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

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Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Dos Mares Hydroelectric Project (DMHP)
18/05/2010
Version 2.00

A.2. Description of the project activity:

The Dos Mares Hydroelectric Project (DMHP) (hereinafter referred to as "Dos Mares Hydro Complex" or "Project") developed by Bontex S.A. and Alternegy S.A. (hereafter referred to as "the Project Developers") is a Greenfield hydroelectric project, composed of three run-of-river hydro power plants constructed in cascade with a total installed capacity of 117.79 MWe, i.e. Gualaca (25.33 MWe), Lorena (33.77 MWe) and Prudencia (58.68 MWe). The DMHP is located in the Province of Chiriquí, in the Gualaca and David Districts of Panama (hereafter referred to as the "Host Country").

The purpose of the Dos Mares Hydro Complex is to use the hydrological resources of the Chiriquí River basin to generate electricity for the national electricity transmission grid of Panama. The water will come from the regularized discharge of the Estí hydroelectric power plant and from the Estí River. In the last unit (Prudencia Hydropower Plant), a complementary flow will be added coming from two other rivers (Cochea and Papayal rivers).

The average annual generation for DMHP is projected to be 597.31 GWh. Figure A1 shows a schematic overview of the project activity.

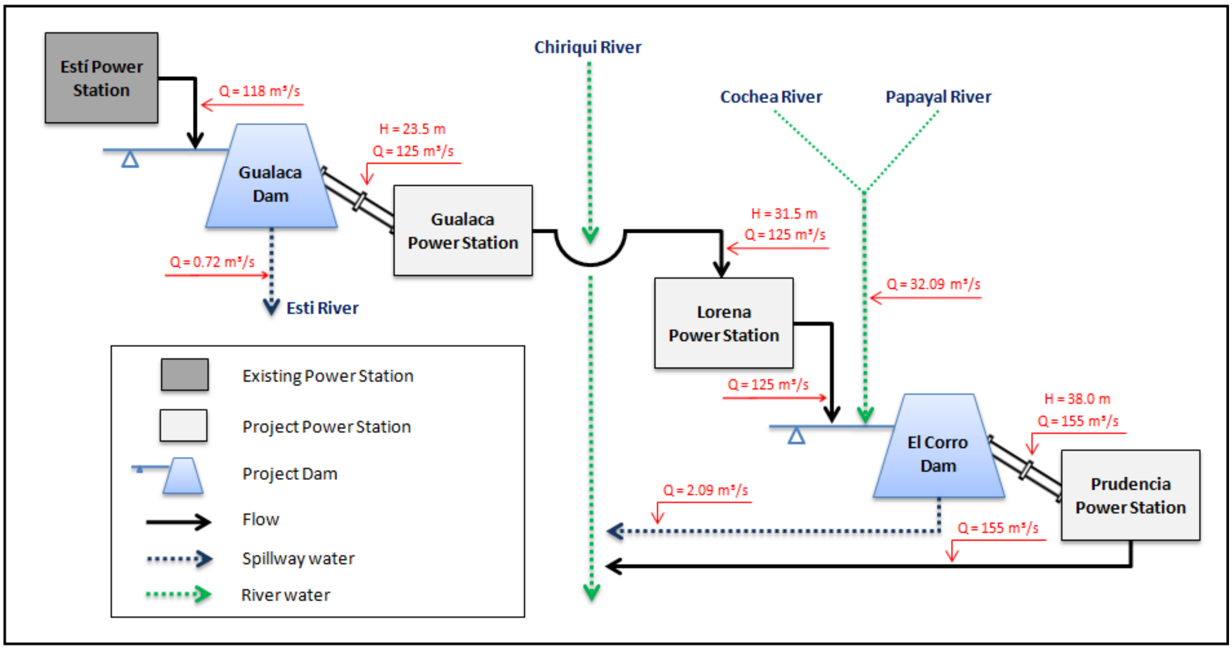

Figure A 1: Schematic presentation of the project activity

The Gualaca and Prudencia power plants will dispose each of one reservoir and one associated dam. The Gualaca reservoir (related to the Gualaca power plant) receives water from the Estí hydropower plant and the Estí River (see Figure A 1 and Figure A 4) and the El Corro reservoir (related to the Prudencia power plant) receives the discharge from Lorena power plant and the two rivers Cochea and Papayal. This configuration assures technical and environmental synergies and reduces the risk of flow fluctuations and environmental impacts, which were key variables considered in the investment decision.

The project developers Bontex S.A. and Altenergy S.A. are fully owned Panamanian subsidiaries of GDF SUEZ S.A. One of the leading energy providers in the world, GDF SUEZ is the largest Independent Power Producer worldwide and is active across the entire energy value chain, in electricity and natural gas, upstream to downstream. It develops its businesses (energy, energy services and environment) around a responsible growth model to take up the great challenges: responding to energy needs, fighting against climate change and maximizing the use of resources. GDF SUEZ relies on diversified supply sources as well as flexible and highly efficient power generation in order to provide innovative energy solutions to individuals, cities and businesses.

The three power plants will be connected by a single 230 kV transmission line to the existing Guasquitas substation of the National Interconnection System of Panama (SIN, *Sistema Interconectado Nacional*), operated by the National Dispatch Center (CND, *Centro Nacional de Despacho*) and owned by the National Transmission Company (ETESA, *Empresa de Transmisión Eléctrica S.A.*). Each of the three power plants will be equipped with 2 Kaplan turbines and the respective generators.

The 6 generation units (2 for each of the 3 power plants: Gualaca, Prudencia and Lorena) are expected to initiate commercial operation according to a chronogram which is available in Table A 1. The dates refer to the expected start of commercial operation for each turbine.

Table A 1: Construction starting date and expected commercial operation dates for Gualaca, Prudencia and Lorena Hydropower Plants

Plant/Unit (turbine)	Construction – Starting Date	Expected Commercial Operating Start Date
GUALACA		
Turbine 1	13 August 2008	15 June 2010
Turbine 2	13 August 2008	15 July 2010
LORENA		
Turbine 3	13 August 2008	15 November 2010
Turbine 4	13 August 2008	15 December 2010
PRUDENCIA		
Turbine 5	13 August 2008	15 March 2011
Turbine 6	13 August 2008	15 May 2011

The project activity will contribute to the reduction of greenhouse gas emissions by displacing electricity generation from grid connected fossil fuel-fired power plants. Furthermore, there are no project emissions as it is constituted by 3 hydro power plants, each with power densities greater than 10 W/m^2. [1]

[1] Please refer to Table B 1: Power density for each individual hydropower power plant and for the

This project contributes to the sustainable development in Panama through:

- Use of local renewable energy resources (hydro power) to displace thermal power generation;
- Mitigation of high additional water flow in the Estí River[2] which are a consequence of the Estí hydroelectric power plant operation: The Dos Mares Hydro Complex reverts waters that the Estí plant had diverted from the Chiriqui river into the Estí River back into the original Chiriquí River and therefore mitigates a significant environmental impact of the Estí hydroelectric power plant. The additional intake of natural flow from the Cochea and Papayal Rivers for supplying Prudencia is not a flow diversion as both rivers already flow into the Chiriquí River;
- Employment generation in the region of Chiriquí where the project is located;
- Expansion of available power in Panamanian grid to meet increasing energy demand through clean and renewable sources;
- Improvement of road infrastructure to the benefit of the local communities;
- Positive impacts on the balance of trade, as Panama's coal and oil imports used to fuel national thermal plants will be replaced by the use of renewable indigenous energy sources.

A.3. Project participants:

Name of Party involved	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant
Panamá (host)	• Bontex S.A. (private entity) • Altenergy S.A. (private entity)	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Republic of Panama.

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

Chiriquí Province.

Dos Hydro Mares Complex. See also section B.3 for the definition of project boundary and section B.6.1 for calculation of the projected emissions reductions.

[2] Some of the negative impacts of the Estí hydropower plant on the Estí River can be found in the report "*Audit of social and economic impacts of the Rio Estí Hydroelectric Project, Panama*", published in 2006 at the Uppsala University (Sweden), section 6.4 (Higuerón). Available at: http://www.env-impact.geo.uu.se/118Bergsten.pdf (last accessed on 13 May 2010).

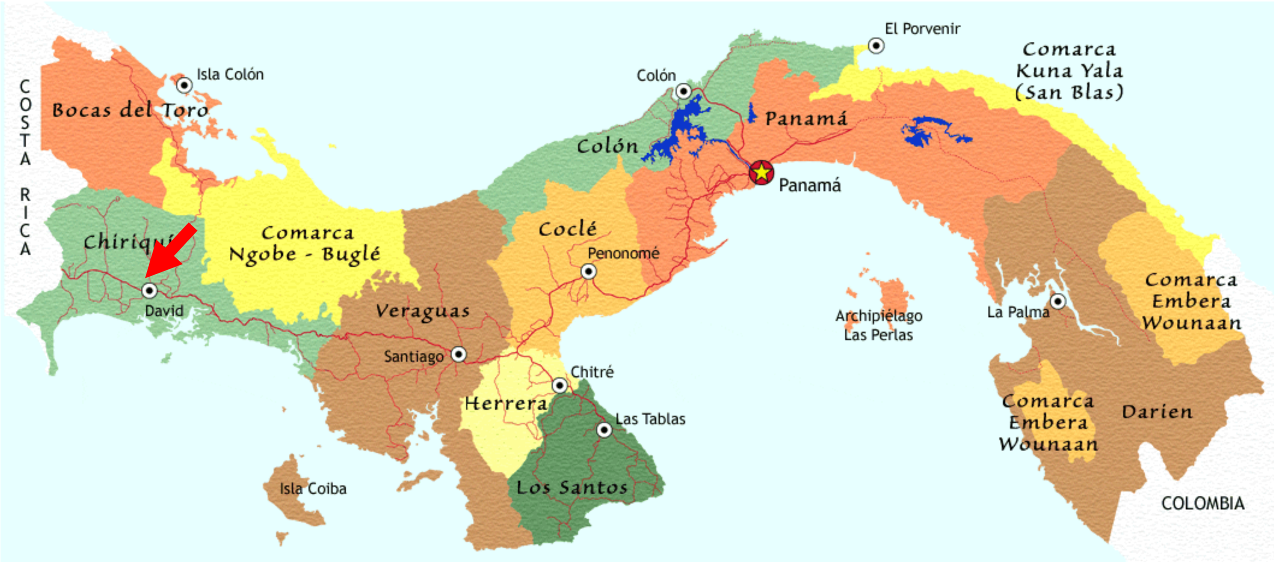

Figure A 2: Panama and the province of Chiriquí

A.4.1.3.	City/Town/Community etc:

The Gualaca hydroelectric power plant will be constructed in the vicinity of the Gualaca town, in the flatlands between the Estí and Chiriquí Rivers.

The Lorena hydroelectric power plant will be constructed near the community of Guayabal, located in the Bijagual Township.

The Prudencia hydroelectric power plant will be constructed near the community of El Valle, located in the Las Lomas Township.

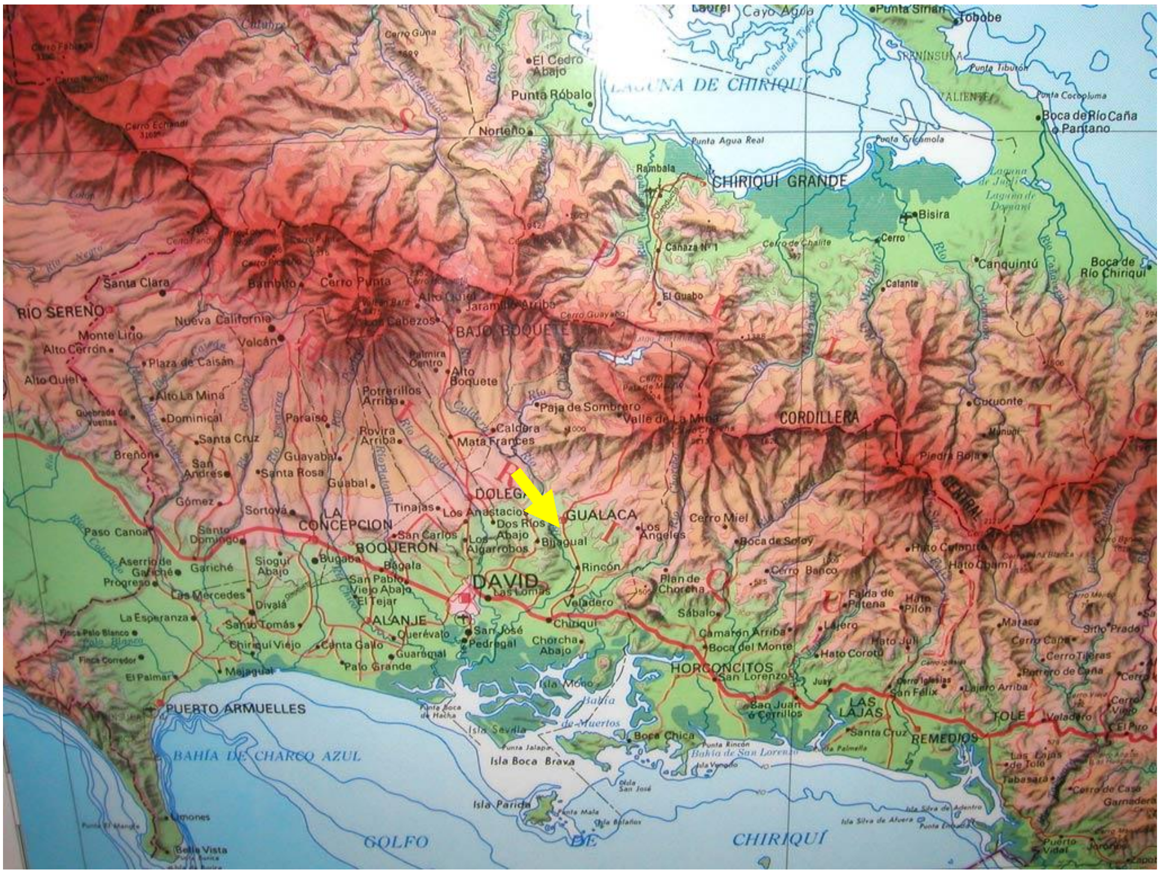

Figure A 3: The province of Chiriquí and indication of the project location

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity:

Geographic coordinates for each of the three hydroelectric power plants are described below:

Table A 2: Project hydropower plants geographical coordinates

LOCAL	COORDINATES		
	GUALACA	LORENA	PRUDENCIA
DAM	8° 31' 57.9274" N 82° 17' 36.811"W	-	8° 26' 34.113"N 82° 19' 36.685"W
HEAD POND	8° 30' 6.5344" N 82° 17' 58.765"W	8° 27' 15.459"N 82° 19' 58.993"W	8° 25' 25.441"N 82° 20' 36.817"W
POWER HOUSE	8°30' 4.568"N 82° 17' 58.758"W	8° 27' 13.800"N 82° 20' 0.194"W	8° 25' 21.08"N 82° 20' 38.259"W
WATER RESTITUTION	8° 29' 55.008 "N 82° 18' 6.657"W	8° 27' 5.571"N 82° 20' 7.953"W	8° 23' 23.858"N 82° 22' 56.312"W

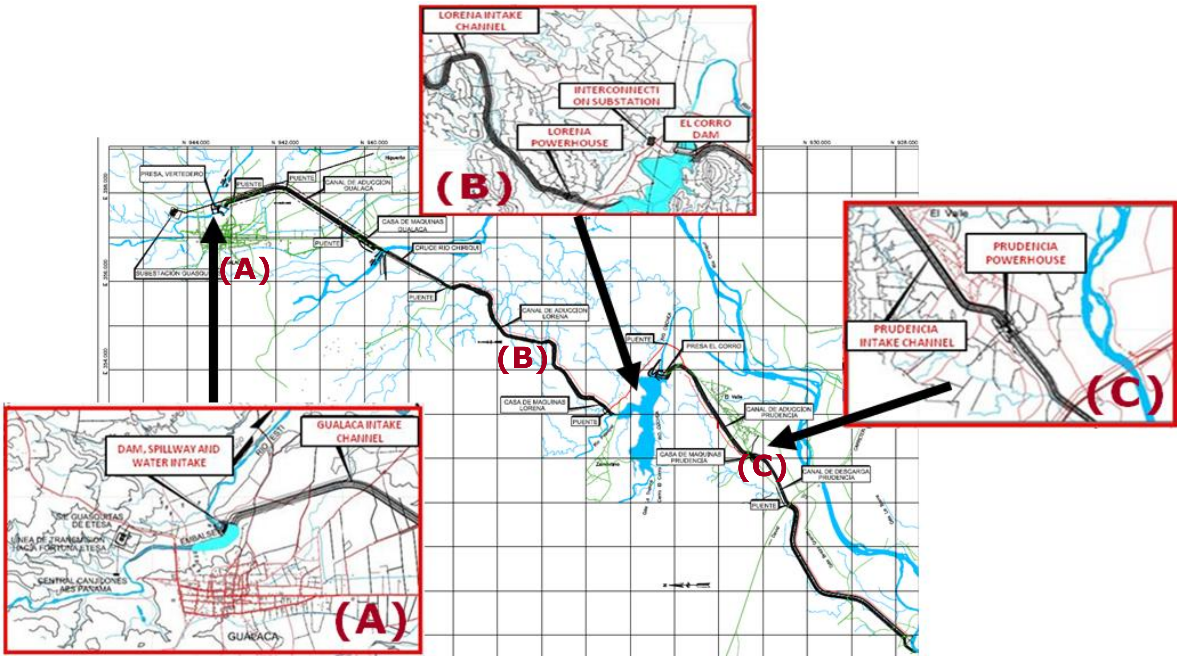

Figure A 4: Project activities locations: (A) Water intake at Gualaca - Gualaca Dam; (B) Power plant at Lorena and El Corro Dam (C) Power plant at Prudencia

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

The project activity falls within *Sectoral Scope 1: Energy industries (renewable/non-renewable sources).*

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

As previously mentioned, the Dos Mares Hydro Complex is composed by three hydropower plants: Gualaca, Lorena and Prudencia. The integrated construction and operation allows exploring effectively the full energy potential of the lower Chiriqui River Basin, between an elevation of 100 masl (Gualaca) and an elevation of 2 masl (Prudencia), achieving a gross head of 98 meters. In order to attain this objective, it was necessary to fraction this head in 3 locations that were equipped with independent power houses, substations and transmission networks and finally connected by open channels. It is important to emphasize that all three power plants are of the run-of-river type, and consequently their generation and dispatch is completely interrelated.

This specific design, if operated as a complex, is efficient from energy generation perspective, but implies the construction of extensive channels and consequently demands extensive fill and excavation works. The building of close to 20 km of channels in fact is the reason for the project activity's particularly high investment costs as their construction represents approximately 50% of the total civil works.

In spite of these high costs, the implementation as a hydropower complex and the parallel construction of all plants allow to generate important cost synergies, as well as the identification and implementation of improvements in the project design. As a consequence of this, the project was optimized when possibilities for further improvement were identified after starting of the construction.

Specifically, it was decided to take benefit of the total available head, releasing the turbinated water in the Chiriqui River at elevation of 2.00 masl instead of the elevation of 4.00 masl as originally planned. This improvement allows an incremental capacity of 3 MW, but also demands increased investment expenditures to finance a lower power house, a longer discharge channel as well as to purchase a more powerful generator.

General Description of Gualaca hydroelectric power plant

The Gualaca hydroelectric power plant takes advantage of the turbinated water released by the Estí hydroelectric power plant and the water from Estí River. Water is collected in the Gualaca reservoir, formed from the construction of the Gualaca dam on the Estí River. The main feature of the Gualaca hydroelectric power plant is that the regularized discharges of the Estí hydro power plant, allowing a constant generation of energy, with a high capacity factor.

The Gualaca hydroelectric power plant will consist of:

- An earth-fill dam, constructed on the Estí River, with free discharge concrete spillway on the dam's left abutment and a spillway controlled by a sector floodgate;
- Adduction channel, with a 3.63 km extension that will carry the water to a head pond at its end;
- Intake structure reinforced by concrete galleries and metal pressure pipes that will conduct water to the power house;
- Power house with two horizontal axis Kaplan turbines, type "S" and a generator each;
- Discharge channel of approximately 0.32 km.

Table A 3: Main parameters for the Gualaca hydroelectric power plant[3]

Description	Unit of Measurement
Adduction channel water level	100.0 masl
Discharge channel water level	76.5 masl
Gross head	23.5 m
Nominal Discharge	125 m^3/s
Installed Capacity[4]	25.33 MW_e
Net head	22.63 m
Average Annual Generation	130,51 GWh/yr

[3] GDF SUEZ Energy Central America - GSECA "*Proyecto Dos Mares, Estudio Energético*", 6425G-IN-G00-004 Rev. 0.5, published on November 2009 by Leme Engenharia, República de Panamá.

[4] Two turbogenerator units of 12.67 MW each

General Description of Lorena hydroelectric power plant

The Lorena hydroelectric power plant generates electrical power by using water from the Gualaca hydroelectric power plant that will pass below the Chiriquí River by means of a concrete culvert.

The Lorena hydroelectric power plant will consist of:

- Chiriquí River crossing of 1.5 km extension that will receive the turbinated water from the discharge channel of the Gualaca hydroelectric power plant, flowing at 125 cubic meters per second up to the adduction channel. The water will pass below the Chiriquí River by means of a concrete culvert.
- Adduction channel of 5.16 km long that will conduct the water to a head pond;
- Intake structure and metal penstock that will conduct the water to the power house;
- Power house with two horizontal axis Kaplan turbines, types “S” and a generator each;
- Discharge channel with an approximate extension of 0.35 km with turbinated water that flows into the El Corro reservoir.

Table A 4: Main parameters for the Lorena hydroelectric power plant[5]

Description	Unit of Measurement
Adduction channel water level	76.5 masl
Discharge channel water level	45 masl
Gross head	31.5 m
Flood design	125 m³/s
Installed Capacity[6]	33.78 MW_e
Net head	30.23 m
Average Annual Generation	174,65 GWh/yr

General Description of Prudencia hydroelectric power plant

The Prudencia hydroelectric power plant generates electrical power by using water from the Lorena hydroelectric power plant. In addition to the regular 125 m³/s that will be discharged by the Lorena hydroelectric power plant, a complementary flow of 30 m³/s will be obtained from the Cochea and Papayal Rivers.
The Prudencia hydroelectric power plant consists of:

- El Corro earth fill dam, on the Cochea River, a free discharge concrete spillway and a controlled spillway
- Adduction channel of 2.9 km length, from the reservoir created by El Corro Dam up to the head pond of Prudencia power house;
- Intake structures and metal penstock that will conduct the water to the power plant;
- The power house with two vertical axis Kaplan S type turbines and a generator each

[5]GDF SUEZ Energy Central America - GSECA “*Proyecto Dos Mares, Estudio Energético*”, 6425G-IN-G00-004 Rev. 0.5, published on November 2009 by Leme Engenharia, República de Panamá..

[6] Two turbogenerator units of 16.89MW each.

- Discharge channel with an approximate extension of 6.0 km that flows into the Chiriquí River;
- Bridge for the Pan-American Highway over the discharge channel.

