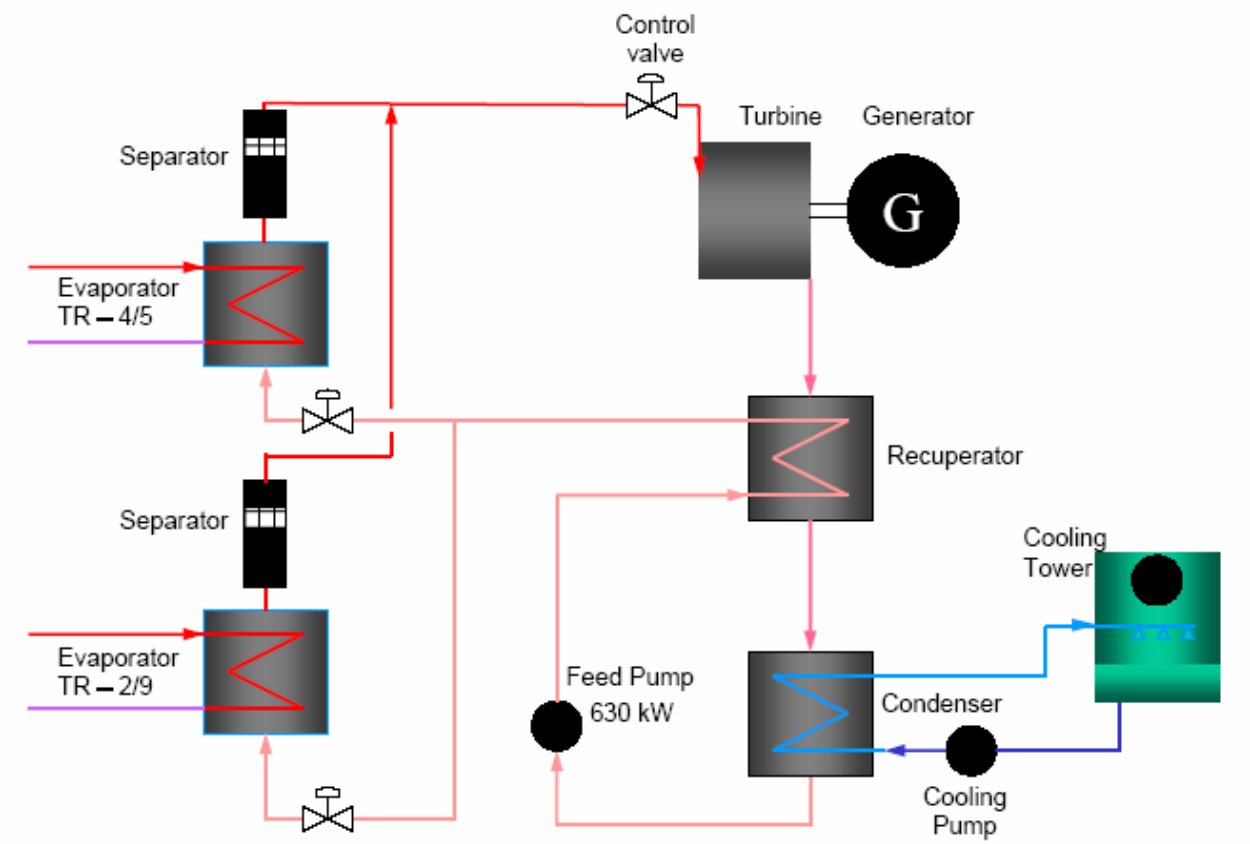


Figure 1: The Process Flow Diagram