Table A 5: Main parameters for the Prudencia hydroelectric power plant[7]

Description	Unit of Measurement
Adduction channel water level	45 masl
Discharge channel water level	2.0 masl
Gross head	43 m
Nominal discharge	155 m^3/s
Installed Capacity[8]	58.77 MW_e
Nominal head	42.27 m
Average Annual Generation	292,15 GWh/yr

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

Year	Annual estimation of emissions reduction in tonnes of CO_2e
2011	**288,824**
2012	**336,882**
2013	**336,882**
2014	**336,882**
2015	**336,882**
2016	**336,882**
2017	**336,882**
Total Estimated Reductions (tonnes of CO_2e)	**2,310,116**
Total Number of Crediting Years	**7**
Annual Average over the Crediting Period (tonnes of CO_2e)	**330,017**

A.4.5. Public funding of the project activity:

There is no public funding from Annex I countries for the proposed project activity.

[7] GDF SUEZ Energy Central America - GSECA "*Proyecto Dos Mares, Estudio Energético*", 6425G-IN-G00-004 Rev. 0.5, published on November 2009 by; Leme Engenharia, República de Panamá.

[8] Two turbogenerator units of 29.34 MW each.

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:

Project activity applies the approved consolidated baseline and monitoring methodology ACM0002 "*Consolidated baseline methodology for grid-connected electricity generation from renewable sources*" version 11 (EB 47).

This methodology refers to the latest approved versions of the following tools:

- "*Tool to calculate the emission factor for an electricity system*" – version 02 (EB 50)
- "*Tool for the demonstration and assessment of additionality*" – version 5.2 (EB 39)
- "*Guidelines for objective demonstration of barriers*" – version 1 (EB 50)

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

The proposed project activity is a new grid-connected renewable power generation plant, comprising three interconnected units. It does not involve on-site switching from fossil fuel to renewable sources, as it does consist of the installation of three new run-of-river hydroelectric power plants along the Chiriquí River: Gualaca Hydroelectric Project, Lorena Hydroelectric Project and Prudencia Hydroelectric Project. The Dos Mares Hydro Complex will dispose of two new reservoirs with their associated dams.

The *Gualaca reservoir* is obtained by the Gualaca Dam to be constructed on the Estí river and is intended to collect water for the adduction channel to the Gualaca hydropower plant. After being released by the Gualaca hydropower plant, the waters are being conducted directly to the Lorena hydropower plant, without any reservoir in between. The *El Corro reservoir* shall be constructed on the Cochea River and is supplied also by the waters coming from the Lorena outflow and from Cochea and Papayal rivers. As shown in Table B 1, the power density of the reservoir in the Dos Mares Hydro Complex is well above 10 W/m^2.

Table B 1: Power density for each individual hydropower power plant and for the Dos Hydro Mares Complex

Power Plant	Reservoir Surface[9] m^2	Installed Capacity [10](W)	Power Density (W/m^2)
Gualaca	80,000	25,330,000	317
Lorena	-	33,770,000	-
Prudencia (El Corro)	1,050,000	58,680,000	56
Total Dos Mares	1,130,000	117,780,000	**104**

[9]SUEZ Energy Central America - SECA, "*Proyectos Hidroelectricos Gualaca, Lorena y Prudencia, Diseño Básico,- Informe Final Volumen I – Texto*", 6425B-IN-G00-001-R0; published on April 2008 by Leme Engenharia, República de Panamá, pages 46 (for Gualaca reservoir) and 49 (for Prudencia reservoir - El Corro), pages 46 (for Gualaca reservoir) and 49 (for Prudencia reservoir - El Corro).

10 GDF SUEZ Energy Central America - GSECA "*Proyecto Dos Mares, Estudio Energético*", 6425G-IN-G00-004 Rev. 0.5, published on November 2009 by Leme Engenharia, República de Panamá.

The three plants will be connected to the 230 kV national electrical transmission system of Panama (SIN, *Sistema Interconectado Nacional*), operated by the National Dispatch Center (CND, *Centro Nacional de Despacho*) and owned by Empresa de Transmisión Eléctrica S.A. (ETESA).

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

Source		Gas	Included?	Justification/explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity.	CO_2	Yes	Main emission source. (According to ACM0002 v.11)
		CH_4	No	Minor emission source. (According to ACM0002 v.11)
		N_2O	No	Minor emission source. (According to ACM0002 v.11)
Project activity	For hydro power plants, emissions of CH_4 from the reservoir.	CO_2	No	Minor emission source. (According to ACM0002 v.11)
		CH_4	No	As the power densities of the two hydroelectric plants of the project activity containing a reservoir are greater than 10 W/m^2 each (see Table B1) no project emissions have to be accounted for (ACM0002 v.11).
		N_2O	No	Minor emission source. (According to ACM0002 v.11)

The spatial extent of the project boundary includes the project power plants and all power plants connected physically to the electricity system that the CDM project activity is connected to. This system is the national electrical transmission system of 115 kV and 230 kV of Panama (SIN, *Sistema Interconectado Nacional*).

The geographic and system boundaries of the SIN are clearly identified and information on the characteristics is readily available.[11] The flow diagram of the project and its boundaries is presented below:

[11] Map of the national electrical transmission system (SIN), available at: http://www.etesa.com.pa/plan_expansion.php?act=mapa and http://www.cnd.com.pa/publico/documentos/sin.pdf (last accessed on May 11, 2010).

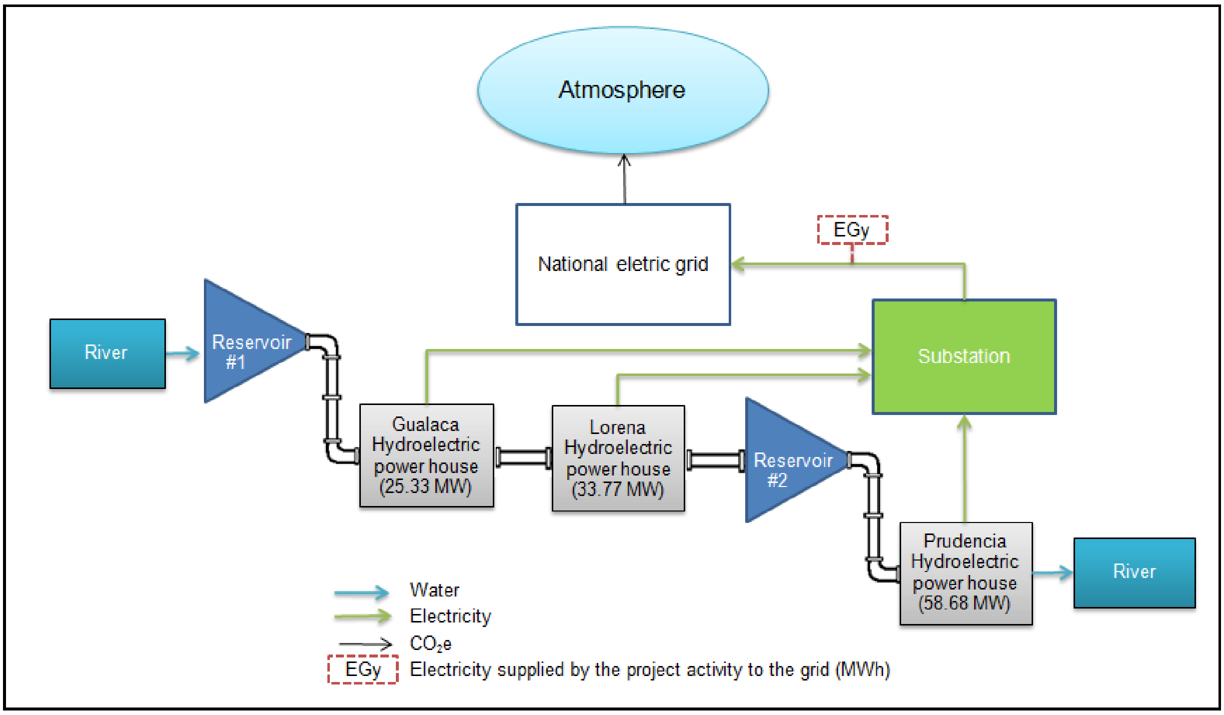

Figure B 1: Flow diagram of the project activity and its boundaries

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

The project activity is the installation of three new grid-connected renewable power plants.

In conformity with approved consolidated baseline and monitoring methodology ACM0002, the baseline scenario is the following:

"Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system"".

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 following steps from the "*Tool for the Demonstration and Assessment of Additionality*", Version 5.2, will be completed in this section:

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations
Step 2: Investment Analysis
Step 3: Barrier Analysis
Step 4: Common Practice Analysis

As the project activity has its starting date (see Section C.1.1.) before August 2, 2008 and prior to the date of publication of the PDD for global stakeholder consultation, it is required to demonstrate that a) the CDM was seriously considered in the decision to implement the project activity and b) that continuing and real actions were taken to secure CDM status for the project in parallel with its implementation. ("*Guidance on the Demonstration and Assessment of Prior Consideration of the CDM*" version 03, EB49).

a) Prove of awareness of the CDM prior to the project activity start date:

Power plants that today integrate the Dos Mares Hydro Complex were initially developed by two independent project developers, Bontex SA (Gualaca) and Alternegy SA (Lorena and Prudencia), that were acquired by Suez Energy International (SEI) in October 2007. Both developers have considered CDM status of their projects as essential to find investors for the hydro power facilities. They have registered the projects at National Environment Authority (ANAM - *Autoridad Nacional del Medio Ambiente*), the DNA of Panama, as early as 2005.

- **Alternegy SA (Hydroelectric Power Plants Lorena and Prudencia)**

  ANAM issued a Letter of No Objection ("*Carta de Complacencia*") for the HPP Lorena[12] and Prudencia [13] in favor of Alternegy SA on September 16, 2005.

  Press releases published by Altenergy SA in 2005[14] and 2006,[15] show that the company was actively looking for, and negotiating with, partners and investors to implement the projects Lorena and Prudencia. The CDM revenues were reiterated as an important contribution to the project's financial sustainability.

- **Bontex SA (Hydroelectric Power Plant Gualaca)**

  The Environmental Impact Assessment (EIA) for the Gualaca hydroelectric power plant, carried out by MWH Panama in August 2004, contains a calculation of the estimated CO_2-emission reductions, including the revenues that the development of the project as a CDM would generate.[16]

  ANAM issued a Letter of No Objection ("*Carta de Complacencia*") for the Gualaca HPP in favour of Bontex SA on March 20, 2007.[17]

- **Acquisition Process by Suez Energy International and CDM Awareness**

[12] For Lorena Hydropower Plant, please refer to the file: "*Carta de Complacencia*", Code SAG 240-05, September 15, 2005.

[13] For Prudencia Hydropower Plant, please refer to the file: "*Carta de Complacencia*", Code SAG 241-05, September, 16, 2005.

[14] Press Release "*Alternergy advances JV negotiations with 3 hydro projects*"- http://member.bnamericas.com/news/electricpower/Alternegy_advances_JV_negotiations_on_3_hydro_projects (last accessed on May 11, 2010).

[15] Press Release "*Alternergy seeks investors, EPC cos, for hydro projects" -* http://member.bnamericas.com/news/electricpower/Alternegy_seeks_investors,_EPC_cos_for_hydro_projects (last accessed on May 11, 2010).

[16] "*Bontex S.A. - Proyecto Hidroeléctrico Gualaca, Estudio de Impacto Ambiental Categoria III*", published on August 2004 by MWH Panamá S. A.; pages 13 and 78-81.

[17] For Gualaca Hydropower Plant, please refer to the file: "*Carta de Complacencia*", Code: SAG 096-07, March 20, 2007.

Based on the actions undertaken by Alternegy SA and Bontex SA, to promote the implementation of the HPPs Prudencia and Lorena, as well as Gualaca under the CDM, Suez Energy Central America (SECA), on behalf of Suez Energy International (SEI)[18] started to evaluate the investments and their potential under the Clean Development Mechanism. Table B 2 gives an overview about the related assessments and actions undertaken by SECA/SEI and shows that the potential for the generation of CERs by the proposed project activities were a decisive criteria to decide on the acquisition of the companies and the respective concessions in December 2007, as well as for the decision to initiate the project implementation in June 2008. The chronology of the events clearly reveals the close interconnection of CDM project analysis and the acquisition and investment process.

Table B 2: Awareness of the CDM Prior to the Project Activity Start Date[19]

9 Jul, 2007	CDM	Request by Suez Energy International (SEI), to analyze the Projects CDM eligibility and its CER generation potential to Tractebel Engineering (TE).
13 Jul, 2007	CDM	Quick Scan CDM Feasibility Analysis by TE.
19 Dec 2007	Project Milestone	SEI acquires Bontex SA and therefore the concession for the HPP Gualaca.
24 Jan, 2008	Project Milestone	SEI acquires Alternegy SA and therefore the concessions for the HPP Lorena and Prudencia.
10-13 Mar 2008	CDM	Data gathering meeting of TE at SECA offices in Panama City and signature of a CDM consultancy contract between SECA and TE.
21Mar 2008	CDM	Conclusions of the data gathering meeting of TE at SECA.
4 July 2008	**Project Start Date/Investment Decision**	EPC contract signature for Electro-mechanical equipment and services.

The definition of the Project Start Date:

The starting date of the CDM project activity was defined as the signature of the EPC contract for Electro-mechanical equipment and services, which implies a cost of US$ 128 Million, which is a significant share of the capital commitments. A few days later, on July 11, the EPC contract for Civil Works was signed. Compared to these expenses, the costs for preliminary engineering studies and the investment for purchasing of the companies Bontex SA and Altenergy SA and therefore of the HPP concessions were of minor relevance and did not necessarily imply the implementation of the projects, but they were a closely related and necessary precondition to develop the projects to a stage where their full implementation was granted.

The definition of the signature of the EPC contracts as project starting date complies with the provisions of the CDM Glossary of Terms, Version 03: "*The starting date of a CDM project activity is the earliest date at which*

[18] Later, on July 16, 2008, the merger between Suez and GDF was concluded and Suez Energy International became part of the GDF SUEZ Group. Further information available on: http://www.gdfsuez.com/en/finance/shareholders/shareholders-meetings/merger-shareholders-meeting-of-16-july-2008/merger-shareholders-meeting-of-16-july-2008/, (last access on May 14, 2010).
[19] All supporting evidences for Table B 2 were made available to the auditors.

either the implementation or construction or real action of a project activity begins", as well as with the respective clarifications provided at EB 41:

> "*In light of the above definition, the start date shall be considered to be the date on which the project participant has committed to expenditures related to the implementation or related to the construction of the project activity. This, for example, can be the date on which contracts have been signed for equipment or construction/operation services required for the project activity. Minor pre-project expenses, e.g. the contracting of services /payment of fees for feasibility studies or preliminary surveys, should not be considered in the determination of the start date as they do not necessarily indicate the commencement of implementation of the project*."

b) Prove of continuing and ongoing action to secure CDM status during implementation:

After the Project Activity Start Date in July 2008, a second meeting with Tractebel Engineering (TE) was organized in Panama in July 2008 to initiate the preparation of the PDD. Following the conclusion of the project's first PDD version, SGS was contracted on April 07, 2009 to conduct the project validation and on July 29, 2009, the project was published for Global Stakeholder Process (GSP)[20]. Later, during the validation process, which was conducted in parallel to the ongoing construction, the Project suffered minor modifications and optimisations in the plants design and as a consequence the Project Participants opted to revise the PDD and resubmit the project to GSP. Table B 3 provides an overview about the references that can be shown to prove the ongoing actions mentioned.

Table B 3: Continuing and Real Actions to Secure CDM Status during Implementation[21]

3 Aug, 2008	First PDD Draft.
14 May, 2009	Signature of the Validation contract with SGS.
29 Jul, 2009	PDD published for GSP on the UNFCCC website.
14-15 Sep 2009	First validation audit takes place.
17 May, 2010[22]	Project Participants communicate to the UNFCCC the intention to re-initiate the GSP due to changes in the project design.

Conclusion

Based on above evidence it is clearly demonstrated that the CDM was seriously considered in the decision to implement the project activity and that continuing and real actions were taken to secure CDM status for the project in parallel with its implementation.

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[20]For further information, please access: http://cdm.unfccc.int/Projects/Validation/index.html (last accessed on May 11, 2010).

[21] All supporting evidences for Table B 3 were made available to the auditors.

[22] For further information, please access: http://cdm.unfccc.int/Projects/Validation/DB/77SXKZAEIURP9D5GVL96QQDE1HRWTZ/view.html (last accessed on May 17, 2010).

Step 1 - Identification of Alternatives to the Project Activity Consistent with Current Laws and Regulations

Sub-step 1a – Define Alternatives to the Project Activity

The project activity comprises three hydroelectric power plants in a complex. No alternative scenarios for each of them have been identified separately because they are constructed jointly and in cascade. These plants will have an integrated operation and use broadly similar technologies. In addition, the construction of the three power units as a single project activity produces technical and environmental synergies. Based on this assumption, the identified realistic and credible alternatives available to the project participants or similar project developers that provide outputs or services comparable with the proposed project activity are the following three scenarios:

Alternative 1: Implement the project activity without being registered as a CDM project;

Alternative 2: The continuation of the current situation (i.e. do not implement any power generation project). The power generated under the project would be generated in existing and new grid-connected power plants in the electricity system;

Alternative 3: Implement a fossil-fuel fired power plant;

Typical fossil-fuel fired power plants considered in the ETESA Report on the Expansion of SIN 2007-2012[23], include Bunker C fired internal combustion engines and natural gas turbines with a capacity of 100 MW. In addition, a coal fired option is considered with an installed capacity of 150 MW.

Therefore, the inclusion of fossil-fuel fired power plants to account for the electricity system's demand will be predominantly based on small to midsized thermal power plants (100-150 MW) fuelled either on oil (Bunker C) or coal.

Sub-step 1b – Consistency with Mandatory Laws and Regulations

The identified alternatives are in compliance with all applicable legal and regulatory requirements, including:

- Law N°.6 of February 3, 1997[24], Law Decree N°.10 of February 26, 1998[25], Executive Decree N°.22 of June, 1998[26], and Regulation to Law N°.6 of February 3, 1997[27]. These regulations were issued during the privatization process and are the basis of the current Regulatory and Institutional Framework for the power sector in Panama. Law N°.6 and its related regulations constitute the Panamanian General Law of Electricity and delineate an energy market prompted by commercial actors, who can sell and buy energy

[23] "*Plan de Expansión del Sistema Interconectado Nacional 2007-2021*", published on October 15, 2007 by ETESA, República doPanamá, p.137/461 – Table N° 6.3.

[24] For further information, please refer to: http://www.mef.gob.pa/cope/pdf/LEY%206%20DE%201997%20MARCO%20REGULATORIO%20ELECTRICIDAD.pdf (last accessed on May 17, 2010).

[25] For further information, please refer to: http://www.ariae.org/pdf/panam_ley2.pdf (last accessed on May 17, 2010).

[26] For further information, please refer to: http://www.etesa.com.pa/documentos/decretoejecutivo22a.pdf (last accessed on May 17, 2010).

[27] For further information, please refer to: http://www.asamblea.gob.pa/actualidad/proyectos/2009/2009_P_054.pdf (last accessed on May 17, 2010).

by means of long-term contracts and in the spot market. Under this market design, the State has contemplated four main objectives:

- Promote competition and efficiency;
- Improve the coverage and the quality of the energy and of the service;
- Regulate the distribution and transmissions services;
- Improve the environmental quality.

- Law N°.45 of 4th August 2004[28] establishes specific incentives for the promotion of different kinds of clean and renewable energy sources.

According to the GTZ[29], the mentioned law offers diverse benefits and incentives for new hydroelectric generation and other traditional and non-traditional clean and renewable sources. The legislation classifies[30] hydropower and geothermal plants, as well as biomass generation according to their capacity and defines specific incentives for each group. Also, the incentives are specifically related to the amount of CO_2 emission reductions that can be obtained by the implementation of such projects. For hydropower plants above 20 MW and therefore applicable for the Dos Mares Hydro Complex, the regulation defines a fiscal credit on income tax of up to 50% of the taxable income until a maximum amount of 25% of the total investment and valid for the first 10 years of energy generation, which is related to the volume of emission reductions generated by the project.

Following the provisions of the CDM, the legislation above and the respective comparative advantages it provides to renewable energies (when compared to more emission intensive technologies such as coal or diesel fired power plants) represents an E- legislation, an issue that will be further discussed below

Conclusion Step 1

Because none of the identified alternatives breaks any law or regulatory requirement or are posed to do so in the future, including the fact that none of the three alternatives are post to go against technical standards and dispositions of environmental conservation or cultural patrimony conservation, all three scenarios are in compliance with all applicable laws and regulations and are also realistic and credible alternatives available to the project participants or similar project developers.

In addition, the Law N°.45 of 4th August 2004 defines incentives for the establishment of different kinds of renewable energies, including hydropower plants above 20 MW as it is the case for the Dos Mares Hydro Complex. These incentives represent a comparative advantage of the Alternative 1, but they do not make Alternative 2 and Alternative 3 illegal or unattainable. In addition, since this law was published after 11th November 2001, this law is considered an E- policy and any incentives or benefits that result from it may be removed from the Investment Analysis, as will be discussed bellow.

Step 2 – Investment Analysis

According to the Tool, the investment analysis shall demonstrate that the proposed project activity is:

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[28] Law 45/2004, available at: http://www.mef.gob.pa/cope/pdf/Law%2045-2004%20_Renewable%20Energies%20Promotion.pdf (Last Accessed on May 10, 2010).

[29] “Energy-policy Framework Conditions for Electricity Markets and Renewable Energies – 16 Country Analyses” published on November 2009 by GTZ. Available at: http://gtz.de/de/dokumente/gtz2009-en-terna-panama.pdf (last accessed on May 10, 2010).

[30] The legislation (Law 45/2004) defines incentives for i) Renewable Energy Plants of up to 500 kW, ii) for plants up to 10 MW, iii) for plants between 10 to 20 MW, as well as iv) above 20MW. The incentives are defined for each of the groups and decrease from i) to iv).

- Economically or financially less attractive than at least one other alternative, as identified in Step 1; or
- Not economically or financially feasible, without the revenue from the sale of certified emission reductions (CERs).

To comply with the Tool, the investment analysis is performed along the following sub-steps:

Sub-step 2a – Determine Appropriate Analysis Method

The proposed project activity generates financial and economic benefits other than CDM related income, therefore the Simple Cost Analysis (Option I) cannot be taken. Between Investment Comparison Analysis (Option II) and Benchmark Analysis (Option III), the Benchmark Analysis was chosen as the appropriate analysis method.

The Benchmark Analysis (Option III) is suited for the analysis of the additionality of the proposed project activity because the baseline scenario does not require investment by the project developer, or in other words, the project developer has the free choice to invest or not to invest.[31]

Sub-step 2b – Benchmark Analysis (Option III)

The identified financial indicator most suitable for the project type and decision context is the project Internal Rate of Return (IRR). The project IRR calculates a return based on project cash outflows and cash inflows, irrespective of the source of financing. This means that financing expenditures (i.e. loan repayments and interest) are not included in the calculation of the project IRR, as outlined by paragraph 9 of the Annex to the Tool "*Guidelines on the Assessment of the Investment Analysis*". In order to accurately reflect the assumptions and economic circumstances at the project starting date as used by the Project sponsor for the investment decision, the financial model is presented in nominal terms, i.e. all revenues and costs have been projected including the inflation as expected at the time of the investment decision.

For definition of an applicable benchmark according to the "*Tool for the demonstration and assessment of additionally*" Version 05.2, the Project Participants followed the option (d) "Government/official benchmarks where such benchmarks are used for investment decisions".

As a matter of fact, the Government of Panama, through its resolution Nr. AN 1194-Elec of October 10, 2007,[32] defines a rate of 13% in real terms as the capital cost for energy generation assets that are economically adapted and adequate to the existing conditions of demand and supply of the Republic of Panama. This rate, together with other variables for investment costs and operational costs of a gas turbine, which is the most economic technology for energy generation currently available and has a lifetime of 20 years, is used to calculate the cap price for the auctions of the Long Term Capacity Reserve ("*Servicio Auxiliar de Largo Plazo*"). Under these auctions, the Government purchases energy generation capacity to assure that the country's energy demand can be satisfied at any time. Consequently, the intention is to offer the investors of power generation assets in Panama long term capacity fees that allow financing, maintenance and operation of their plants, as well as adequate remuneration of the capital invested. As the remuneration paid generates taxable income to the generators, the nature of the rate is pre-tax, i.e. it ignores the income tax that has to be paid by the generator.

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[31] "*Guidance on the Assessment of Investment Analysis*", version 2 (EB41), paragraph.15.

[32] Autoridad Nacional de Los Servicios Públicos, Resolución AN No.1194"; published on October 10, 2007 by República de Panamá. Available at: http://www.asep.gob.pa/openpdf.php?idresol=AN No.1194-(last accessed on May 13, 2010).

Based on the above explanation, the benchmark defined by the AN No.1194-Elec reflects a government-defined pre-tax opportunity cost for the power sector that is used as a basis for annual auctions, transactions and therefore investment decisions, consequently fulfilling the criteria of the Guidelines. As the rate is given in real terms, it was adjusted for the average inflation as projected to be 1.92% p.a. for the US CPI,[33] as used by the Project participant in the financial analysis of the Project Activity.

Therefore the applicable benchmark for the Dos Mares Hydro Complex is calculated the following manner:

Pre-tax benchmark in nominal terms = [(1+13%) x (1+1.92%)] -1 = 15.17%.

This rate fulfils the criteria of: i) being an independent standard in the market, ii) it considers the specific characteristics of the Panamanian power sector and iii) it is not linked to the subjective profitability expectation or risk profile of a particular project developer.

Sub-step 2c – Calculation and Comparison of the Financial Indicators

General Issues in Calculation and Presentation

- **Nature of the model**. In compatibility with the benchmark defined and following paragraph 5 of the "*Guidance on the Assessment of Investment Analysis*" (Version 02),[34] the taxation and any tax benefit of the depreciation are not considered in the cash flow projection. Consequently the return calculated is a pre-tax return and, therefore, compatible with the nature of the benchmark defined.

- **Period of assessment.** The period of assessment considers the validity of the concession contract of the project (50 years), executed with *Autoridad Nacional de los Servicios Publicos.*[35] The concession for Lorena and Prudencia came into force on January 21, 2008, and for Gualaca on June 12, 2007. Consequently, they will expire mid 2047 or in January 2048 and the assessment period for the investment analysis has been chosen to run from beginning of 2008 until end of 2057. The choice of this period is in accordance with the paragraph 3 of the Annex to the Tool: "*Guidance on the Assessment of Investment Analysis*". Accordingly, the IRR calculations shall as a preference reflect the period of expected operation. Since the concessions to project developers have been granted for a 50 years period[36], this is considered the expected operation period of the Project.

- **Fair value of project activity asset at the end of the period of assessment.** Since the concession period is 50 years the assessment period reflects the full period of expected operation and no residual value of the project assets had to be considered.

[33] US CPI index can be consulted at Bureau of Labor Statistics (United States Department of Labor), Available at: http://www.bls.gov/cpi/ (last accessed on May 17, 2010).

[34] According to the Guideline, "*Taxation should only be included as an expense in the IRR/NPV calculation in cases where the benchmark or other comparator is intended for post-tax comparisons*."

[35](1) "*Contrato de Concesión para la Generación Hidroeléctrica- Central Hidroeléctrica Gualaca* "; issued by Autoridad Nacional de los Servicios Publicos, on June 12 2007;(2) "*Contrato de Concesión para la Generación Hidroeléctrica- Central Hidroeléctrica Lorena* "; issued by Autoridad Nacional de los Servicios Publicos, on January 21 2008; (3) "*Contrato de Concesión para la Generación Hidroeléctrica- Central Hidroeléctrica Prudencia* "; issued by Autoridad Nacional de los Servicios Publicos, on January 21, 2008.

[36] According to Article 56 of the Law nº 06 ("*Ley No. 6 de 3 de febrero de 1997*", Republica de Panama), the concession contracts for the exploration of hydroelectric and geothermal power plants have a maximum duration of 50 years. Article 57 of the same Law allows for the renewal of the concession contract for a period not superior to the concession that has been previously granted. For further information, please refer to the *Autoridad Nacional de los Servicios Publicos*: http://www.asep.gob.pa/default.asp.

- **Applicable data used in the investment analysis**. All investment and operational cost assumptions, as well as the economic projections and input values used in the investment analysis were based on valid and applicable assumptions used by the Project Participants at the time of the investment decision. After the project starting date, a slight increase in the installed capacity occurred as a consequence of improved project design. As this was not known at the project starting date, the respective incremental generation capacity and investment has been used to model the projects return under the conditions and assumptions that were applicable at the project starting date in order to show that this does not impact the additionality of the Project. In addition, and with the objective to show that the assumptions and projections made by the Project Participant at the project starting date are conservative, some specific sensitivities were calculated by replacing the original assumptions effectively used by the Project Participants with other variables that are based on referenced governmental and historic data. Table B 5 provides an overview of all the key assumptions and applicable references provided to the DOE.

- **Treatment of *inter alia* subsides/financial incentives:** According to the Additionality Tool, any subsidies and incentives shall be included in the calculation of the financial indicator under consideration of EB guidance on the consideration of national/local/sectoral policies and measures for the baseline setting. On its 22nd meeting[37], the CDM Executive Board defined that national and/or sectoral policies and circumstances are to be taken into account on the establishment of a baseline scenario, without creating perverse incentives that may impact host Parties' contributions to the ultimate objective of the Convention. As a result, the Board agreed to define E- policy as:

  "*National and/or sectoral policies or regulations that give comparative advantages to less emissions-intensive technologies over more emissions-intensive technologies (e.g. public subsidies to promote the diffusion of renewable energy or to finance energy efficiency programs)*"

  Further, the Board agreed that such policies should be addressed as follows:

  E- Policies "*that have been implemented since the adoption by the COP of the CDM M&P (decision 17/CP.7, 11 November 2001) need not be taken into account in developing a baseline scenario (i.e. the baseline scenario could refer to a hypothetical situation without the national and/or sectoral policies or regulations being in place).*"

  As exposed above, for hydropower plants above 20 MW, the Law N°.45 of 4 August, 2004, defines a fiscal credit to reduce income tax up to the limit of 25% of the capital expenditure and up to 50% of the annual tax due and calculated in relation to the amount of emission reductions generated by the project. As the calculation of this fiscal benefit is not yet clearly defined and regulated and as it would only impact the calculation of the income tax, this incentive is not being captured by the pre-tax financial model presented, which is in line with the provisions of the EB on E- policies.

- **Pre-Project Start Costs**: Specific expenditures related to the preliminary engineering studies and the acquisitions of the project companies and the HPPs concessions that occurred prior to the project starting date in July 2008 are clearly identified in order to allow a project evaluation under the assumption that these investments are sunk costs, following the guidance of paragraph 6 of the Guidance on the Assessment of Investment Analysis (Version 02).

[37] For further information, please refer to EB 22, Annex 3, available at: http://cdm.unfccc.int/EB/022/eb22_repan3.pdf (last accessed on May, 17, 2010).

Table B 4: Economic variables used for investment analysis

Variables that define capital expenditures:			
Item	**Description**	**Unit**	**Value**
Capex	80% of the total Capex is defined by the EPC contracts signed at project start and follows a three year expenditure plan to finance the construction of the hydro complex. The rest is composed by costs for engineering, management, socio-environmental programs, insurance and applicable taxes related to the construction.	kUS$	**2008**: (117,613) **2009**: (159,710) **2010**: (103,252)
Incremental Capex	Optimization of the project design required incremental investments. As this was not known at project start, this increase, together with the corresponding incremental energy and capacity, is considered in a modified Base Case to show that the optimization would not have impacted the financial additionality of the project if it had been known at project start.	kUS$	(10,700)
Pre-Project Start Costs	Before the signature of the EPC contracts, which defined the project start, the acquisition of Bontex S.A and Altenergy S.A, as well as the development of preliminary engineering studies required expenditures that would be sunk costs if the project was not developed. This specific risk was incurred by the Project Developer based on the appraisal of the projects' CDM potential. To evaluate its impact on the project evaluation if such costs were considered sunk costs, a modified Base Case excluding this cost is presented.	kUS$	(14,000)
Variables that define revenues:			
Item	**Description**	**Unit**	**Value**
Total Energy for Sale	The total average[38] energy generated and projected for sale as projected at the project start date are referenced by CND reports from April 2008 and a total generation of 568.32 GWh p.a. has been calculated from the specific values for Gualaca (126.55 GWh p.a.) Lorena (168.62 GWh p.a.) and Prudencia (273.15 GWh p.a.).	GWh p.a.	568.3
Incremental Energy for Sale	After the optimization of the project, the total average energy generated by the Dos Mares Hydro Complex is projected to be 597.31 GWh p.a., i.e. 29 GWh higher than originally projected. As this was not known at project start, this increase, together with the corresponding incremental investment, is considered in a modified Base Case to show that the optimization would not have impacted the financial additionality of the project if it had been known at project start.	GWh p.a	29.0

[38] It is important to reiterate that this average considers many years and that in a given year the energy generated will be higher or lower than this average. This uncertainty, which is related to the hydrology of the water resources, is a specific risk for the Investor.

PPA Volume and contract validity	The signature of a PPA[39] requires selling of firm (i.e. guaranteed) energy (energy + capacity) and accordingly the volume of energy to be sold was modeled in way to avoid exposure to the spot market. The PPA validity is limited to 10 years and renewal or extension is not possible under the Panamanian regulation.	GWh p.a.	479
Spot Volume	The Spot Volume is calculated from the total energy available for sales, net of the PPA Volume, during the validity of the PPA. After the expiration of the PPA in 2021, the total energy is sold on the spot market (Total Energy Volume for Sale). As a function of the project optimization, the energy projected to be sold on the spot market increased by 29 GW when compared to the assumptions of the investment decision.	GWh	**2012-21**: 89.3 **After 2021:** 568.3 **After Optimisation**: + 29.0
Monomic Price for the PPA	The value assumed for investment decision was chosen as the value deemed competitive and realistic when comparing to previous experiences in electricity auctions held in Panama.[40]	US$	104.80
Spot Market Energy Price	As PPAs are limited to 10 years and as not all energy can be contracted under the PPA to avoid exposure to the spot market, it is necessary to project the future spot price to allow accurate evaluation of the project. This is common practice in the energy sector and for hydrothermal systems like Panama, the SDDP dispatch model was used to model spot prices until 2015. The tool was developed by the company PSR-Inc and it is used by the CND, a fact that allows evaluating that the assumptions made by the Project Participants are conservative. For the long run, starting in 2015, the Project Participants considered that the spot price will be defined by the cost of generating energy with a new coal plant of 150 MW. This assumption yields consistently higher spot prices than those projected by the government of Panama, as will be shown.	US$	variable
Spot Market Energy Price as projected by ETESA	To compare and validate the assumptions made by the Project Participants, the Project's return has also been calculated by using the projections for the LRMC made by ETESA in Panama's 2007 National Expansion Plan.[41] In fact, on page 104, of the report, ETESA projects different scenarios, of which the highest (most conservative in the terms of the CDM) was used to calculate the Project's return for comparison.	US$	variable

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[39] "*Texto Unificado, Anexos, Parametros, Critérios y Procedimientos para la Compraventa Garatinzada de Energia y/o Potencia para las Empresas de Distribución Eléctrica*", published on June 2008 at the ASEP website: http://www.asep.gob.pa/electric/Anexos/Reglas_de_Compra.pdf (last access on May, 13, 2010).

[40] Previous auctions held in Panama: In December 2004, an offer for energy sales at 107.18 US$/MWh that Bontex had made was rejected. In July 2006, AES and Termica Caribe offers were rejected with 109.47 US$/MWh and 105.35 US$/MWh respectively.

[41] "*Plan de Expansión del Sistema Interconectado Nacional 2007-2021*", published on October 15, 2007 by ETESA, República de Panamá: http://www.mef.gob.pa/cope/pdf/PLAN%20DE%20EXPANSI%C3%93N%20DEL%20SIN%202007-Actualizado.PDF (last access on May 13 2010).

Excess Capacity Sold	The energy sold under the PPA is backed by the respective capacity sold, in this case defined to be 80 MW. Nevertheless, the energy sold to the spot does not need to be backed by capacity. Consequently, the excess capacity as defined by the Panamanian regulator CND can be sold separately. The maximum salable capacity has been defined by the CND in April 2008 to be 103.75 MW, calculated from the specific values for Gualaca (23.04 MW), Lorena (30.62 MW) and Prudencia (50.09 MW).	MW	103.75
Additional Capacity for sale	After the project optimization, the capacity for sale could be revised to an estimate of 108.63 MW. As this was not known at project starting date and will still depend on the approval by the CND, this increase, together with the corresponding incremental investment, is considered in a modified Base Case to show that the optimization would not have impacted the financial additionality of the project if it had been known at project start.	MW	108.63
Revenue from Capacity Sales	The price for capacity is very elastic to the demand and as extensive new efficient generation units are being build and older more inefficient units are being dispatched less, the Project Participants expect an excess of capacity in the long run, driving revenues from the selling of capacity to zero.	kUS$	variable
Revenue from Capacity Sales **Sensitivity case**	In order to complement the Project Participants' assumption that Capacity remuneration will rise in the short term and then go to zero, a sensitivity case was calculated by replacing the original assumptions by historic prices. See below the prices that have been observed in the 5 years (including 2008) before the project start, as well as their average. 2004---6.65 $/kW-month 2005---7.38 $/kW-month 2006---7.53 $/kW-month 2007---7.53 $/kW-month 2008---10.13 $/kW-month <u>Average: 7.84 $kW-month</u> This sensitivity done using historic prices assumes that this average price will rise with the inflation.	kUS$	7.84 $/kW-month

Variables that define operational costs:			
Item	**Description**	**Unit**	**Value**
Transmission Cost	These costs refer to transmission and connection costs to the grid and are based on references published by ETESA.[42] The cost is proportional to the plant's installed capacity.	kUSD/MW p.a.	24.82
Regulatory Contribution	This refers to a regulatory tax which is 1% of the revenues.[43]	%	1
O&M fixed	The fixed O&M costs were based on internal projections and experiences, as well as on local plant specifics.	kUSD p.a.	1,800
O&M variable	The variable O&M costs are based on Projects Participants experiences and estimates.	US$ /MWh	1
Total O&M Costs (only for comparaison)	The gross expenses for fixed and variable O&M are about 2.57 MM US$ p.a., i.e. about 0.7% of the capital expenditures of the plant. According to relevant literature the operational cost usually is about 1% of the Capex.[44] Another interesting overview of O&M data presented by other CDM Project Activities[45] also shows that the total O&M costs presented here are at the lower limit and therefore conservative.		
SG&A	Costs for SG&A comprises 710 kUSD for insurance. In addition about 250 kUSD were assumed for general administration costs.	kUSD p.a.	960

Calculation of the project IRR

The purpose of the project IRR calculation is to determine the viability of the project to service debt. Therefore, as mentioned above, financing expenditures (i.e. loan repayments and interest) is not included in the calculation of project IRR, following the provisions of paragraph 9 of the Annex to the Tool: "*Guidance on the Assessment of Investment Analysis*". Further, as already explained above, the presented cash flow does not consider the payment of tax and therefore the return calculated is compatible with the benchmark defined.

Results of the investment analysis

The details of the investment analysis are presented in Annex 5. This annex provides a spreadsheet version of the base case of the investment analysis, based on the assumptions described above and explained further below.

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[42] "*Informe de Actualización Año 4 2008-2009*", published on April 14, 2008, page 5, Table Zona 4, Cost = 24.82 USD/kW/year.

[43] Defined by Law No. 6, art. 21, issued on February 3, 1997. Available at: : http://www.mef.gob.pa/cope/pdf/LEY%206%20DE%201997%20MARCO%20REGULATORIO%20ELECTRICIDAD.pdf (last accessed on May 11, 2010).

[44] "Generation Investment Studies", published in 2004 by PwC, Atkins, MwH. See page 5: Available at http://www.ero-ks.org/GIS/Final_Appendix_10.pdf (last accessed on 13 May, 2010).

[45] Overview available at: http://cdm.unfccc.int/UserManagement/FileStorage/O62PI1RNFV0SYGKDA798JMXWZHU5TL, (last accessed on May 14, 2010).

The result of the investment analysis for the assessment period 2008-2057 is shown in Table B 5. It clearly shows that the nominal pre-tax project IRR of the proposed project activity does not reach the nominal pre-tax hurdle IRR of 15.17%.

In order to show that this conclusion is solid under the rules of the CDM, sensitivities were calculated for: (i) the exclusion of the cost of acquisition of the HPPs concessions and preliminary engineering, which occurred prior to the effective project start date and, ii) the increase in the projects generation capacity as a consequence of the projects optimization that occurred after the project start date. Table B 5 and Figure B 2 give an overview about the results which are commented below.

Table B 5: Results of the investment analysis expressed in nominal pre-tax return rates

Description	Nominal Project IRR
Benchmark for pre-tax returns in nominal terms	15.17%
a) Base Case at Project Start	13.0%
b) Base Case if ignoring costs incurred prior to project start date	13.5%
c) Base Case after Project optimisation	13.4%

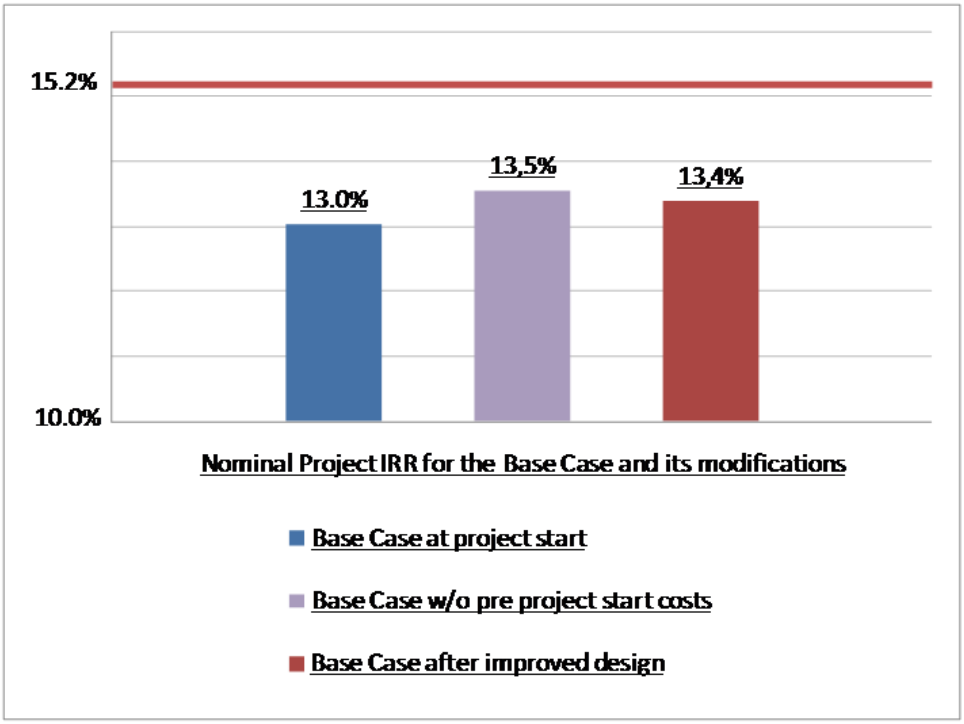

Figure B 2: Graphical comparison of the results of the investment analysis in comparison to the benchmark (all rates nominal and related to pre-tax returns)

a) Base Case at Project Start: This has been calculated by using the variables that the Project Participants had assumed at investment decision, as described above, but disregarding revenues from the CDM. Also, it includes the expenditures for the acquisition of the HPP concessions and preliminary engineering design works that were necessary as a basis for the EPC negotiation. These costs are closely related and necessary for the definitive project implementation, though technically these have been incurred prior to the project starting date and therefore, following a strict interpretation of the guidelines of paragraph six of the "*Guidance on the Assessment of Investment Analysis*" (Version 02), could be defined as sunk costs.

b) Base Case if ignoring pre project start costs for acquisitions of HPPs concessions: When the PPs acquired the companies Bontex S.A and Altenergy S.A this could not be considered as project start date under the rules of the CDM as it did not guarantee or initiate the construction of the project. Nevertheless these initial investments were a necessary step to progress towards implementation and the CDM has been a key criterion to purchase the concessions in spite of the yet uncertain decision to implement the plant. The related costs could be considered sunk costs for the purpose of investment evaluation at project start. On the other hand, there are arguments to include the costs in the investment analysis when we consider the rationale provided in "*Guidance on the Assessment of Investment Analysis*" (Version 02), paragraph 6:

> "*The use of investment analysis to demonstrate additionality is intended to assess whether or not a reasonable investor would or not decide to proceed with a particular project activity without the benefits of the CDM. This decision will therefore be based on the relevant information available at the time of the investment decision and not information available at an earlier or later point. Any expenditures occurred prior to the decision to proceed with the investment in the project will not impact the final investment decision as such expenses (sunk costs) which remain unaffected by the decision to proceed or not with a project activity*."

The decision to acquire the project companies Bontex S.A and Altenergy S.A and, therefore, the concessions for the construction of the HPPs, were clearly related to the projects CDM potential. The subsequent investment decision and start of project implementation then again considered the CDM revenues as key criteria and is closely related to the acquisition of these companies. This consideration shows that the Project Participants had decided to purchase the concessions as a first step because of the CDM and if this would not have been done, the effective project implementation, which again considered CDM, as well as the costs of the acquisition of the concessions as these were closely related to the project implementation. Nevertheless, and to show that this would not materially alter the conclusion about the financial additionality of the project, the PPs present the result of the evaluation if these acquisition costs were treated as sunk costs.

c) **Base Case after project optimization:** As can be demonstrated by official documentation from the CND, studies about on the Basic Project design prepared by the Leme Engenharia, a subsidiary of Tractebel Engineering, as well as from the EPC contracts that were signed at that time, the Project Participants at Project Start, were not aware about possible optimisations that would allow to increase the projects generation capacity. In fact, if the Project Participants had not decided to invest into the Project, these optimisations would not have been identified nor implemented as they obviously depended on the Project implementation itself. Accordingly, these optimizations should not impact the additionality assessment of the Project, which is defined at project start. Nevertheless, the optimisation of the project represents a change in its basic design and the Project Participants suggest to follow the principles of Annex 67/EB 48 to adequately evaluate how the change in generation capacity could have impacted the additionality if it would have been known at project start. The Guidelines define (paragraph 8): "*The re-assessment of additionality shall be based on all original input data, thereby – in case of investment analysis – in principle only modifying the changed key parameters in the original spreadsheet calculations*."

Accordingly, we present an adjustment of the Base Case that considers the optimized project configuration as if it would have been known *ab initio*. This means that the incremental energy and capacity and the resulting revenues, as well as those additional capital expenditures strictly related to the optimisation[46] are included in the evaluation, while all other parameters are maintained as defined at project start.

[46] Other cost increases that occurred were not contemplated for this evaluation as they are not related to the optimization, but consequence contingencies that were not foreseen at Project start.

d) **Evaluation and Conclusion:** The a) return on investment as projected by the PPs at project start, as well as the modifications of the base case for evaluation of b) the impact that the treatment of pre-project start costs and c) the later project optimisation could have on the financial additionality, show that in all cases the Project's return is below the benchmark and that the Project cannot be considered as financially attractive without CDM revenues.

Sub-step 2d – Sensitivity analysis of the investment analysis

The sensitivity analysis of the project IRR without CER revenues is used to demonstrate that the financial attractiveness of the proposed project activity is robust to reasonable variations of the critical variables that constitute more than 20% of either total project costs or total project revenues. The variations in the sensitivity analysis cover a range of +10% and –10%, as per recommendations of paragraph 17 of the Annex to the Tool. In addition, some specific variables that are subject to material uncertainties or that were based on complex assumptions and economic models, used by the Project Participants for investment decision at the project start date, are being varied or complemented with official data to illustrate that the assumptions made by the Project Participants were conservative in the terms of the CDM. The selected critical variables and the results of the sensitivity analysis are presented in Table B 6 and Figure B 3, and each of the items is being discussed below.

Table B 6: Results of the sensitivity analysis of the investment analysis

PARAMETER	VARIATION	IRR
Benchmark	-	15.2%
Base Case		13.0%
Capex	+10.0%	11.9%
	-10.0%	14.4%
Opex	+10.0%	12.8%
	- 10.0%	13.2%
Revenues	-10.0%	12.3%
	+10.0%	13.7%
Higher PPA price*	-	14.0%
Higher capacity price*	-	13.8%
ETESA Spot price*	-	11.0%

*The assumptions for these sensitivities are explained in detail further below.

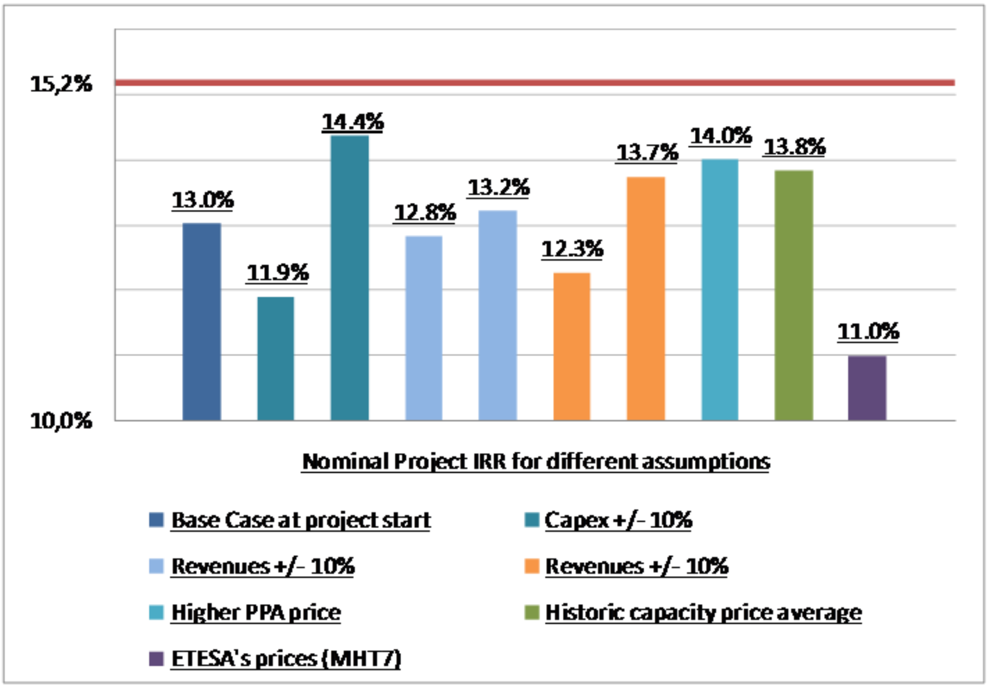

Figure B 3: Sensitivity analysis

a) **Changes in Capital Expenditures**: As 80% of the capital expenditures were defined by the signing of the EPC contracts, the minimum value is quite well defined and it is difficult that the projected costs can be significantly lower. On the contrary, the possibility that additional costs and contingencies not foreseen in the EPC contracts occur and lead to cost overruns is much more frequent[47].

b) **Changes in Operational Expenditures**: As discussed above, the operation and maintenance of a hydro power complex that consists of three HPPs is significantly more expensive than the operation of one big HPP with the same total installed capacity, although some cost efficiency is being obtained by building and administrating the plants as a complex. These synergies had been fully taken into account at investment decision and further significant cost reductions are not likely, nor would they have a material impact on the financial performance of the project.

c) **Changes in the Revenues**: The project revenues are the most critical variable when deciding a capital intensive investment like a hydropower plant, especially if long term PPA contracting is difficult, uncertain or limited in time and volume. As spot prices are very volatile and difficult to project, it is difficult to decide such a long term investment on the basis of such projections and a long term PPA is important to reduce market risks. On the other side, a PPA requires a firm commitment to deliver energy and in case the plant is not able to generate the energy that was committed due to hydrology or delays, the Project Participants have to purchase energy in the spot market to make up for the short fall. Consequently, it is advisable to sell the share of the energy to be generated with high certainty (even under unfavorable hydrological conditions) under a PPA and sell the uncertain energy that exceeds the volume sold under the PPA on the spot market. On the other side, this allows to sell a share of the generation capacity as defined by the regulator according to its established criteria as capacity. Accordingly, Project revenues are defined by the following variables:

[47] In fact, the Dos Mares Hydro Complex has already faced unexpected costs increases, but these were not considered in the investment analysis.

- PPA Price
- Future Spot Price
- Future Capacity Price
- Volume of Energy Projected.

All variables are uncertain, but as they do not have significant correlation, it is expected that they compensate each other to a certain degree and, consequently, a 10% variation in revenues in the long run is a reasonable variation. The results show that the investor is exposed to significant risks in case revenues are continuously below the projections. On the other hand, even revenues that are constantly 10% higher than projected are not sufficient to reach the benchmark. Finally, to understand better the assumptions and variables that define the projected revenue, the following additional sensitivities have been developed:

i) **Higher PPA price**: At project start the Project Participants evaluated that they would be able to sell the energy generated at an annualized price of 104.80 US$ on a flat basis[48] for the maximum permitted contract validity of 10 years. As a maximum sensitivity at the time, a value of 120 US$ has been assumed, which is 14.5% higher than the central estimate, but the benchmark would still not be reached.

ii) **Higher Capacity Price**: Based on the specific evaluation of the evolution of the growth of energy demand in the short term and significant expansion of the generation park in the mid and longer term, the Project Participants projected that the demand and price for capacity would be comparably high in the first years, but then revenues from sales of capacity would converge to zero as from 2015. In order to contrast this assumption with a scenario where capacity prices would be paid during the whole lifetime of the project, this sensitivity projects that the future prices will develop in line with the average prices, as paid in the past five years (prior to project start), adjusted by inflation. The results obtained for this projection is that the revenues from the sales of capacity do not significantly influence the project's financial performance and the return projected for this scenario does not reach the benchmark.

iii) **Sensitivity to the Spot Price**: As already explained, the revenues are much influenced by the spot price as PPAs are limited to 10 years. On the other hand, it is difficult to project the future spot prices for such a long period and the Project Participants have been using the assumptions that the prices in the long run will be defined by a coal-fired thermal plant as this was deemed the most reasonable assumptions for the expansion of the Panama energy system. For the short term, the Project Participants used an economic model called SDDP, which is commonly applied for this purpose and it is used in particular by the Panamanian CND to calculate the Long Run Marginal Cost projections published annually by ETESA. Interestingly, ETESA, in its 2007 publication, presents a series of different scenarios, all of which indicate projections that are materially lower than those assumed by the Project Participants at project start. To allow a direct comparison between their own assumptions and different scenarios published by ETESA, Project Participants choose the scenario MHT7[49] as it is the one that projects the highest future spot prices and therefore represents the most conservative assumption in terms of the CDM. The comparison shows that the assumptions used by the Project Participants for their

[48] PPA's in Panama are not inflation adjusted, but follow a annual schedule and their monomic (energy + capacity) price are expressed in US$ Flat / MWh.

[49] For further information on ETESA's price scenarios, please refer to: http://www.mef.gob.pa/cope/pdf/PLAN%20DE%20EXPANSI%C3%93N%20DEL%20SIN%202007-Actualizado.PDF (last accessed on May 17, 2010).

investment decision project much higher future Spot Prices than ETESA's highest scenario and, consequently, are even more conservative in terms of the CDM and that the most favorable governmental projection available at the time of Project Start.

The results confirm that the nominal pre-tax project IRR of the proposed project activity will not reach the benchmark of 15.17%, even when the critical variables are varied in a range of ± 10% or when the Project Participants assumptions used for the investment decision are improved to a the maximum level that could be deemed reasonable.

Conclusion Step 2

Since the project financial unattractiveness concluded in Sub-step 2c has proved to be robust to reasonable variations in critical assumptions as demonstrated in Sub-step 2d, the project is unlikely to be financial attractive, meaning the project is additional under Step 2.

Step 3 - Barrier Analysis

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

Following the provisions of the "*Tool for the demonstration and assessment of additionality*" (Version 05.2), here referred to as the "Additionality Tool", as well as the guidance provided by the "*Guidelines for the objective demonstration and Assessment of Barriers*" (version 01), here referred to as the "Guidelines on Barriers", the following barriers have been identified to prevent the implementation of the proposed project activity from being carried out if the project was not registered as a CDM activity:

1) Investment Barriers, other than the economical/financial barriers described in Step 2 above:

(a) According to the Additionality Tool, an investment barrier is shown if "*For alternatives undertaken and operated by private entities*", as it is the case of the proposed project activity, "*similar activities have only been implemented with grants or other non-commercial finance terms*." As will be shown in Step 4, Common Practice Analysis, many of the hydropower plants operating today in Panama have been developed and financed under conditions that are very different from those that apply today to the Dos Mares Hydro Complex. As discussed below, most hydropower plants were developed under a different investment environment or granted with benefits that are classified as non-commercial terms, which do not apply to the context of the Dos Mares Hydro Complex.

i. The major share of the HPPs developments in Panama were developed before 1997 by the state-owned Institute of Hydraulic Resources and Electrification (*Instituto de Recursos Hidraulicos y de Electrificacion* (IRHE)), prior to the privatisation of the energy sector. Consequently, the implementation of those plants did not face the same regulatory risks or costs and difficulties for financing as they apply to the Dos Mares Complex.

ii. The HPPs Anton 1-2 and the Estí[50] plant initiated their development before or during the privatisation process and therefore rely on circumstances and arrangements that do not apply to the Dos Mares Hydro Complex. In fact, the Anton 1-2 plants initiated construction under the old regulatory framework, while Esti had its Power Purchase Agreement signed on January 14, 1999 as part of the privatisation process, therefore creating specific circumstances that conditioned the development of the project.

[50] For further information, please refer to Section B.5, step 4, Common Practice Analysis.

iii. New generation facilities have been developed by the ACP (the Panama Canal Authority) that now represents 115MW of available generation for sale in the Wholesale Electricity Market (almost 7% of the total installed capacity of the system). The state owned ACP, is an auto producer (with the main objective to guaranty the energy supply for the Panama Canal) and its economic circumstances and decision criteria are not comparable to those of an Independent Power Producer that has to sell its energy on market, as will be also discussed in the Common Practice Analysis.

iv. Despite the significant hydropower potential of Panama, thermal generation continues to experience a significant growth.[51] In particular, run-of-river hydropower plants represent approximately 14% of the total installed capacity connected to the national grid.[52] Of these, only 57.7% are related to projects implemented after the year 2000[53] (or 8.1% of the total installed capacity after 2000). In fact, no new run-of-river hydropower plants had been installed in Panama since 1970s, except those that have pursued CDM revenues after the year 2000 (Estí, Concepción, and Mendre). Also, most of the projects under construction or being developed are pursuing CDM status, which shows the relevance that this Mechanism has as incentive for hydropower in Panama.

Result: It is clearly shown that all other hydropower projects operating in Panama had been developed under economic circumstances and/or by institutions that are not comparable to those that apply for DMHP, or, as DMHP is doing, are seeking or obtained CDM registration. Consequently, the criterion is fulfilled and an investment barrier is confirmed.

(b) According to the Additionality Tool, an investment barrier is shown if "*No private capital is available from domestic or international capital markets due to real or perceived risk associated with investment in the country where the proposed CDM project activity is to be implemented, as demonstrated by the credit rating of the country or other country investment reports of reputed origin*."

Further, paragraph 9 of the Guidelines on Barriers (Guideline 6) requires to show that the financing of the project was assured only due to the benefit of the CDM.

The following paragraphs will illustrate that this is a fact for the case of Panama and that the investment barrier was overcome specifically due to the consideration of the CDM benefits.

i. According to a 2007 World Bank publication,[54] "*El Salvador, Guatemala, Honduras and Panama, like Nicaragua, have witnessed the reality that liberalization favors power sector investments with short payback periods, while such capital-intensive investments as hydropower and geothermal energy are stymied. In their generation portfolios, all five countries have clearly expressed their preference for RE for reasons related to the environment, foreign exchange and*

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[51] Installed capacity supplied by CND : "*Capacidad Instalada por Ano*" , CND Official document. Available at: http://www.cnd.com.pa/publico/documentos/capacidad_instalada.pdf (last accessed on May 13, 2010).

[52] Installed capacity supplied by CND: "*Capacidad Instalada por Ano*", CND Official document. Available at: http://www.cnd.com.pa/publico/documentos/capacidad_instalada.pdf (last accessed on May 13, 2010).

[53] This can be easily calculated from information available at "*Capacidad Instalada por Ano*" , CND Official document: http://www.cnd.com.pa/publico/documentos/capacidad_instalada.pdf (last accessed on May 13, 2010).

[54] " *Unlocking Potential, Reducing Risk. Renewable Energy Policies for Nicaragua",* by Wolfgang Mostert. Renewable Energy Special Report 003/07. IBRD/World Bank, August 2007, Available at http://www.esmap.org/filez/pubs/10292007102111_Nicaragua_Enhanced_Report4-10-07.pdf (last accessed on May 13 2010).

long-term price stability. All have lamented that private sector RE investments have been delayed, yet, none has imposed a moratorium on conventional thermal power investment. All have had difficulty obtaining parliamentary approval of their respective water laws. These countries, along with Costa Rica, share an interest in designing rules for a Central American power market that facilitate investment in RE-based generation in their respective countries." The government interest in renewable energy development in Panama is clear when one reads the Law No. 45 of 4th August 2004,[55] which has the objective "*to offer suitable incentives for the construction and development of mini-hydroelectric power station systems, hydroelectric power station systems (...)*", among "*other new, renewable, and clean sources.*" This law also clearly promotes projects that generate carbon credits through "*fiscal incentives of up to twenty-five percent (25%) of the direct investment cost in the respective cost, based upon the reduction of tons of equivalent carbon dioxide (CO_2) emission per year.*"

ii. A clear indication of the difficulty to finance and implement HPPs in Panama is the fact that at least seven (7) concessions for hydropower development that initiated the Environmental Licensing in the period of 2002-2005, as it is the case for Gualaca, Lorena and Prudencia, had their concessions cancelled after several extensions that had been requested and granted.[56] Two of the concessions (Lalin and Lalin II) in fact had belonged to Altenergy S.A., which is now owned by GDF SUEZ Group and a Project Participant of Dos Mares Hydro Complex. In fact, the implementation of hydropower projects Gualaca, Lorena, and Prudencia (now part of Dos Mares Hydro Complex) had already suffered similar delays and the fact that Altenergy S.A. was seeking[57] for investors and partners for the development of the project illustrates the referenced difficulties that the company faced to find investors also for Lorena and Prudencia.

iii. The fact that Suez Energy International (SEI) acquired the two project companies in December 2007 and January 2008 only after diligent appraisal of the CDM potential and eligibility of the Projects under the CDM shows that the CER revenues were a key criteria and interest. Though this acquisition did not yet assure the implementation of the project, it allowed overcoming the investment barrier because SEI has access to funds in order to finance the project implementation.

Result: The evidences show that similar projects faced difficulties to finance their HPP projects and to proceed to implementation, as well as the fact that it is easier to finance thermal power plants due to their lower capital intensity and shorter investment maturity, a situation that lead to an increasing fossilization of the Panamanian energy matrix and that confirms the existence of an investment barrier. In addition, the specific interest that Suez Energy International had in the CDM revenues helped to overcome this barrier.

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[55] Law No.45 of 4th August 2004. Available at: http://www.mef.gob.pa/cope/pdf/Law%2045-2004%20_Renewable%20Energies%20Promotion.pdf (accessed on 13 May 2010).

[56] See government decisions on concessions published in the following links: http://www.asep.gob.pa/www/pdf/AN%20No.%20367-Elec.pdf, http://www.asep.gob.pa/www/pdf/AN%20No.%20366-Elec.pdf, http://www.asep.gob.pa/www/pdf/AN%20No.%20422-Elec.pdf, http://www.asep.gob.pa/www/pdf/AN%20No.%20446-Elec.pdf, http://www.asep.gob.pa/www/pdf/AN%20No.%20490-Elec.pdf, http://www.asep.gob.pa/www/pdf/AN%20No.%20542-Elec.pdf, http://www.asep.gob.pa/www/pdf/AN%20No.2383-Elec.pdf (last accessed on 13 May 2010).

[57] Press Release "*Alternergy advances JV negotiations with 3 hydro projects*". Available at: http://member.bnamericas.com/news/electricpower/Alternegy_advances_JV_negotiations_on_3_hydro_projects , and Press Release "*Alternergy seeks investors, EPC cos for hrydro projects*". Available at: http://member.bnamericas.com/news/electricpower/Alternegy_seeks_investors,_EPC_cos_for_hydro_projects (both last accessed on 11 May 2010).

Technological Barriers:

(a) According to the Additionality Tool, a technological barrier is represented by a "*Risk of technological failure: the process/technology failure risk in the local circumstances is significantly greater than for other technologies that provide services or outputs comparable to those of the proposed CDM project activity, as demonstrated by relevant scientific literature or technology manufacturer information*." Following some references that illustrate the increased specific risks that a hydropower development like the Dos Mares Hydro Complex faces when compared to standard thermal power plants:

  i) Due to the specific configuration that has to be adapted to the local geological and hydrological circumstances of each plant, hydropower projects are well known to have higher and more uncertain implementation costs when compared to other types of energy projects such as thermal plants, as well as increased risk for cost overruns due to unforeseen problems, especially those related to geology. In a study from the World Bank these technical features and the corresponding costs differences and uncertainties are well delineated: "The specific cost of a hydro power station ($/kW) is typically 100 to 200 percent more than a thermal power station, depending upon the site characteristics and the type of thermal plant. This gap widens when private financiers require fixed price EPC contracts, because the contingency that has to be priced in for hydro is much higher than for thermal power projects."[58] Also, the report in its section 6 about Project Implementation Arrangements, defines the following hydro specific problems:

     a. The need for expensive and time-consuming front-end studies to determine the optimum project parameters;
     b. The difficulty of establishing in advance of construction a firm cost and completion date;
     c. The need to apportion construction risks in a way that does not unduly inflate the contract price.

  ii) Also according to this study, the average capital cost required for implementing a baseload hydro power project (which is the case of a run-off-river HPP) is on average 1,960 US$/kW, while only 600 US$/kW are required for implementing a thermal power plant.[59] Further, in the specific case of the Dos Mares Complex, this cost was much higher, about 3,230 US$/kW. This above average cost is a consequence of the plant specific design complexity, which requires the construction of long channels, three power houses and two reservoirs. In case the three plants were not developed and constructed together, these costs would increase, making them even less likely to be implemented, as it was the case of the similar plant concessions that expired without being implemented. (Investment Barrier item (b) sub-item ii)).

Result: From the references provided it is clear that the risks for geological problems, cost overruns and delays in construction, as well as the uncertainty of the final expenditure are much higher for HPPs when compared to other technologies that provide services or outputs comparable to those of the HPP, as it is the case for standard thermal power plant as they are common practice in Panama. This is

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[58] World Bank Discussion Paper No. 420, "*Financing of Private Hydropower Projects*" , July 2000; Section 8, Page 65, 2nd paragraph. Available: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2000/08/19/000094946_00081906365947/Rendered/PDF/multi_page.pdf (last accessed on May 13, 2010).

[59] World Bank Discussion Paper No. 420, "*Financing of Private Hydropower Projects*" , July 2000 Section 8, Page 68, Assumptions Table. Available at: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2000/08/19/000094946_00081906365947/Rendered/PDF/multi_page.pdf (last accessed on May 13, 2010).

especially true for the Project Activity at hand which was only feasible by aggregating the individual HPPs into a Complex and by considering the specific benefits of the CDM.

In addition, these risks are not fully reflected in the investment analysis because typically such uncertainties would require a higher return on investment. Nevertheless, a general sector benchmark related to a thermal power plant has been used.

(b) According to the Additionality Tool, a technological barrier is also presented by the criteria that "*Skilled and/or properly trained labour to operate and maintain the technology is not available in the relevant country/region*."

i) As already stated, the development of the projects Gualaca, Prudencia, and Lorena was only possible after they were acquired by GDF-SUEZ in October 2007 and after they could be assessed in detail for developing the basic project design that was necessary for EPC negotiation and investment approval. For this purpose, and especially considering the complexity of constructing the three projects as an optimized hydropower complex, Suez Energy International relied on Tractebel Engineering, a specialized engineering company, which is part of the same group and which has extensive experience in hydropower technology. As the access to this technical resource was only possible due to the involvement of SEI, which in turn was motivated specifically by the CDM, this shows that the CDM was crucial to retain technical expertise that was able to conceive and develop the project as a hydropower complex.

Result: It is clear that without GDF-SUEZ interest in CDM these individual projects would not have been optimized and, consequently, they would not have been installed.

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

As it has been shown above, there are clear investment barriers for *Alternative 1: The proposed project activity - construction of a new hydropower project - not undertaken as a CDM project*.

In contrast, the *Alternative 2: Continuation of the current situation (no project activity or other alternatives undertaken)* is not hindered by any of the barriers mentioned. In fact, the installation of thermal power generation units has prevailed in the last 3 years,[60] despite of the large hydropower potential of Panama.

Based on the definitions of the Additionality Tool, it can be concluded that the barriers identified i) "*effectively prevent potential project proponents from carrying out the proposed project activity undertaken without being registered as a CDM project activity*", and ii) "*do not prevent the implementation of at least one of the alternatives*", as defined by the Additionality Tool.

Consequently both Sub-steps 3a-3b are satisfied and we proceed to Step 4.

Step 4 – Common Practice Analysis

Sub-step 4a – Analyze Other Activities Similar to the Proposed Project Activity

[60] "*Capacidad Instalada por Ano*", CND Official document. Available at: http://www.cnd.com.pa/publico/documentos/capacidad_instalada.pdf (last accessed on May 13 2010).

According to the "*Tool for the Demonstration and Assessment of Additionality*", Project Proponents shall "*provide an analysis of any other activities that are operational and that are similar to the proposed project activity. Projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc*." Based on this definition, the criteria and the characteristics of the proposed project activity to identify similar operational activities are presented in the table below.

Table B 7: Characteristics of the proposed project activity

Criteria		Characteristics of similar Hydroelectric Power Plants (HPPs)
1	**Regulation Environment**	HPPs developed and implemented after the privatisation of the electricity sector in Panama (1997-1998).
2	**Market Participation**	HPPs developed by private generators or Independent Power Producer (IPP)
3	**Scale**	HPPs with an installed capacity above 20MW [61]
4	**Technology**	HPPs that are part of a complex of a hydroelectric complex, build in cascade, rather than a single independent plant.
5	**CDM Project Activity**	HPPs that have been published for Global Stakeholder Process.

The analysis of similar activities comprises all operational hydropower plants connected to the national transmission grid (SIN) (defined as the project boundary). These plants are presented in the table below.

[61] Law No 45 of August 4, 2004 establishes the different scales of hydropower projects in Panama. For further details, please refer to http://www.mef.gob.pa/cope/pdf/Law%2045-2004%20_Renewable%20Energies%20Promotion.pdf (last accessed in 13 May 2010)

Table B 8: Operating Grid-Connected Hydroelectric Power Plants in Panama[62]

Plant	Exclusion According to the Defined Criteria					Built by	Current Owner	Commercial Operation Date (COD)	Capacity (MWe)	Type
	1	2	3	4	5					
Bayano 1-2	x			x		IRHE[2]	AES	1976	260.0	Reservoir, 2x87 MW; 1x86 MW, upgraded by 24 MW in 2004
La Estrella 1-2	x					IRHE[2]	AES	1978-79	47.20	Run-of-River, 2x21 MW, upgraded by 5.2 MW in 2006
Los Valles 1-2	x					IRHE[2]	AES	1979	54.8	Run-of-River, 2x24 MW, upgraded by 6.8 MW in 2007
Fortuna 1-3	x			x		IRHE[2]	ENEL[3]	1984	300.0	Reservoir, 3x100 MW
La Yeguada	x			x		IRHE[2]	EDEMET	1967	7.0	Reservoir, last unit became operational in 1973
Bayano 3				x		AES	AES	2002	86.0	Reservoir, 1x86 MW
Estí 1-2	x				x	AES	AES	2003	120.0	Run-of-River with 2 dams, 2 x 60 MW
Concepción					x	Istmus Hydro	Istmus Hydro	2008	10.0	Run-of-River
Mendre					x	Caldera Energy	Caldera Energy	2009	18.9	Run-of-River
Gatún	x	x		x		ACP	ACP	1914	22.5	Reservoir, 3x3 MW, 3x4.5 MW, last unit (Gatún 6) became operational in 1947.
Madden	x	x		x		ACP	ACP	1935 [5]	36.0	Reservoir, 3x12MW, last unit (Madden 3) became operational in 1942.
Dolega	x				x	N/A	EDECHI	1937 [5]	3.12	Run-of-River, refurbished in 2000.[6]
Macho de Monte	x				x	N/A	EDECHI	1937-1938	2.4	Run-of-River, 2x1.2 MW, refurbished in 2002.[7]
Antón 1,2	x		x			Hidro Panama	Hidro Panama	1999 [8]	2.8	Run-of-River
Arkapal	x					Arkapal	Arkapal	1982 [9]	0.675	Run-of-River
Candela			x			Café de Eleta	Café de Eleta	2006 [10]	0.55	Run-of-River

Criterion 1: Regulation Environment

Before the privatization process in 1997-99, energy services in Panama, including generation, transmission and distribution were integrally provided by the Institute of Hydraulic Resources and Electrification (*Instituto de Recursos Hidraulicos y de Electrificación* (IRHE)), a former state-owned utility, which controlled Panama's

62 Source: Please refer to Common Practice Analysis Excel Spreadsheet.

generation assets, corresponding to 920 MW of installed capacity — two-thirds hydroelectric and one-third thermal — and a distribution grid with 454,000 connections that covered 67% of the country. With the privatization program that initiated in 1997, as a part of a broader sectoral reform program, the IRHE was finally de-verticalized in 1999[63] and divided into: three distribution companies (Metro-Oeste, Noreste, and Chiriquí), four generation companies (Bayano, 192 MW; Bahia las Minas, 292 MW; Fortuna, 300 MW; and Chiriqui, 222 MW) and one transmission company that remained as a state-owned company (ETESA).[64]

Panama's power sector privatization and regulatory reform aimed to reduce tariff levels with an efficient and reliable provision of energy services by introducing competition in the generation, and distribution of electricity and attracting capital for rehabilitation and new investments. The new model, defined by the approval of the Law 6 from February 3, 1997, enabled the participation of the private sector, notably in the generation segment,[65] and catalyzed the expansion of the energy matrix (installed capacity) by approximately 95%.

As previously mentioned the Law No. 6 /1997 separated the generation, transmission and distribution activities and established the current institutional organization of Panama's energy sector, by creating the main electricity institutions in the country:

- COPE (Comisión de Política Económica) - part of the Ministry of Economic Policy and Planning, being in charge of political formulation and definition of energy sector's strategy.
- ETESA (Transmission company) - defines policy and criteria for the expansion of the SIN, and prepares the expansion plan according to strategies and policy established by COPE.
- CND (National Dispatching Center) – entity controlled by ETESA that is responsible for central dispatching of generated energy and coordination of market operations and transactions.
- ASEP (Autoridad de los Servicios Públicos) – Panamanian regulatory authority.

In accordance with the Tool, which clearly states that project activities are to be considered similar if they "take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc", it is evident that hydropower plants that were developed and constructed under the state owned model and prior to 1999, cannot be considered similar and therefore are to be excluded from the Common Practice Analysis (Bayano 1-2, La Estrella 1-2, Los Valles 1-2, Fortuna 1-3, La Yeguada, Gatún, Madden, Dolega, Macho de Monte, Arkapal, Antón 1-2).

In addition to the projects that have been fully developed or that started their construction under the state monopole and before the institution of the private sector model, it is important to analyze the case of the Estí Hydropower Plant, which emerged under the old regulatory scheme, but was build under the new regulatory framework and commissioned in 2003. In fact, this large hydropower plant had been conceived in the early 1990's by the government owned energy production institute IRHE.[66] As clearly stated by AES,[67] during the

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[63] For further information, please access the link "*Perfil Coorporativo*" at http://www.fortuna.com.pa/ (last accessed on May 11, 2010) .

[64] "*Panama: Instituto de Recursos Hidraulicos y de Electrificacion*", issued by International Finance Corporation (World Bank Group), on December 2008. Available at: http://www.ifc.org/ifcext/psa.nsf/AttachmentsByTitle/PPPseries_IRHE/$FILE/CIA_PPPseries_IRHE.pdf (last accessed on 13 May 2010).

[65] As referenced by CEPAL, the SIN is composed of 27 generation assets, being 23 private owned and 4 public-owned generation units. The public generation units are controlled by Autoridad del Canal de Panamá (ACP) and were specially built to supply energy for the Canal Zone. (For further references, access: "Istmo Centroamericano: Estadisticas del Subsector Electrico, Informe preliminar del segmento de la producción de electricidad":Available at: http://www.eclac.org/publicaciones/xml/3/39413/L961.pdf (last accessed on May 13, 2010).

[66] "*Audit of social and economic impacts of the Rio Estí Hydroelectric Project, Panama*", published in 2006 at the Uppsala University (Sweden), section 6.4 (Higuerón). Link: http://www.env-impact.geo.uu.se/118Bergsten.pdf (last accessed on 13 May 2010).

privatization of IRHE, when the Company acquired 49% of the shares of Bayano and Chiriquí, it was beneficiated with the rights to construct, control and operate the Estí Hydropower Project. In addition, and as part of the privatization process, in January 1999, a PPA was signed for the Estí Power Plant, creating circumstances that are not comparable to those that apply to the decision and the development of the Dos Mares HPP. Considering this specific characteristics and the fact that Estí Hydropower Plant emerged from the privatization process, we understand that it can be excluded from the Common Practice Analysis under the criteria of having been developed under different regulatory and economic circumstances.

Criterion 2: Market Participation

According to the Law 6/97, energy market in Panama envisages three types of power producers:

- Generators: Legal entities that produces electricity to be commercialized (internationally often referred to as Independent Power Producer - IPP);
- Self-generators: Legal entities that produce electricity for their own consumption and not for commercialization to third parties. These entities are only allowed to sell specific energy surplus volumes to ETESA or other defined market agents.
- Co-generators: Legal entities that do not produce electricity as a main product, but rather as a sub-product of an industrial process. These entities are allowed to sell the energy produced to ETESA or other defined market agents.

Consequently, as indicated in Table B 8, project activities are only to be considered similar to the Dos Mares Hydro Complex if they were developed by agents that classify as Generator/Independent Power Producer (IPP) and produce electricity for commercialisation under long term PPAs or the energy Sport Market. In contrast to this concept and as described by *Empresa de Transmisión Electrica SA* (ETESA), the *Autoridad del Canal de Panamá* (ACP) classifies as self-generator that develops and operates energy generation projects to supply the energy demand related to the operation of the Canal Zone. As a consequence, ACP is only allowed to sell the surplus of electricity[68] into the SIN. Besides the fact that Gatún and Madden have been constructed prior to the privatization process in 1997, these two dam type hydroelectric power projects of the *Autoridad del Canal de Panamá* (ACP, Panama Canal Authority) would therefore also be excluded from the Common Practice Analysis by the criterion of Market Participation as they operate under the environment of a self-producer, which is not comparable to the circumstances of an IPP.

Criterion 3: Scale

National Law No 45 of August 4, 2004[69], defines a national threshold to classify hydroelectric generation systems with the purpose of offering suitable incentives for the construction and development of mini-hydroelectric power station systems, small hydroelectric power station systems, among others. As per Article 2 of the mentioned Law:

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[67] For further information, please refer to AES Panamá website, Section "*Antecedentes*". Available at: http://www.aespanama.com/antecedentes.asp (last accessed on May 11, 2010).

[68] "*ETESA: Plan de Expansión del Sistema Interconectado Nacional 2007-2021, 15 October 2007, Panamá."* – TOME II – Plan indicative de generación – Chapter 5.4 par.2 p.127/461; Available at: http://www.mef.gob.pa/cope/pdf/PLAN%20DE%20EXPANSI%C3%93N%20DEL%20SIN%202007-Actualizado.PDF (last accessed on May 13 2010).

[69] The incentives granted by the Law 45/04 have been described by GTZ, "*Energy-policy Framework Conditions for Electricity Markets and Renewable Energies – 16 Country Analyses*", November 2009. Available at: http://gtz.de/de/dokumente/gtz2009-en-terna-panama.pdf (last accessed on May 10, 2010).

- Mini-Hydroelectric power station systems are defined as "*power stations of electrical generation stations with an installed capacity of up to 10 MW, as well as the lines, substations and distribution and/or transmission systems necessary for the proper connection to the distribution system and/or to the transmission system*."

- Small hydroelectric power station systems are defined as "*power generation stations or set of power generation stations with an installed capacity greater than 10 MW and up to 20 MW, as well as all the lines, substations and distribution and/or transmission systems necessary for the proper connection to the distribution and/or transmission system.*"

Based on the above definitions of scale, when compared to plants with a capacity greater than 20 MW, project activities such as Dolega, Macho de Monte, Arkapal, and Antón 1-2 cannot be considered as similar, and, in addition to the exclusion under the Criterion 1 as explained above, are also to be excluded from the Common Practice Analysis based on the criterion of scale. In addition, the Candela Mini hydropower plant, which has been developed under the private sector model and was commissioned in 2006, can also be excluded because it was developed after the publication of the law and therefore benefits from incentives. Consequently, it is not comparable to the proposed project activity and shall be excluded from the Common Practice Analysis.

Criterion 4: Technology

The proposed project activity is a complex of three run-of-river power plants built in cascade with two plants having a dam and a regulating reservoir. Therefore, according to the "*Tool for the demonstration and assessment of additionality*" – version 05.2, only "*project that rely on a broadly similar technology can be considered similar to the proposed project activity*". Consequently, the hydropower plants that have an accumulation reservoir, such as Bayano 1-2, Fortuna 1-3, La Yeguada, Bayano 3, Gatún, Madden, would also be excluded from the Common Practice Analysis through the application of the Technology Criterion. This differentiation justified because Run-of- River HPPs are typical base load plants, while HPPs with a reservoir are used to supply peak load and consequently have higher flexibility and are less exposed to hydrological risks.

Considering the list of run-of-river power plants (La Estrella 1-2, Los Valles 1-2, Estí 1-2, Concepción, Mendre, Dolega, Macho de Monte, Antón 1-2, Arkapal, and Candela), the only hydropower plants that have not been excluded through the previous criteria are Concepción and Mendre. These project activities will be assessed under Criterion 5.

Criterion 5: CDM Project Activity

According to the "*Tool for the demonstration and assessment of additionality*" – version 05.2, page 10, Sub-step 4a: "Other CDM project activities (registered project activities and project activities which have been published on the UNFCCC website for global stakeholder consultation as part of the validation process) are not to be included in common practice analysis". The table below indicates all hydro projects from Panama that have been published on the UNFCCC website for Global Stakeholder Process.

As one can confirm in the table below, 18 hydropower projects have been published for global stakeholder consultation at the UNFCCC website. If only the operational hydropower projects are taken into account, this number falls to 7 project activities (Estí, Bayano, Fortuna, Dolega, Macho de Monte, Concepción and Mendre). In conclusion, since the only remaining projects that had not been excluded by the application of the 4 first criteria (Concepción and Mendre) are being developed as CDM project activities, these hydropower plants can also be excluded from the Common Practice Analysis.

Table B 9: Hydro projects from Panama published for Global Stakeholder Process[70]

Title	Type	Published for Global Stakeholder Consultation	Installed Capacity (MW)
Esti Hydroelectric Project	Hydro	18/oct/06	120
Bayano Hydroelectric Expansion and Upgrade Project in Panama	Hydro	18/oct/06	51
Changuinola I Hydroelectric Project in Panama	Hydro	10/jul/08	222.5
Increase of Power Generation of the hydroelectric power station Fortuna in Panama (IPGFP).	Hydro	20/sep/06	0
"Los Algarrobos" Small-Scale Hydroelectric Project	Hydro	27/may/05	9.7
Project for refurbishment and upgrading of dolega hydropower plant (to 3,12MW)	Hydro	01/jun/05	0.3
Project for refurbishment and upgrading of Macho de Monte hydropower plant (from 0,7 MW to 2,4 MW)	Hydro	01/jun/05	1.7
Concepción Hydroelectric Project	Hydro	01/nov/05	10
Paso Ancho hydroelectric project	Hydro	18/mar/06	5
Small-scale project of the Hydroelectric Power Plant of Cañazas	Hydro	15/may/08	5.9
El Síndigo hydroelectric project	Hydro	24/may/08	10
Ojo de Agua hydroelectric project	Hydro	24/may/08	6.4
Los Estrechos hydroelectric project	Hydro	24/jun/08	10
Barro Blanco Hydroelectric Power Plant Project	Hydro	10/oct/08	28.8
Dos Mares Hydroelectric Project	Hydro	29/jul/09	115
Pedregalito Hydroelectric Power Plant Project	Hydro	04/sep/09	20
Mendre Hydroelectric Power Plant Project	Hydro	04/sep/09	19.8
Macano Small Hydro Power Plant	Hydro	09/mar/10	3.4

[70] According to "CDM *Pipeline overview*" last updated on May 1st, 2010. Available at: http://www.cd4cdm.org/ and confirmed at: https://cdm.unfccc.int/ (last accessed on May 7, 2010).

Sub-step 4b – Discuss any Similar Options that Are Occurring

Based on the analysis performed under Step 4a, no similar project activities could be observed in Panama.

Conclusion Step 4

The proposed project activity is not common practice and is additional under Step 4.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

The emission reductions of the proposed project activity are calculated through applying the approved baseline methodology ACM0002, v11 (see Section B.1).
For new hydropower plants, emissions reductions in year *y* of a crediting period are calculated as follows:

$$ER_y = BE_y - PE_y \qquad (01)$$

Where:
ER_y = Emission reductions in year *y* (tCO_2/yr)
BE_y = Baseline emissions in year *y* (tCO_2/yr)
PE_y = Project emissions in year *y* (tCO_2/yr)

In conformity with approved baseline methodology ACM0002 (v.11), there are no leakage emissions to be taken into account.

Project emissions (PE_y)

For most renewable power generation project activities, PE_y = 0. However, some project activities may involve project emissions that can be significant. These emissions shall be accounted for as project emissions by using the following equation:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y} \qquad (02)$$

Where:

PE_y	=	Project emissions in year *y* (tCO_2e/yr)
$PE_{FF,y}$	=	Project emissions from fossil fuel consumption in year *y* (tCO_2/yr)
$PE_{GP,y}$	=	Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (tCO_2e/yr)
$PE_{HP,y}$	=	Project emissions from water reservoirs of hydro power plants in year *y* (tCO_2e/yr)

Considering that the project activity is a hydropower generation plant, $PE_{GP,y}$=0 and $PE_{FF,y}$=0.

- **Emissions from reservoirs ($PE_{HP,y}$)** are to be taken into account for hydro power project activities that result in new reservoirs or in the increase of existing reservoirs, if the power density of the power plants is greater than 4 W/m^2 and less than or equal to 10 W/m^2. For hydroelectric power plants with power densities greater than 10 W/m^2 the emissions are equal to zero.

The power density of each hydroelectric power plant *j* of the Dos Mares Hydro Complex is calculated as follows:

$$PD_j = \frac{Cap_{PJ,j} - Cap_{BL,j}}{A_{PJ,j} - A_{BL,j}} \qquad (03)$$

where:

PD_j	=	Power density of the project activity, in W/m^2
$Cap_{PJ,j}$	=	Installed capacity of the hydro power plant after the implementation of the project activity (W).
Cap_{BLj}	=	Installed capacity of the hydro power plant before the implementation of the project activity (W). For new hydro power plants, this value is zero.
$A_{PJ,j}$	=	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2).
$A_{BL,j}$	=	Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new hydro power plants, this value is zero.
j	=	hydropower plant *j* of the project activity.

As Cap_{BLj} and $A_{BL,j}$ are considered zero for new hydropower plants, the power densities for each power plant of the project activity (j) is calculated as follows:

$$PD_j = \frac{Cap_{PJ,j}}{A_{PJ,j}} \qquad (04)$$

Where:

PD_j	=	Power density of the project activity, in W/m^2
$Cap_{PJ,j}$	=	Installed capacity of the hydro power plant after the implementation of the project activity (W)
$A_{PJ,j}$	=	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2)
j	=	hydroelectric power plant *j* of the project activity

The proposed project activity consists of the construction of a hydropower complex, composed of two new regulation reservoirs for the operation of the Gualaca and Prudencia hydroelectric power plants. Based on the characteristics of both new reservoirs, as indicated in Table B 1, the power densities of each power plant and of the hydropower complex is significantly larger than 10 W/m^2. This means that no emissions from reservoirs should be taken into account as project emissions, or

$PE_{HP,y}=0$.

As a result, project emissions are equal to zero ($PE_y=0$).

Baseline emissions (*BE_y*)

Baseline emissions include only CO2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants. The baseline emissions are to be calculated as follows:

$$BE_y = EG_{PJ,y} \times EF_{grid,CM,y} \tag{05}$$

Where:

BE_y	=	Baseline emissions in year y (tCO_2/yr);
$EG_{PJ,y}$	=	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr);
$EF_{grid,CM,y}$	=	Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "*Tool to calculate the emission factor for an electricity system*" (tCO_2/MWh).

The DMHP is the installation of a new grid-connected renewable power complex at a site where no renewable power plant was operated prior to the implementation of the project activity. For that reason, according to the methodology $EG_{PJ,y}$ is defined as follow:

$$EG_{PJ,y} = EG_{facility,y} \tag{06}$$

Where:

$EG_{PJ,y}$	=	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr);
$EG_{facility,y}$	=	Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y* (MWh/yr).

Calculation of $EF_{grid,CM,y}$

In conformity with the "*Tool to calculate the emission factor for an electricity system*" (v.2), the calculation of the combined margin CO_2 baseline emission factor is carried out following the six steps outlined below:

Step 1: Identify the relevant electricity system.
Step 2: Choose whether to include off-grid power plants in the project electricity system (optional).
Step 3: Select method to determine the operating margin (OM).
Step 4: Calculate the operating margin emission factor according to the selected method.
Step 5: Identify the group of power units to be included in the build margin (BM).
Step 6: Calculate the build margin emission factor.
Step 7: Calculate the combined margin (CM) emissions factor.

Step 1: Identify the relevant electricity system.

For determining the electricity emission factors, a project electricity system is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity (e.g. the renewable power plant location or the consumers where electricity is being saved) and that can be dispatched without significant transmission constraints.

Similarly, a connected electricity system, e.g. national or international, is defined as an electricity system that is connected by transmission lines to the project electricity system. Power plants within the connected electricity system can be dispatched without significant transmission constraints but transmission to the project electricity system has significant transmission constraint.

If the DNA of the host country has published a delineation of the project electricity system and connected electricity systems, these delineations should be used.

The project electricity system for the proposed project activity is the Panamanian national electrical transmission system of 115kV and 230 kV (SIN, *Sistema Interconnectado Nacional)*[71], owned and operated by *Empresa de Transmisión Eléctrica S.A.* (ETESA). Power dispatch activities are performed by the National Dispatch Center (CND, *Centro Nacional de Despacho*), a part of ETESA.

The net electricity generated and dispatched by CND (total, hydro, thermal and import) is taken from the Table "*Resumen Estadistico*" in the annual reports of CND[72] for the years 2005 to 2008 and in the Monthly electricity generation reports from CND for the years 2005 to 2009[73].

Step 2: Choose whether to include off-grid power plants in the project electricity system

Project participants may choose between the following two options to calculate the operating margin and build margin emission factor:

Option I: Only grid power plants are included in the calculation.
Option II: Both grid power plants and off-grid power plants are included in the calculation.

Due to lack of sufficient information on off-grid plants and their data such as electricity generated, installed capacity and fuel consumption, only grid power plants were included in the calculation (Option I).

Step 3: Select method to determine the operating margin (OM).

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:

- Simple OM;
- Simple adjusted OM;
- Dispatch data analysis OM, or
- Average OM.

Simple adjusted OM method was chosen to perform the $EF_{grid,OM,y}$ calculation.

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[71] Map of the national electrical transmission system (SIN), available at: http://www.etesa.com.pa/plan_expansion.php?act=mapa and http://www.cnd.com.pa/publico/documentos/sin.pdf (last accessed on May 11, 2010).
[72] "Informe de la Operaci'on del sistema y del Mercado Mayorista de Electricidad (CND Annual Reports) Available at: http://www.cnd.com.pa/publico/mostrararchivosanual.php?despacho=CndAnual&titulo=ANUAL DEL CND (last accessed on May 13, 2010):

- CND Annual Reports 2005: page, 12 Resumen Estadístico
- CND Annual Reports 2006: page 9 Resumen Estadístico
- CND Annual Reports 2007:, page 35 Resumen Estadístico
- CND Annual Reports 2008:; page 27 Resumen Estadístico

[73] Monthly Energy Generation for the years 2005, 2006, 2007, 2008 and 2009. Available at: http://www.cnd.com.pa/publico/mostrararchivosanual.php?despacho=GeneracionMensual&titulo=GENERACION MENSUAL (last accessed on May 13, 2010).

The *ex-ante* option was selected for the data vintage, *i.e.* a 3-year generation-weighted average, based on the most recent data available at the time of submission of the initial or updated[74] CDM-PDD to the DOE for validation, without requirement to monitor and recalculate the emissions factor during the crediting period. The data vintage for the first crediting period of the proposed project activity is the 3 year period 2007-2009.

Step 4: Calculate the operating margin emission factor according to the selected method

The simple adjusted OM emission factor ($EF_{grid,OM-adj,y}$) is a variation of the simple OM, where the power plants / units (including imports) are separated in low-cost/must-run power sources (k) and other power sources (m). As under Option A of the simple OM, it is calculated based on the net electricity generation of each power unit and an emission factor for each power unit, as follows:

$$EF_{grid,OM-adj,y} = (1 - \lambda_y) x \frac{\sum_m EG_{m,y} \ x \ EF_{EL,m,y}}{\sum_m EG_{m,y}} + \lambda_y \ x \frac{\sum_k EG_{k,y} \ x \ EF_{EL,k,y}}{\sum_k EG_{k,y}} \quad (07)$$

Where:

$EF_{grid,OM-adj,y}$ = Simple adjusted OM CO_2 emission factor in year y (tCO_2/MWh)
y = Each year of the three year data vintage period to calculate the OM
$FC_{i,m,y}$ = Amount of fossil fuel type i consumed by power plant/unit j in year y (m^3)
$NCV_{i,y}$ = Net caloric value of fossil fuel type i in year y (GJ/m^3)
$EF_{CO2,i,y}$ = CO_2 emission factor of fossil fuel type i in year y (tCO_2/GJ)
$EF_{EL,m,y}$ = CO_2 emission factor of power plant/unit j in year y (tCO_2/MWh)
$EG_{m,y}$ = Net electricity generated and delivered to the grid power plant/unit j in year y (MWh)
m = Power plants/units which are not low-cost/must-run
$FC_{i,k,y}$ = Amount of fossil fuel type i consumed by power plant/unit k in year y (m^3)
$EF_{EL,k,y}$ = O_2 emission factor of power plant/unit k in year y (tCO_2/MWh)
$EG_{k,y}$ = Net electricity generated and delivered to the grid power plant/unit k in year y (MWh)
k = Power plants/units which are low-cost/must-run

Determination of $EF_{EL,m,y}$

The CO_2 emission factor of power plant/unit j in year y is calculated by using one of the 3 available options:

- **Option A1:**

$$EF_{EL,m,y} = \frac{\sum_j FC_{i,m,y} \ x \ NCV_{i,y} \ x \ EF_{CO2,i,y}}{EG_{m.y}} \quad (08)$$

Where :

[74] In case of request for renewal of the crediting period of a registered CDM project activity (EB 43, Annex 13, par. §4) (i.e. nine to six months prior to the date of expiration of the on-going crediting period).

$EF_{EL,j,y}$ = CO_2 emission factor of power plant/unit j in year y (tCO2/MWh)
$FC_{i,m,y}$ = Amount of fossil fuel type *i* consumed by power unit *m* in year *y* (Mass or volume unit)
$NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,y}$ = CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ)
$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
m = All power units serving the grid in year y except low-cost/must-run power units
i = All fossil fuel types combusted in power unit m in year y
y = The relevant year as per the data vintage chosen in Step 3

- **Option A2:**

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \ x\ 3.6}{\eta_{m,y}} \quad (09)$$

Where:
$EF_{EL,j,y}$ = CO2 emission factor of power plant/unit j in year y (tCO2/MWh)
$\eta_{j,y}$ = Average net energy conversion efficiency of power plant/unit *j* in year *y* (%)
$EF_{CO2,i,y}$ = Average CO_2 emission factor of fuel type *i* in year *y* (tCO_2/GJ)
m = All power units serving the grid in year y except low-cost/must-run power units
y = The relevant year as per the data vintage chosen in Step 3

- **Option A3:**

If for power unit m only data on electricity generation is available, an emission factor of 0 tCO2/MWh can be assumed as a simple and conservative approach.

For the ex-ante determination of $EF_{EL,m,y}$ option A.1 was chosen due to access to fuel information, such as type of fuel used, fuel consumption, net calorific value and fuel emission factor.

Determination of $EG_{m,y}$

The annual net electricity generated and dispatched by the CND from the individual participating power plants/units *m*, including LC/MR ($EG_{k,y}$) and non-LC/MR ($EG_{m,y}$) power plants, is taken from the publicly available spreadsheets indicating the monthly net generated and dispatched electricity.[75]

The net electricity generated and dispatched by CND for power plants/units *m* for both LC/MR (*j*) and not-LC/MR (*k*) power plants for the years 2007, 2008 and 2009 are presented in Annex 3, Tables 2.1 and 2.2

[75] Monthly Energy Generation for the years 2005, 2006, 2007, 2008 and 2009. Available at: http://www.cnd.com.pa/publico/mostrararchivosanual.php?despacho=GeneracionMensual&titulo=GENERACION MENSUAL (last accessed on May 13, 2010).

Determination of $EF_{EL,m,y}$

No public reliable data on fuel consumption data at power plant/unit level is available for the participating fossil fuel fired electricity generation plants at SIN for the period 2007-2009. Nevertheless, fuel efficiency (in quantity of fuel per MWh) is available,[76] permitting an indirect calculation of the fuel consumption. Therefore, option A1 could be selected. [77]

Lambda (λ_y)

Lambda ***(λ_y)*** is defined as follows:

$$\lambda_y\,(\%) = \frac{Number\ of\ hours\ low-cost/must-run\ sources\ are\ on\ the\ margin\ in\ year\ y}{8760\ hours\ per\ year} \qquad (10)$$

Lambda is calculated in a four steps process for each year *y* in the period 2007-2009:

(1) Plot a load duration curve by sorting chronological load data (in MW) for each hour of the year *y*, from the highest to the lowest MW level. Plot MW against 8760 hours in the year, in descending order.

(2) Sum the annual net electricity supplied to the grid (in MWh) from all low-cost/must-run power plants/units, including electricity imports (i.e. $\Sigma_k EG_{k,y}$).

(3) Plot a horizontal line across the load duration curve such that the area under the curve (MW times hours) equals the total annual net electricity supplied to the grid (in MWh) from low-cost/must-run power plants/units, including electricity imports (i.e. $\Sigma_k EG_{k,y}$).

(4) Determine the number of hours for which low-cost/must-run sources, including electricity imports, are on the margin in year *y*, by locating the intersection of the horizontal line plotted in step (3) and the load duration curve plotted in step (1). The number of hours (out of the total of 8760 hours) to the right of the intersection is the number of hours for which low-cost/must-run sources are on the margin. If the lines do not intersect, then one may conclude that low-cost/must-run sources do not appear on the margin and λ_y is equal to zero.

Step 5: Identify the group of power units to be included in the build margin (BM).

The build margin (BM) refers to a cohort of power units that reflect the type of power units whose construction could be affected by the proposed CDM project activity.

The sample group of power units *m* used to calculate the build margin consists of either:

- The set of five power units that have been built most recently, or

[76] Fuel Efficiency (*rendimiento*) from: "*ETESA: Plan de Expansón del SIN 2009-2023*", Republica de Panama, published on November 30,2010; page 142, Table1.3. Available at: http://www.etesa.com.pa/plan_expansion.php (last accessed on May 08, 2010)
[77] See section B.6.1, Step 4, sub-step: Determination of $EF_{EL,m,y}$.

- The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

Project participants should use the set of power units that comprises the larger annual generation. In the case of BM 2009 calculation for Panamanian National Interconnected System (SIN), the set of power additions that comprise 20% of the system generation and have been built most recently will be used, as will be further discussed on section B.6.3.

Step 6: Calculate the build margin emission factor

The BM emissions factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units *m* during the most recent year y for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_{m} EG_{m,y} \times EF_{EL,m,y}}{\sum_{m} EG_{m,y}} \quad (11)$$

Where:

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
m = Power units included in the build margin
y = Most recent historical year for which power generation data is available.

The CO_2 emission factor of each power unit *m* ($EF_{EL,m,y}$) should be determined as per the guidance in step 4 (a) for Simple OM, using options A1, A2 and A3 (see Substep 4, item: Determination of $EF_{EL,m,y}$), using for *y* the most recent historical year for which power generation data is available, and using for *m* the power units included in the build margin.

Step 7: Calculate the combined margin (CM) emissions factor.

The combined margin emissions factor for the first crediting period is calculated as follows:

$$EF_{grid,CM,2009} = EF_{grid,OM\text{-}adj,\,2007\text{-}2009} \times w_{OM} + EF_{grid,BM,\,2009} \times w_{BM} \quad (12)$$

Where:

$EF_{grid,OM\text{-}adj,\,2007\text{-}2009}$ = Average operating margin CO_2 emission factor in period 2007-2009 (tCO_2/MWh)
$EF_{grid,BM,,\,2009}$ = Build margin CO_2 emission factor in year 2009 (tCO_2/MWh)
w_{OM} = Weighting of OM CO_2 emission factor (%)
w_{BM} = Weighting of BM CO_2 emission factor (%)

For calculating the combined margin emissions factor $EF_{grid,CM}$, the weighting default values as indicated in the "*Tool to calculate the emission factor for an electricity system*" (v. 2), applicable for hydroelectric power projects, are used: w_{OM} = 0.5 and w_{BM} = 0.5 for the first crediting period, and w_{OM} = 0.25 and w_{BM} = 0.75 for the second and third crediting periods.

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

This section list data and parameters that remain fixed during the crediting period.

Data / Parameter:	$EG_{m,y}$, EG_{y}, $EG_{k,y}$
Data unit:	MWh
Description:	Net electricity generated by power plant/unit *m* and *k* (or in the project electricity system in case of *EGy*) connected to the grid in years 2005 2006, 2007, 2008 and 2009.
Source of data used:	Monthly Energy Generation reports published by CND, for the years 2005, 2006, 2007, 2008 and 2009.[78]
Value applied:	See Annex 3, Tables 2.1 and 2.2
Data choice justification or description of measurement methods and procedures actually applied :	The data used is from an officially published monthly grid electricity supply data by the operator CND for 2005, 2006, 2007, 2008 and 2009.
Any comment:	-

Data / Parameter:	$EF_{CO2,i,y}$
Data unit:	tCO_2/GJ
Description:	Weighted average CO_2 emission factor of fuel type *i* in year *y*
Source of data used:	IPCC default values at the lower limit of uncertainty at a 95% confidence interval as provided in Vol.2 Energy, Stationary Combustion - Table 2.2
Value applied:	See Annex 3 –Table 3.1. Same values for 2007, 2008 and 2009. Fuel types *i* include: - Bunker C (IPCC category: Residual Fuel Oil) - Diesel Marine (IPCC category: Gas/Diesel Oil) - Diesel Light (IPCC category: Gas/Diesel Oil)
Data choice justification or description of measurement methods and procedures actually applied :	No values provided by the fuel suppliers of the power plants/units are available. No regional or national average default values have been defined.
Any comment:	Used for calculating the CO_2 emission factor $EF_{ELm,y}$ of power plants/units *m*, expressed in tCO_2/MWh, in year y.

Data / Parameter:	***FCi,m,y,***

[78] Monthly Energy Generation for the years 2005, 2006, 2007, 2008 and 2009. Available at: http://www.cnd.com.pa/publico/mostrararchivosanual.php?despacho=GeneracionMensual&titulo=GENERACION MENSUAL (last accessed on May 13, 2010).

Data unit:	gal
Description:	Fuel consumption for power plant/unit *m* and fuel type *i* in years 2007, 2008 and 2009.
Source of data used:	Calculated by multiplying the Fuel efficiency in gal/MWh (as published in the ETESA, *Plan de Expansión del Sistema Interconectado National 2009-2023*, p.142 – Table N°1.3)[79] by the Energy Generation for each power plant ($EG_{m,y}$), as described in Section B.6.1 item "Determination of $EF_{EL,m,y}$".and showed in Annex 3 - Table 3.3.
Value applied:	See Annex 3 -Table 3.3. (Same values for 2005, 2006 and 2007)
Data choice justification or description of measurement methods and procedures actually applied :	The values are used in annual expansion plan for the electricity system in Panama. The Plan is published by ETESA and approved by ASEP (*Autoridad Nacional de los Servicios Públicos*).
Any comment:	-

Data / Parameter:	$NCV_{,i,j}$
Data unit:	kcal/gal
Description:	Weighted average net caloric value of fuel type *i* in year *y*, as published by ETESA
Source of data used:	ETESA, *Plan de Expansión del Sistema Interconectado National 2009-2023,* p.182– Table 8.1[80]
Value applied:	See Annex 3 – Table 3.1 - Same values for 2005, 2006 and 2007
Data choice justification or description of measurement methods and procedures actually applied :	The values are used in annual expansion plan for the electricity system in Panama published by ETESA and approved by ASEP (Autoridad Nacional de los Servicios Públicos)
Any comment:	-

Data / Parameter:	**Grid emission factor ($EF_{grid,CM,y}$)**
Data unit:	tCO_2/MWh
Description:	CO_2 emission factor for the Panamanian national grid
Source of data used:	Factor calculated based on data calculated for Build Margin and for Operating Margin
Value applied:	0.5640
Justification of the choice of data or description of measurement methods and procedures actually	Factor was calculated according to the approved methodology – ACM0002, version 11 and the "*Tool to calculate the emission factor for an electricity system*".

[79] "*ETESA: Plan de Expansón del SIN 2009-2023*", Republica de Panama, published on November 30, 2010. Available at: http://www.etesa.com.pa/plan_expansion.php (last accessed on May 08, 2010).

[80] *Ibid*

applied :	
Any comment:	-

B.6.3 Ex-ante calculation of emission reductions:

Operating margin

- **Lambda (*λ*$_y$)**

Information on electricity hourly dispatched to the SIN for the years 2007, 2008 and 2009, is available at CND website.[81] This data together with LC/MR (low-cost/must run) total electricity generation[82] was used to calculate λ_y, and the results are shown in Figure B 4, Figure B 5, Figure B 6, and Table B 10 (below):

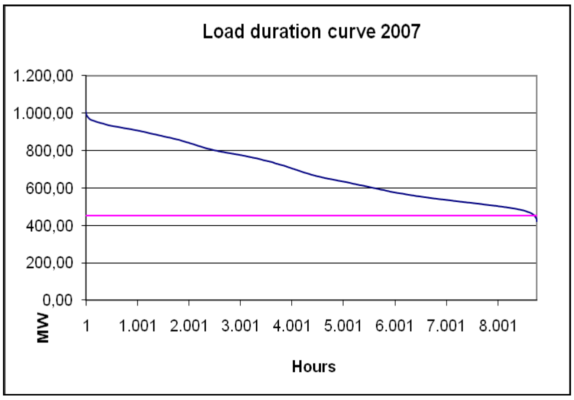

Figure B 4: Lambda 2007 (λ_{2007})

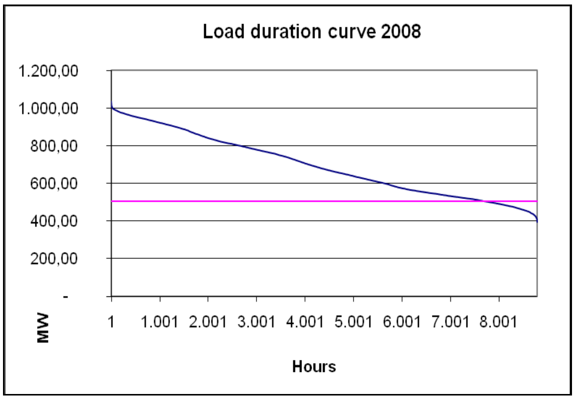

Figure B 5: Lambda 2008 (λ_{2008})

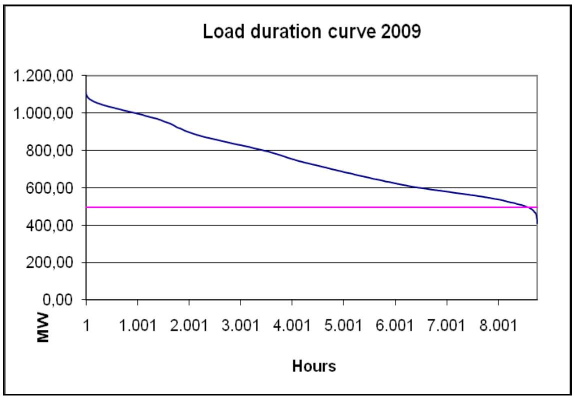

Figure B 6: Lambda 2009 (λ_{2009})

[81]Electricity Dispatched hourly for the years 2007,2008 and 2009 - files available in monthly reports: http://www.cnd.com.pa/publico/mostrararchivosmensuales.php?despacho=ComportamientoSistema&titulo=COMPORTAMIENTO%20DEL%20SISTEMA (last accessed on May 13, 2010).

[82] See Annex 3, Tables 1.1 and 1.2.

Table B 10: Lambda (first crediting period)

Year	Annual Generation from LC/MR [1] [2] (MWh)	Operational hours	1-Lambda ($1-\lambda_y$)[3]	Lambda (λ_y) [3]
2007	3,970,985.38	8760	0.9950	0.0050
2008[3]	4,426,593.95	8784	0.8784	0.1216
2009	4,315,533.99	8760	0.9813	0.0187

[1]Please refer to Annex 3, Tables 1.1 and 1.2.
[2] LC/MR stands for low-cost/must run units.
[3] Leap year.

- **Determining $EF_{EL,m,y}$**

Equation (08) was used for determining $EF_{EL,m,y}$. Information on Fuel Consumption, CO_2 emission factor for fossil fuel and electricity generation of the non-LC/MR units can be found in Annex 3. The summary of the results is presented below:

Table B 11: CO_2 Emission factor of the non-LC/MR power units ($EF_{EL,m,y}$)

Unit	$EF_{EL,m,y}$ (tCO_2/MWh)		
	2007	**2008**	**2009**
BAHIA LAS MINAS			
Bahia Las Minas 2	**0.9934**	**0.9934**	**0.9934**
Bahia Las Minas 3	**0.9301**	**0.9301**	**0.9301**
Bahia Las Minas 4	**0.9421**	**0.9421**	**0.9421**
John Brown 5 (single cycle)	**0.6604**	**0.6604**	**0.6604**
John Brown 6 (single cycle)	**0.6604**	**0.6604**	**0.6604**
Bahia Las Minas 8 (single cycle)	**0.6604**	**0.6604**	**0.6604**
Ciclo Combinado	**0.6604**	**0.6604**	**0.6604**
COPESA	**0.7175**	**0.7175**	**0.7175**
PAN-AM	**0.6886**	**0.6886**	**0.6886**
IDB/CATIVÁ	**0.0000**	**0.6873**	**0.6873**
TG PANAMÁ	**1.0843**	**1.0843**	**1.0843**
TERMICA CARIBE/El GIRAL	**0.0000**	**0.0000**	**0.7005**
GENA/CATIVÁ II/ TERMOCOLON	**0.0000**	**0.0000**	**0.6348**
PACORA	**0.6591**	**0.6591**	**0.6591**

Using the calculated values for $EF_{EL,m,y}$ and for λ_y it is possible to obtain the $EF_{grid,OM-adj,y}$. by applying Equation (7). To be used *ex-ante*, the $EF_{grid,OM-adj,y}$ must be calculated as a 3-year-generation-weighted-average as shown below:

Table B 12: Generation-weighted average OM 2007-2009

Year in the baseline	$EF_{grid,OM-adj,y}$	Total Net Electricity Generated (MWh)
2007	0.7365	6,164,519.74
2008	0.6410	6,276,374.74
2009	0.6914	6,702,752.40
$EF_{grid,OM-adj,2007-2009}$ (tCO_2/MWh)		**0.6894**

Build Margin

As can be seen in Table B 13, the five most recently built power units in Panama, delivering electricity to SIN, comprise less than 20% of the electricity generated by the electricity system in 2009 (6,702,752.40 MWh),[83] the most recent historical year for which power generation data is available. For that reason to comprise with the 20% it was necessary to consider the cohort of 7 units in total. The BM emission factor ($EF_{grid,BM,2009}$) was calculated using Equation 11. The result is presented in the following table:

Table B 13: Sample group of power units *m* used to calculated the build margin

	Power Units in the Build Margin [1]	Commercial Operations Start Year[2]	Type of Unit [2]	Generation 2009 [MWh/yr]	Accumulated Annual Generation	$EF_{EL,m,2009}$ [3] [tCO_2/MWh]
1	**GENA/CATIVÁ II/ TERMOCOLON**	2009	Thermal	61,723	0.92%	0.6348
2	**TERMICA CARIBE/El GIRAL (1-8)**	2009	Thermal	126,788	2.81%	0.7005
3	**IDB/CATIVÁ (1-10)**	August 2008	Thermal	488,574	10.10%	0.6873
4	**HIDRO CANDELA**	2006	Hydro	1,698	10.13%	-
5	**ESTÍ (2)**	November 2003	Hydro	295,201	14.53%	-
6	**ESTÍ (1)**	November 2003	Hydro	302,871	19.05%	-
7	**PACORA**	January 2003	Thermal	437,124	25.57%	0.6591
	$EF_{grid,BM,2009}$ (tCO2/MWh)			**0.4387**		

Source:

[1] CDM Projects excluded from the Build Margin Group:
ISTIMUS/ CONCEPCIÓN (1-2) - Registration details can be found at: http://cdm.unfccc.int/Projects/DB/SGS-UKL1158218203.57/view .

[2] See Annex 3, OM-BM Assumptions, Tables 2.1 and 2.2.

[3] See Table B 11Table B 11 above.

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[83] Total dispatched electricity by SIN in 2009. See Annex 3, Table 1.1.

Combined Margin

The result of the calculation of the combined margin emissions factor $EF_{grid,CM,2009}$ for the first crediting period is presented in:

Table B 14: CO_2 Grid Emission Factor 2009 – Combined Margin

$EF_{grid, CM, 2009}$ (tCO_2/MWh)
0.5640

Emission Reductions

Baseline emissions were calculated using Equation (05) and Equation (06). The results are below:

Table B 15: Baseline Emissions

Year	EG_y (MWh)	$EF_{grid,CM,y}$ (tCO_2/MWh)	BE_y (tCO_2)
2011	512,100.00	0.5640	**288,824**
2012	597,310.00	0.5640	**336,882**
2013	597,310.00	0.5640	**336,882**
2014	597,310.00	0.5640	**336,882**
2015	597,310.00	0.5640	**336,882**
2016	597,310.00	0.5640	**336,882**
2017	597,310.00	0.5640	**336,882**

As previously mentioned in section B.6.1, there is neither Project Emissions nor Leakage to be accounted for ($PE_y = LE_y = 0$) in the Emission Reductions Estimative. The results of the *ex-ante* estimation of emission reductions are presented below:

Table B 16: Emission Reductions

Year	BEy	PEy	LEy	Ery
2011	288,824	0	0	**288,824**
2012	336,882	0	0	**336,882**
2013	336,882	0	0	**336,882**
2014	336,882	0	0	**336,882**
2015	336,882	0	0	**336,882**
2016	336,882	0	0	**336,882**
2017	336,882	0	0	**336,882**

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

Year	Estimation of project activity emissions [$tCO2_e$]	Estimation of baseline emissions [$tCO2_e$]	Estimation of leakage emissions [$tCO2_e$]	Estimation of overall emission reductions [$tCO2_e$]
2011	0	288,824	0	**288,824**
2012	0	336,882	0	**336,882**
2013	0	336,882	0	**336,882**
2014	0	336,882	0	**336,882**
2015	0	336,882	0	**336,882**
2016	0	336,882	0	**336,882**
2017	0	336,882	0	**336,882**
Total	**0**	**2,310,116**	**0**	**2,310,116**

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

B.7.1 Data and parameters monitored:

Data / Parameter:	$EG_{PJ,y}$
Data unit:	MWh
Description:	Electricity supplied by the project activity to the grid
Source of data to be used:	Project activity site
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The *ex-ante* total electricity supplied by the proposed project activity is obtained by summing up the *ex-ante* determined supply of each hydroelectric power plant belonging to the proposed project activity, as indicated in Table B 15 in Section B.6.3.
Description of measurement methods and procedures to be applied:	The total annual electricity of the proposed project activity supplied to SIN in the crediting period shall be obtained by the Central Measurement Energy System (*Sistema de Medición Eléctrica Central - SMEC*), installed at the project site.
Monitoring frequency	Continuously measurement and monthly recording
QA/QC procedures to be applied:	Electricity supplied by the project activity to the grid.
Any comment:	

B.7.2 Description of the monitoring plan:

This section details the steps taken to monitor the greenhouse gas emissions reductions on a regular basis from the Dos Mares Hydroelectric Project (DMHP). The Monitoring set up for this Project Activity has been developed to ensure that from the start, the DMHP is well organized in terms of the collection and archiving of complete and reliable data and fully complies with the provisions of ACM0002 (version 11) and the VVM (version 1.1).

1. **Monitoring Organization.**

Overall responsibility for the monitoring and reporting activities lies within the project participants. Bontex S.A and Altenergy S.A will designate a Project Manager (*Jefe de Central*) for the hydropower plants (Gualaca, Lorena and Prudencia). This professional will be directly involved with plants daily operation and also responsible for supervising the collection, storage, review and reporting of measured project data and other monitoring activities, such as maintenance, and follow-up of calibration procedures. A staff under the responsibility of the power plant managers will be assigned to perform daily monitoring activities. This staff will be appropriately trained in order to assure full compliance with operational national requirements and, consequently, a transparent, credible and accurate CDM monitoring process. The diagram below describes the main operational structure and the allocation of responsibilities.

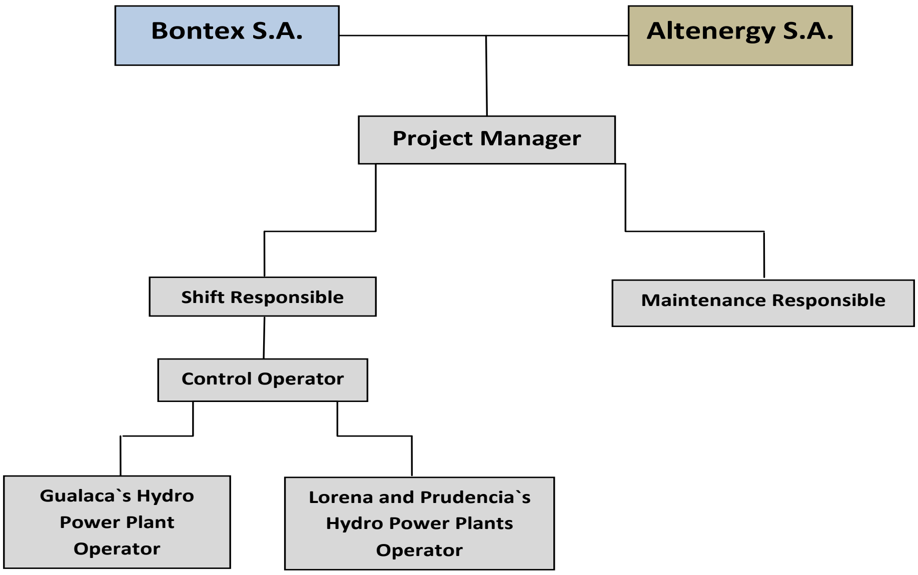

Figure B 7: Management Structure and Responsibilities

2. **Data Collection, Recording and Archiving**

Data Management involves the Project Developers and the National Dispatch Center (*Centro Nacional de Despacho - CND*), granting a high level of security to the information generated during the Project Activity's operation. Measurements of the electricity generated and provided to the grid will be electronically monitored through the use of on-site metering equipment. Operation parameters will be continuously followed up and recorded at the control room. The monitored data is thus archived in spreadsheets and backed up regularly.

These data are also remotely monitored and recorded on a continuous basis by the National Dispatch Center[84], the entity responsible for interconnected grid operation. According to the national standard procedures, the energy produced by generators and dispatched to the national grid shall be calculated by the Central Measurement Energy System (*Sistema de Medición Eléctrica Central - SMEC*). The SMEC mainly comprises the commercial meters and communication protocols with CND. Therefore, all measured data can be obtained by accessing both the Project Activity's internal server and the CND database. In addition, as per national standards, the commercial meters shall keep the measured data for a minimum of 12 days, as an additional redundancy for data recovering.

Based on the monitored data, the system operator makes a balance on each node of the network and publishes a monthly report with all the data of the system. This report is sent monthly by the system operator to the Project Activity operator. Data monitored as per the ACM0002 (v.11) will be kept legible, dated, and readily identifiable and be made accessible for audit purposes either in electronic files or physical documents.

Other physical document such as invoices, paper-based maps, diagrams and other relevant monitoring requirements will be collected and archived in a central place, together with this monitoring plan. In order to facilitate auditors' reference of relevant data relating to the project, the project material and monitoring results will be indexed. All electronic and paper-based information will be stored by the project owner and kept at least for 2 years after the end of the crediting period. Further information that needs to be archived is listed below:

- PDD, including the electronic spreadsheets and supporting documentation (assumptions, data estimations, measurement methods, etc.);
- DOE Validation and Verification Reports.
- Dispatch Meter Calibration Reports;
- Energy Meter Reading Reports;

3. Quality Assurance and Quality Control

Accuracy patterns of the meters used at the project site are defined by CND. According to the available procedures, meters used will be bi-directional meters with an accuracy of equal to or higher than 0.2s (Class 0.2). As mentioned above, the project owner will keep a back-up meter installed in order to assure that measurement is continuously conducted and high quality standards are maintained. The backup meter shall also meet the relevant national standards.

The data generated will be analyzed daily by the shift responsible and consolidated in a monthly report that will be reviewed by the project manager. Furthermore, since all data is transmitted electronically to CND, the quality of the measured data will be checked by its operation personal as well. If during the QA/QC procedures, data is classified as inaccurate or if, a mal-functioning of the installed meters is detected, the procedures defined by CND must be implemented[85].

[84] The Main Electricity Metering System equipment and Backup Electricity Metering System equipment (commercial meters) will be owned and maintained by Project Operator but will be operated by the CND. Both electricity meters will have the capability to be read remotely through a communication line and will have the provisions to record on memory the accumulated electricity produced. Both CND and Project Operator have the right to read either meter. (For further information on SMEC's components, please refer to "*Cambios Realizados al Reglamento de Operación*" (Page 50, Annex A – *Sistema de Medición Comercial para todos los Agentes Participantes del Mercado Electrico Nacional*, NII2.1.2).

[85] These procedures will be presented in item 5 (Corrective Actions) of "*Cambios Realizados a las Reglas Comerciales para el Mercado Mayorista de Electricidad, , Republica de Panama , Ente Regulador de los Servicios Publicos* ", and can be accessed at:

4. Audits, Maintenance, and Calibration of Equipments

CND requires and conducts audits to check the correct functioning of the SMEC on a yearly basis. The National Dispatch Center launches every year an Auditing Program ("*Programación Auditoria SMEC*") which corresponds to the annual SMEC verification program, defined for all generators connected to the national grid. Besides these programmed auditing, if CND or the Project Developers find out any possible error(s), discrepancies or malfunctioning in the measurements or in the SMEC itself, a non-programmed audit is scheduled with the aim of verifying and maintaining the system, as per the provisions Conceptual Verification Map ("*Mapa Conceptual de Verificación*"[86]). The procedures adopted during the verification of SMEC are defined by CND and described at the SMEC Verification Methodology ("*Metodología para Verificación del Sistema de Medición Comercial*"[87]). Verification results are finally published at SMEC's Annual Audit Report ("*Informe de Auditoria Annual de los Sistemas de Medición Comercial a los Participantes del Mercado Mayorista de Electricidad*") that can be accessed at the CND's website[88].

Except for the programmed auditing, CND does not require any other maintenance procedures.

The SMEC's commercial meters, installed at the substations, will be calibrated at commissioning and the issued certificate is then submitted for CND's approval. CND is also responsible for defining the need of periodical calibrations (i.e. CND staff may require the calibration of project's equipments during the programmed audits). When needed, periodical calibrations will be conducted by a testing facility accredited under Panamanian law. CND is responsible for certifying/approving the calibrations conducted by the accredited testing facility.

5. Corrective Actions

As mentioned above, the CND conducts on an annual basis a programmed audit to verify the SMEC. The results/findings of the audits are published at SMEC's Annual Audit Report ("*Informe de Auditoria Annual de los Sistemas de Medición Comercial a los Participantes del Mercado Mayorista de Electricidad*") available at CND's website. This report lists the major and minor non-conformities, as well as the corrective actions that shall be undertaken in order to close the pending issue[89].

In terms of data, if measurements are classified as inaccurate or otherwise, a mal-functioning of the installed meters is detected, the following procedures for the main and backup meters shall be applied[90]:

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http://www.cnd.com.pa/publico/documentos/norm_reglascomerciales.pdf (last accessed on May 12, 2010). Please refer to pages 64 and 65, item 14.3.

[86] Centro Nacional de Despacho, "*Mapa Conceptual de Verificación*". Available: http://www.cnd.com.pa/publico/documentos/Smec_MapaConceptual.pdf (last accessed on 12 May 2010).

[87] Centro Nacional de Despacho, "*Metodología para Verificación del Sistema de Medición Comercial"* Available: http://www.cnd.com.pa/publico/documentos/Smec_Metodologia.pdf (last accessed on May 12, 2010).

[88] For further information, please refer to CND: "*Auditoria Anual SMEC*". Available at: http://www.cnd.com.pa/publico/mostrararchivosanual.php?despacho=AuditoriaSmec&titulo=AUDITORIA%20ANUAL%20SMEC (last accessed on May 12, 2010).

[89] An example of this document can be accessed on CND: "*Auditoria Anual SMEC*". Available at: http://www.cnd.com.pa/publico/mostrararchivosanual.php?despacho=AuditoriaSmec&titulo=AUDITORIA%20ANUAL%20SMEC . (last accessed on May 12, 2010). .

[90] These procedures will be presented in item 5 (Corrective Actions) of "*Cambios Realizados a las Reglas Comerciales para el Mercado Mayorista de Electricidad, , Republica de Panama , Ente Regulador de los Servicios Publicos* ", Republica de Panama, Ente Regulador de los Servicios Publicos", and can be accessed at http://www.cnd.com.pa/publico/documentos/norm_reglascomerciales.pdf (last accessed on May 12, 2010). Please refer to pages 64 and 65, item 14.3.

- If information from the main meter is not available, data from backup meter shall be accessed;
- If information from the backup meter is not available, data from the CND measurement system in the delivery points for the energy retail market shall be accessed;
- If information from CND measurement system is not available, data from SCADA System shall be accessed;
- If information from SCADA System is not available, data should be recovered locally through the coordination with CND and the project developer;
- If there is no available information, CND shall use the dispatch programmed values.

In addition to these measures, a non-programmed audit may be required by both CND and the Project Developer and the verification procedures shall be applied.

6. Training of Monitoring Personnel

Staff involved with monitoring activities will be suitably qualified and trained in the operation and relevant requirements from CND (such as Programmed Audits). They will also receive instructions for the correct and timely performance of the monitoring plan of DMHP.

7. **Verification of the Monitoring Results and Emission Reduction Calculation**

Emission reduction calculation will be coordinated by the Project Manager and conducted by project staff with the support of a third party (i.e.: GDF SUEZ Latin America or consultancy company). The calculation will be used for the development of the monitoring report, as required by the verification process. The main objective of the verification is to independently verify that the project has achieved the emission reductions as reported and projected in the PDD.

The responsibilities for verification of the projects are as follows:

- Sign a verification service agreement with specific DOE and agree to a time framework set by the EB for carrying out verification activities. Project Partcipants will make the arrangements for the verification and will prepare for the audit and verification process to the best of its abilities.

- The proposed project owner will facilitate the verification through providing the DOE with all required necessary information, before, during and, in the event of queries, after the verification.

- The proposed project owner will fully cooperate with the DOE and instruct its staff and management to be available for interviews and respond honestly to all questions from the DOE.

The verification audits will be based on the requirements of the latest version of the VVM.

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)

The baseline study was completed on 11 May 2010. The entity determining the baseline as carbon project consultant is Tractebel Engineering S.A., assisted by its subsidiary Econergy Brasil Ltda and revised by GDF SUEZ regional staff.

Neither Tractebel Engineering S.A. nor Econergy Brasil Ltda or GDF SUEZ Latin America[91] are project participants, as can be confirmed in Section A.3 and Annex 1.

Contact persons for Tractebel Engineering, for Econergy Brasil Ltda and for GDF SUEZ Latin America are:

Company	Tractebel Engineering	Econergy Brasil Ltda	GDF SUEZ Latin America (Internal Revision)
Contact Person	Johan Pype Energy Assets Consulting	Marcos Costa	Anamélia Medeiros and Philipp Hauser
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Website	http://www.tractebel-engineering.com	http://www.econergy.com	http://www.gdfsuez.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:

4 July, 2008.
The EPC contracts for electro-mechanical works and for civil works were signed respectively on July 4, 2008 (Alstom & Areva Koblitz) and on July 11, 2008 (C.N. Odebrecht).

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

50 years.

[91] Both Bontex S.A. and Alternergy S.A. are fully owned Panamanian subsidiaries of GDF SUEZ S.A. and have been defined as Project Participants. Other Annex I Project Participants may be added in the future once the Annex I LoAs are obtained.

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:

1 January, 2011[92] or the project's registration date (whichever is later)

C.2.1.2. Length of the first crediting period:

7y-0m.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

N/A

C.2.2.2. Length:

N/A

SECTION D. Environmental impacts

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

The proposed project activity complies with the specific applicable regulations in Panama with regards to Environment Impact Assessment (EIA). According to the Executive Decree nº 59 (from March 16th 1998),[93] any hydro power plant with an installed capacity above 15 MW that produces negative environmental impacts and therefore requires a more stringent analysis of all possible impacts shall present a Category III EIA. Project activities classified under Category III are subjected to the most rigorous type of assessment to be made for a project in Panama and as a result must propose an Environmental Management Plan (*Plan de Manejo Ambiental – PAMA*).

For the DMHP, three different EIAs have been developed to account for the impacts of the hydro power plants of Gualaca, Lorena and Prudencia[94]. The EIAs have been carried out by MWH Panama, S.A. for the Gualaca hydroelectric power plant in August 2004, and by Ing. Enier Portugal for the Lorena and Prudencia hydroelectric power plants in August 2005.

The EIAs have been approved by the National Environmental Authority (ANAM) of Panama on February 3, 2006 for the Gualaca hydroelectric power plant[95], and on August 8 and September 6, 2006 for respectively the

[92] Expected commissioning date of the first operational power plant of the project activity (Gualaca).
[93] Executive Decree nº 59 (March 16, 1998) . Available at: http://www.cnpml.org.pa/cnpml/leyes_normas/decreto_59.pdf (last accessed on May 13, 2010):
[94] Since the environmental licensing process began before the acquisition process of Bontex S.A. and Altenergy S.A. by GDF-SUEZ, three EIAs were developed and will be, for this reason, analysed in separate.

[95]" *República de Panamá, Autoridad Nacional del Ambiente, Resolución Dineodora IA- 007-2006*"; Autoridad Nacional del Ambiente (ANAM), issued February 3, 2006.

Lorena[96] and Prudencia[97] hydroelectric power plants. These governmental approvals confirm that the projects comply with the sustainable development and environmental policies defined by the Panamanian Government.

In addition, to the development and approval of the EIAs for the hydropower Plants of Gualaca, Lorena and Prudencia and in accordance with the national environmental law, Project Proponents had also obtained the required water use permits and developed an EIA for the construction of Project's Transmission Lines.

As per the Executive Decree nº 59/1998, the construction of transmission lines with voltages above 40 kV requires a Category II EIA, as it produces negative impacts that partially affects the environment, being, therefore, mitigated by the adoption of known and simple measures. This EIA has been prepared by ECOAMBIENTE S.A., a local consultant also certified by ANAM, and presented for approval on March 12, 2009. After submitting additional information to comply with ANAM's requests, the Transmission Line's EIA were approved on September 29, 2009.[98]

Concessions for water use have been granted by ANAM in accordance with the national *Resolución AG-0127-2006*[99] which defines the required ecological water flow for assuring the preservation of the affected river's ecosystems. Water Use Concession Agreements have been issued separately for the three hydro power plants comprised by the Dos Mares Hydro Complex.[100]

In conclusion, the EIAs assess a wide range of positive and negative impacts related to physical, biological, socio-economic and cultural environments. Mitigation measures have been defined to limit negative impacts, as will be shown on Section S.2 below. Positive impacts have also been outlined in the EIAs. One of the main positive impacts of the development of the project activity refers to the regularization and reversion of the turbinated waters of the Canjilones hydroelectric power plant (Estí Project) to the original Chiriquí river, minimizing in this way the negative impact that these waters cause along the Estí river.

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:

Where impacts of the project were identified as significant, mitigation measures were suggested and defined in the aim of the Environmental Management Plans (PAMA, *Plan de Adecuación y Manejo Ambiental*). In addition, other mitigation activities, mainly related to minor impacts on local vegetation, have been established by Gualaca, Lorena and Prudencia EIA's Approval Resolutions.[101]

The Tables below summarize the most significant impacts and mitigation measures highlighted by the EIAs and accepted by the National Environmental Authority (ANAM) of Panama.

[96] "*República de Panamá, Autoridad Nacional del Ambiente, Resolución Dineodora IA- 083-2006*"; Autoridad Nacional del Ambiente (ANAM), issued August 7, 2006;
[97] "*República de Panamá, Autoridad Nacional del Ambiente, Resolución Dineodora IA- 099-2006*"; Autoridad Nacional del Ambiente (ANAM), issued September 7, 2006;
[98] For further information, please refer to: "*Resolution DIEDORA IA-771-2009*" .

[99]For further information, please refer to: "Resolucíon AG -0127-2006-Caudal Ecologico"
[100] Gualaca's water use permit was granted by "*Contrato de Concesión Permanente" para Uso de Agua No. 021-2006"*. Lorena and Prudencia's water use permits were granted by "*Resolución No. AG 0732-2006*" and " *Resolución No. AG.0731-2006*", respectively.
[101] Although more specific, mitigation measures defined in the aim of EIA's Approval Resolutions are generally addressed in Tables D1, D2 and D3.

Gualaca hydroelectric power plant

Table D 1: Gualaca's HPP Environmental Impacts and Mitigation Measures

Identified Environmental Impacts	Mitigation Measures
Physical and Biotic Impacts	
Impacts on Soil	
Construction phase: Impacts on soil are related to the i) loss of organic soil as erosion and sedimentation processes as well as landslides are expected to occur as a result of superficial excavation, soil movement, material and equipment transportation, waste disposal and construction of transmission lines; ii) decrease of soil quality by the disposal of residues and effluents.	Mitigation measures comprise: i) avoid cutting unstable slopes; ii) implement stability measures in the slopes; iii) reforestation using native species; iv) establish a proper drainage system; v) reuse of residues; vi) disposal of construction residues in a pre-defined area; v) define a trash management policy; vi) dispose solid residues in surrounding landfill on a periodical basis.
Impacts on Biodiversity and Ecosystems	
Construction phase: Impacts on vegetation are related to: i) decrease of the vegetation covering and forest; ii) disable farming areas for disposal of excavations debris resulting from the construction of the adduction channel; iii) changes in the landscape; iv) decrease of fishing species; v) changes in watercourse dynamics.	Mitigation measures comprise: i) improve the reforestation and conservation of water and soil though the implementation of an environmental education program; ii) reforestation in order to decrease the impacts related to the erosion; iii) reforestation of the area near the channel and where excavation materials are deposited by using native species; iv) to assure the ecological flow during the raining season and a natural flow during the dry season.
Impacts on the Quality of Air	
Construction phase: Impacts on air quality are related to: i) dust generation and atmospheric emissions caused by superficial excavations, transportation of materials and equipments, etc. This increasing amount of air pollutants may cause health problems, fauna displacement and community disapproval.	Mitigation measures comprise: i) during the dry season, spray water in the access ways at least twice a day; ii) to assure a good maintenance of heavy and light vehicles used; iii) to define and monitor speed limits for roads especially not covered by asphalt or concrete.
Noise	
Construction Phase Increasing of noise levels are expected because of transportation of materials and equipments, excavations, land movement and workers concentration. This may cause: i) health problems by noise exposition; ii) displacement of fauna; iii) disapproval of the community.	Mitigation measures comprise: i) work during day time; ii) to assure a good maintenance of heavy and light vehicles used; iii) use of hearing protection for workers.
Impacts on Superficial and Subterranean Waters	
Construction and operation phases Impacts on air quality are related to: i) generation of effluents that could possibly contaminate water streams; ii) changes in the physical-chemical water parameters due to the construction of the derived reservoir; cleaning of the vegetation in the reservoir area and the increase of the Estí river bed level; iii)	Mitigation measures comprise: i) to assure that the effluents generated comply with the national environmental legislation; ii) to clean the vegetation that can be submerged by the increase of the Estí river bed level; iii) monitor the environment in the area of Estí river; iv) evaluate

loss of ecological flow due to changes in the water level and hydrological regime.	the possibility of installing a distribution system of potable water to supply Las Colonias and De Higuerón inhabitants; v) develop infrastructure works to guaranty the water flow of Quebrada del Pueblo after the interception with the adduction channel.
Social and economical impacts	
Impacts on Available Land for economic activities	
Construction and operation phases Impacts on available land include: i) loss of farming area; ii) changes in territory ownership; iii) disapproval of the community due to the decrease of productive areas; iv) possible migratory movements due to the land purchase.	Mitigation measures comprise: i) to buy the impacted areas; ii) to keep the population informed about the construction and operation timeline; ii) to relocate the affected families (3 families).
Cultural inheritance	
Construction phase Impacts include: loss of possible archaeological site.	Mitigation measures comprise: i) instruct the workers about the possibility to find archeology materials and oblige them to inform the authorities about the archeological sites encountered.
Landscape visual quality	
Construction and operation phases Impacts are related to landscape modifications and possible disapproval of the community. Construction.	Mitigation measures include: i) to maintain the ways and roads clean; ii) establish a contract with the municipality to collect the trash and assure it is deposited in a landfill.
Isolation of Communities	
Construction and operation phases Some communities may be isolated. Other impacts refer to changes both on access infrastructure and traffic.	Mitigation measures include: i) construction of access infrastructure; ii) improvement of ways; iii) maintain the existing infrastructure of electricity, telecommunication and potable water.

Lorena hydroelectric power plant

Table D 2: Lorena's HPP Environmental Impacts and Mitigation Measures

Identified environmental impacts	Conclusions and Measures taken
Physical and Biotic Impacts	
Impacts on Biodiversity and Ecosystems	
Construction and Operational Phases: Impacts on flora and fauna are related to: i) suppression of vegetation; ii) impacts on the regional fauna dependent on the existent vegetation; iii) creation of physical barriers to the regional fauna; iv) modification of the local relief.	Mitigation measures comprise: i) to assure that only a small portion of vegetation is suppressed by adopting more sustainable practices; ii) to preserve the forests that does not directly affect the construction of the power plants and substations; iii) to develop a re-forestation program; iv) restoration of the altered relief before project's operation.
Impacts on Soil	
Construction and Operational Phases: Impacts on soil relate to: i) the removal and	Mitigation measures comprise: i) to limit to a minimum quantity the removal of organic soil; ii) to limit the

loss of organic soil for the construction of channel sections, power house and access ways to the dams and power house; ii) changes in the local relief; iii) reduction of the infiltration capacity and increase of superficial draining.	changes in the local relief by adopting more sustainable construction practices; iii) to restore the site relief in cases where it is considered possible; iv) to gather appropriately the organic soil removed in order to allow for its re-utilization.
Impacts on Superficial and Subterranean Waters	
Construction and Operational Phases: Contamination of water courses through the increase amount of suspended sediments;	Mitigation measures include: i) to avoid land and solid material movements towards water courses; i) to avoid gathering of land or other solid material close or inside water courses.
Social and Economic Impacts	
Impacts on Costumes	
Construction Phase Change on local costumes may occur during construction phase as there will be an increase in the number of foreign workers.	To organize annual workshops with the participation of construction workers with the purpose of instruct them on the need to observe and respect local costumes.
Impacts on Available Land for Economic Activities	
Construction and Operational Phases: There will be a loss of land used for agricultural and pasture activities.	The region is characterized by cattle feed farms. Families directly affected will be reallocated (2 families).

Prudencia hydroelectric power plant

Table D 3: Prudencias's HPP Environmental Impacts and Mitigation Measures

Identified environmental impacts	Conclusions and Measures taken
Physical and Biotic Impacts	
Impacts on Biodiversity and Ecosystems	
Construction and Operational Phases: Impacts on flora and fauna are related to: i) suppression of vegetation; ii) impacts on the regional fauna dependent on the existent vegetation; iii) creation of physical barriers to the regional fauna; iv) eutrofication of the area affected by the dam.	Mitigation measures comprise: i) to assure that only a small portion of vegetation is suppressed by adopting the more sustainable practices; ii) to preserve the forests that does not directly affect the construction of the power plants and substations; iii) removal of 33.3 hectares of vegetation to avoid eutrofication; iv) to monitor the regional fauna; v) to develop a re-forestation program.
Impacts on Soil	
Construction and Operational Phases: Impacts on soil are related to: i) the removal and loss of organic soil for the construction of channel sections, power house and access ways to the dams and power house; ii) changes in the local relief; iii) reduction of the	Mitigation measures comprise: i) to limit to a minimum quantity the removal of organic soil; ii) to limit the changes in the local relief by adopting more sustainable construction practices; iii) to restore the site relief in cases where it is considered possible; iv) to gather appropriately the organic soil removed in order to allow

infiltration capacity and increase of superficial draining.	for its re-utilization.
Impacts on Superficial and Subterranean Waters	
Construction and Operational Phases: Impacts on superficial and subterranean waters are related to: i) Contamination of water courses through the increase amount of suspended sediments; ii) Changes in the hydrologic cycle.	Mitigation measures include: i) to avoid land and solid material movements towards water courses; ii) to avoid gathering of land or other solid material close or inside water courses; iii) To maintain the ecological flow down the Cochea River.
Social and Economic Impacts	
Impacts on Costumes	
Construction Phase Change on local costumes may occur during construction phase as there will be an increase in the number of foreign workers.	To organize annual workshops with the participation of construction workers with the purpose of instruct them on the need to observe and respect local costumes.
Impacts on Available Land for Economic Activities	
Construction and Operational Phases: There will be a loss of land used for agricultural and pasture activities.	The region is characterized by cattle feed farms. Families directly affected will be reallocated.

The implementation of the measures highlighted by the EIAs (both for more significant and less significant impacts) will be monitored by ANAM.[102] Besides the negative impacts highlighted at the PAMAs, the implementation of DMHP will generate positive impacts on the local economy by creating employments and improving income generation.

SECTION E. Stakeholders' comment

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

Stakeholder consultation for the Dos Mares Complex was conducted in a three stage process in order to comply with both national environmental law and CDM specific rules. This wide consultation process assures an effective participation of local stakeholders, guaranteeing that all comments and queries received are treated in a transparent way.

First stakeholder consultation Phase: EIA Consultation

First stakeholder consultation process for the individual hydropower plants was conducted as required by the Executive Decree no 59 from March 16th 1998 during the approval process of the Environmental Impact Assessments (EIA) for each of the three hydro power plants: Gualaca, Prudencia and Lorena.[103] The Executive Decree states in article 2 that the required Public Forum is "An instance for citizen participation organized by

[102] For further information on environmental monitoring activities, please refer to ANAM's Inspection Protocols (Protocolos de Inspección de ANAM). These documents have been provided to the DOE during Validation.

[103] The Environmental Impact Assessments have been carried on separately as they were concluded before the acquisition of Alternegy SA and Bontex SA by SUEZ Energy Central America (GSECA) in December 2007 and January 2008.

the Project Developer during the revision of the Environmental Impact Assessment in a date established by the National Environmental Authority (ANAM), in which everyone interested in knowing about the study or interested in commenting on it is invited to attend."

According to Article 10 of the Executive Decree, Project Developers shall facilitate access to project information and to the full text of the EIA to all participants, and provide the necessary means for the audit, inspection and enforcement by the ANAM and the related Sectorial Environmental Units.

In accordance with these rules, after concluding the Gualaca's project EIA in August 2004, audiences were conducted in a local theater ("*Anfiteatro del Cuartel de Bomberos de Gualaca*" – Gualaca District) for local stakeholders on May 19, 2005, with the authorization and regulation of ANAM, represented by Cynthia Sanchéz, Eneida Palma (both from the Department of Environmental Protection of ANAM at Chiriqui) and Edgar Arauz (Regional ANAM Administrator).

The same process conducted for Gualaca was also applied for Lorena and Prudencia. After the finalization of the EIA of Lorena in August 2005, audiences were conducted for local stakeholders at the Province of Chiriquí (District of David, *Rancho Comunal, Plaza de Bijagual*) on October 13, 2005, with the authorization and regulation of ANAM , represented by Cynthia Sanchéz and Gilberto Samaniego (both from the Environmental Protection department of ANAM at Chiriquí).

The forum for Prudencia occurred on October 15, 2005 (EIA finalized in August 2005) and took place in the Province of Chiriquí (District of David, *Rancho Comunal, Plaza de Bijagual*), with the authorization and regulation of ANAM, represented by Gilberto Samaniego and Eneida Palma (both from the Environmental Protection department of ANAM in Chiriquí).

By complying with all the Regulatory demands, which includes stakeholder consultation in the approval process and definition mitigation measures for each of the highlighted environmental impacts, the EIAs of Gualaca, Lorena and Prudencia projects were, as previously mentioned, approved by ANAM as indicated in the following documents: "*Resolución Dinedora IA-007-2006*" for Gualaca's EIA, "*Resolución Dineora" IA-083-06*" for Lorena's EIA, and "*Resolución Dineora IA-099-2006*" for Prudencia's EIA.

It is important to note that the EIA approval process (and by consequence, the stakeholders consultation process) is part of the steps required for the Letter of Approval issued by Panama's Designated National Authority (DNA).[104]

The invitation for the forum of Gualaca Power Plant was made through one of the most important local newspaper in the region, *La Estrella de Panama*. Local residents and representatives were also informed through posters placed in public places in the governmental facilities of the Gualaca City and governmental and non-governmental representatives were formally invited by mail. This forum occurred in Gualaca District and counted with the participation of 75 people, including representatives of governmental agencies, non-governmental organizations and local community.

For the forums of Lorena and Prudencia Project Activities the invitations were also made trough announcements in local newspaper (*La Prensa*). These Public forums occurred in David District and counted with the participation of approximately 300 people each, including representatives of governmental agencies, non-governmental organizations and local community.

[104] For more details on the Panamanian DNA approval process, please refer to: http://www.anam.gob.pa/index.php?option=com_content&view=article&catid=35%3Accp&id=80%3Aaprobacion-local&lang=en (last visited on May 11, 2010).

Second stakeholder consultation Phase: Local Foruns

As part of the GDF-SUEZ policy of involving the community and local authorities in the decision making process, local independent forums were held to consult and to inform the population on the implementation of the Dos Mares Hydro Complex.

People from the local communities and authorities were invited to participate and were allowed to comment on the project. During these forums, representatives from GDF SUEZ showed presentations that included social, healthy and security activities conducted in the development of the project by GDF SUEZ for the local communities. Subjects such as project technical details, social benefits, environmental impacts mitigation, CDM (including global warming, emission reductions and Kyoto Protocol), water resources, and employment among others were also discussed in the presentations.

Along with the presentations, informative fliers were also distributed as part of this consultation phase.

Below there is a list of the local forums conducted in the second Phase of the Dos Mares stakeholder consultation process:

- First local forum in Gualaca: 30 May 2008 ;
- Second local forum in Gualaca 18 June 2009;
- First local forum in El Valle: 28 de Octubre de 2008;
- Second local forum in El Valle: 15 de Octubre de 2009.

Third stakeholder consultation Phase: General Informative Presentation

Further, a third phase of local stakeholder consultation was conducted in order to ensure the broad and continuous stakeholder participation during the development of the Dos Mares CDM Project. This phase was also a way of keeping transparency in the CDM process development by including specific information about Kyoto Protocol, Emission Reductions and the Dos Mares CDM validation process.

The invitations were made by letters sent to local inhabitants, governmental institutions, non-governmental associations, among others, inviting them to analyze and comment on the Dos Mares Project as a CDM project activity. A special presentation was prepared and made available in internet and in case people could not have internet access, physical copies of the presentation were sent.[105]

E.2. Summary of the comments received:

During all phases of the stakeholder consultation made before (phase 1) and during the construction of the Dos Mares Hydro Complex (phases 2 and 3) public opinion showed to be predominantly positive. As an example of these concerns is the extensive work that is being done to ensure better life conditions to local people by conducting some activities such as:

- Improvement of potable water access;
- Donations to local health center and to other social institutions (such as schools and churches)

[105] Copies of the invitation letters sent as well as copy of the presentation sent is been made available to the auditors. Receiving confirmations containing signatures of the stakeholders consulted (or representatives of consulted institution) were also made available to the auditors.

- Installation of solar panels in a isolated communities;

Nevertheless some comments were received reflecting people's concerns about the project and its implementation.[106] Below a summary list of the issues raised over the stakeholder consultation process, separated by topic.

Economy concerns:

- Some people have pointed their wishes to receive electricity tariff reduction (incentives);
- Stakeholders were concerned about the possible negative impacts on tourism, agriculture and fishing reduction;
- It has been required y that employment of local workers should be maximized;
- Concerns about energy production destination (internal market or exportation) and the benefits to the country as a result of project's implementation.

Social and health concerns:

- Villagers and other people consulted were concerned about the disturbance caused in the local communities by the activities related to projects implementation: noise, dust, speed of trucks and vehicles and roads damages;
- Some communities are concerned by the discontinuous supply of water due to local networks deficiencies.

Environmental concerns:

- People have requested vegetation recovering when the construction is concluded; Stakeholders have manifested their concerns on the possibility of reduction on river natural flows when project becomes operational;
- Concerns were raised about impacts on natural life.

Other concerns:

- Some stakeholders emphasized the need to be periodical informed about the progress of the project and the inconveniences that may be faced during the construction period;
- People would also like to be informed by the authorities about the utilization of the taxes and contributions to be collected as a result of project implementation.

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

Following the provisions of VVM paragraph 128 (b), Questions presented during the three stakeholder consultation's phases were answered during the forums in which they were presented and in case comments were received by letters, answers were prepared and delivered to the stakeholders by letters as well.

Actions were also taken in order to addressed people's needs and mitigate the project's impact on their lives. The actions that have been taken to respond the comments include: [107]

[106] Official documents issued by ANAM with the details about the Forums (including a summary of the comments received) are being made available to the auditors during the Validation process. Comments received in other phases of the stakeholder consultation were also made available to the auditors.

[107] Several others mitigation activities are also being carried out and are addressed in Section D of the PDD.

- To collaborate on a best effort basis in the improvements of the water distribution systems of several communities of the region: Gualaca, Higuerón, El Valle, Chiriquí. A relevant improvement has already been performed at Gualaca;
- To monitor that the civil works contractor hires as much local people as possible;
- To perform a specific study about the vulnerable and handicapped people that could be temporally disturbed during the construction works;
- To hold periodical Forums during the construction period.

As previously explained, all questions addressed to the Project Participants during the local stakeholder consultation were answered. The most critical concerns and questions are listed in Section E.2 and detailed answers, with proper confirmation of mail receipt will be provided to the DOE during validation.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The proposed project activity will not receive any public funding.

Annex 3

BASELINE INFORMATION

OM and BM Assumptions

All tables presented in this section can be found in the EF calculation spreadsheet supplied to the auditors together with the PDD.

1) Low cost/must run percentage determination for simple adjusted OM calculation choice:

Table 1.1: Energy generated by source from 2005 to 2009

ENERGY SOURCES	2005	2006	2007	2008	2009	Total 2005-2009
Hydro[1] (MWh)	3,417,575.70	3,196,820.11	3,323,637.65	3,712,262.50	3,588,368.03	**17,238,663.99**
Thermal[1] (MWh)	1,670,937.37	1,827,990.53	2,193,534.35	1,849,780.79	2,387,218.41	**9,929,461.45**
ACP [2] (MWh)	457,873.75	705,699.56	638,611.85	609,294.60	662,837.75	**3,074,317.51**
Import (EOR) [1] [3] (MWh)	54,928.51	34,393.13	8,735.89	105,036.85	64,328.21	**267,422.59**
Total (MWh)	5,601,315.33	5,764,903.33	6,164,519.74	6,276,374.74	6,702,752.40	**30,509,865.54**
Export[3] [4] (MWh)	106,290.00	83,410.00	124,960.00	31,500.00	95,164.18	**441,324.18**

Source:

[1] Monthly Energy Generation for the years 2005, 2006, 2007, 2008 and 2009: http://www.cnd.com.pa/publico/mostrararchivosanual.php?despacho=GeneracionMensual&titulo=GENERACION MENSUAL

[2] ACP is a self -generator with thermal and hydro power plants and as a self generator, it is only allowed to sell surplus of electricity. For that reason, to be conservative in the calculations, electricity originated by ACP was considered to be electricity imports: see Plan de Expansion Interconectado Nacional 2007-2021 of October 15, 2007" – TOME II – Plan indicative de generación – Capitulo 5.4 par.2 p.127-128/461

[3] Annual Reports (INFORME DE LA OPERACIÓN DEL SISTEMA Y DEL MERCADO MAYORISTA DE ELECTRICIDAD) at: http://www.cnd.com.pa/publico/mostrararchivosanual.php?despacho=CndAnual&titulo=ANUAL DEL CND
2005: INFORME DE LA OPERACIÓN DEL SISTEMA Y DEL MERCADO MAYORISTA DE ELECTRICIDAD AÑO 2005 ; page, 12 Resumen Estadístico
2006:INFORME DE LA OPERACIÓN DEL SISTEMA Y DEL MERCADO MAYORISTA DE ELECTRICIDAD AÑO 2006; page 9 Resumen Estadístico
2007: INFORME DE LA OPERACIÓN DEL SISTEMA Y DEL MERCADO MAYORISTA DE ELECTRICIDAD AÑO 2007, page 35 Resumen Estadístico
2008: INFORME DE LA OPERACIÓN DEL SISTEMA Y DEL MERCADO MAYORISTA DE ELECTRICIDAD AÑO 2008; page 27 Resumen Estadístico

[4]As Annual Report for 2009 is not available up to the moment, souce for Export Electricity in 2009 was spreadsheet :
http://www.cnd.com.pa/publico/mostrararchivosanual.php?despacho=ExportacionImportacion&titulo=EXPORTACION%20E%20IMPORTACION

Table 1.2:LC/MR for Simple Adjusted OM calculation

	2005	2006	2007	2008	2009	Total 2005-2009
Low-cost/must-run [1]	3,930,377.96	3,936,912.80	3,970,985.38	4,426,593.95	4,315,533.99	11,838,276.15
Thermal	1,670,937.37	1,827,990.53	2,193,534.35	1,849,780.79	2,387,218.41	9,929,461.45
Total	5,601,315.33	5,764,903.33	6,164,519.74	6,276,374.74	6,702,752.40	21,767,737.60
Percent LC/MR	70.17%	68.29%	64.42%	70.53%	64.38%	**68.29%**

Source:

[1] Hydroelectric power generation and electricity imports (including ACP): $EF_{EL,k,y}$=0

2) Commercial operations start year, installed capacity and electricity dispatched to the SIN on 2007, 2008 and 2009

Table 2.1: Hydro power units.

Unit	CND Code [2]	Commertial Operations Start Year [1]	Owner [3]	2007		2008		2009	
				Installed Capacity [1] (MW)	Electricity Generated [2] (MWh)	Installed Capacity [1] (MW)	Electricity Generated [2] (MWh)	Installed Capacity [1] (MW)	Electricity Generated [2] (MWh)
FORTUNA			Enel Fortuna						
Fortuna 1	FOR1	1984		100.00	448962.73	100.00	582564.77	100.00	598108.77
Fortuna 2	FOR2	1984		100.00	496346.06	100.00	585379.80	100.00	599673.52
Fortuna 3	FOR3	1984		100.00	490484.83	100.00	588589.03	100.00	605578.26
BAYANO			AES Panamá						
Bayano 1	BAY1	1976 refurbished in 2003		87.00	223532.34	87.00	190597.05	87.00	178121.97
Bayano 2	BAY2	1976 refurbished in 2004		87.00	227266.69	87.00	192610.15	87.00	173371.27
Bayano 3	BAY3	November 2002		86.00	238921.69	86.00	200496.80	86.00	173739.23
LA ESTRELA									
La Estrella 1	EST1	1978		21.00	135157.24	21.00	129145.75	21.00	102786.54
La Estrella 2	EST2	1979		21.00	108993.23	21.00	140916.84	21.00	143744.53
LOS VALLES									
Los Valles 1	VAL1	1979		24.00	155979.63	24.00	161267.14	24.00	150373.83
Los Valles 2	VAL2	1979		24.00	139552.97	24.00	145601.92	24.00	128743.74
YEGUADA (1-3)	YEGUADA	unit (1):1967; unit (2):1967; and unit (3): 1973	ESEPSA	7.00		7.00	33827.83	7.00	26967.72
DOLEGA (1-4)	DOLEGA	1937 refurbished in 2000	EDECHI	3.12	17427.78	3.12	17297.42	3.12	15963.53
MACHO DE MONTE	M.MONTE	1938 refurbished in 2002		2.40	12645.41	2.40	11364.19	2.40	10510.93
HIDRO PANAMÁ (ANTON 1-12)	PANAMA	1999	Hidro Panamá	2.80	2558.53	2.80	16452.64	2.80	25469.92
HIDRO CANDELA	CANDELA	2006	Café de Eleta	0.55	2151.89	0.55	2657.17	0.55	1698.12
ISTIMUS/ CONCEPCIÓN (1-2)	ISTMUS	2008	Istimus	0.00	0.00	10.00	41784.01	10.00	55444.17
ESTÍ			AES Panamá						
Estí 1	esti 1	November 2003		60.00	314102.00	60.00	330426.90	60.00	302870.88
Estí 2	esti 2	November 2003		60.00	309554.63	60.00	341283.10	60.00	295201.09
TOTAL HYDRO				785.87	3323637.65	795.87	3712262.50	795.87	3588368.03

Sources:

[1] Ministry of Finance and Economy; Estatistics: http://www.mef.gob.pa/cope/cee/cee_ge/c_ge.htm
Installed capacity by CND: http://www.cnd.com.pa/publico/documentos/capacidad_instalada.pdf

[2] CND monthly report (Net Electricity Dispached to the Grid by unit): http://www.cnd.com.pa/publico/mostrararchivosanual.php?despacho=GeneracionMensual&titulo=GENERACION MENSUAL

[3]Ministry of Finance and Economy; Estatistics: http://www.mef.gob.pa/cope/cee/cee_ge/c_ge.htm
Installed capacity by CND: http://www.cnd.com.pa/publico/documentos/capacidad_instalada.pdf
Annual Report CND 2008 pages 44-46 and 69: http://www.cnd.com.pa/publico/mostrararchivosanual.php?despacho=CndAnual&titulo=ANUAL DEL CND

Legend:

Additional information/sources in comments inside EF calculation Spreadsheet supplied to the auditors along with the PDD

Table 2.2: Thermal power units.

Unit	CND Code [2]	Year Construcition [4]	Fuel Type [3]	Owner [5]	2007		2008		2009	
					Installed Capacity [1] (MW)	$EG_{m,y}$ - Net Electricity Generated [2] (MWh)	Installed Capacity [1] (MW)	$EG_{m,y}$ - Net Electricity Generated [2] (MWh)	Installed Capacity [1] (MW)	$EG_{m,y}$ - Net Electricity Generated [2] (MWh)
BAHIA LAS MINAS										
Bahia Las Minas 2	BLM2	1969	Bunker (Residual Fuel Oil)		40.00	184,383.26	40.00	127,484.00	40.00	18,199.89
Bahia Las Minas 3	BLM3	1972	Bunker (Residual Fuel Oil)		40.00	172,243.26	40.00	117,459.22	40.00	110,761.76
Bahia Las Minas 4	BLM4	1974	Bunker (Residual Fuel Oil)	Bahia Las Minas Corp	40.00	152,744.36	40.00	85,696.78	40.00	91,775.12
John Brown 5 (single cycle)	JB5	1988	Diesel Marine		33.00	1,419.44	33.00	2,085.68	33.00	1,948.70
John Brown 6 (single cycle)	JB6	1988	Diesel Marine		33.00	339.49	33.00	694.56	33.00	1,642.30
Bahia Las Minas 8 (single cycle)	BLM8	1998	Diesel Marine		34.00	10,142.77	34.00	5,469.36	34.00	7,106.66
Ciclo Combinado	Ciclo	Gas turbines on 1998 and Comb. Cycle on 2000	Diesel Marine		160.00	544,456.50	160.00	310,196.85	160.00	344,317.26
COPESA	COPESA	1998	Diesel	COPESA	46.00	64,345.52		72,065.04		15,707.22
PAN-AM	PAN_AM	January 2000	Bunker	PAN-AM Generating	96.00	678,215.89	96.00	629,783.26	96.00	662,821.43
IDB/CATIVÁ (1-10) [4]	IDB	2008	Bunker (Residual Fuel Oil)	IDB- Inversiones y Desarrollos Balboa	-	-	43.50	69,594.87	87.00	488,573.86
TG PANAMÁ	EGESA	1983; refurbished in 2007	Diesel Light	AES until 2006; EGESA after 2007	40.00	4,275.16	40.00	15,987.38	40.00	18,728.99
TERMICA CARIBE/El GIRAL (1-8)	T_caribe	2009	Bunker (Residual Fuel Oil)	Térmica del Caribe	-	-	-	-	50.40	126,788.02
GENA/CATIVÁ II/ TERMOCOLON	GENA	2009	Bunker (Residual Fuel Oil)	GENA- Generadora del Atlántico	-	-	-	-	130.00	61,723.40
PACORA	PACORA	January 2003	Bunker	Pedregal	54.00	380,968.70	54.00	413,263.79	54.00	437,123.81
TOTAL THERMAL					516.00	2,193,534.35	513.50	1,849,780.79	737.40	2,387,218.41

Sources:
[1] Ministry of Finance and Economy; Estatistics: http://www.mef.gob.pa/cope/cee/cee_ge/c_ge.htm
CND: http://www.cnd.com.pa/publico/documentos/capacidad_instalada.pdf
[2] CND monthly report (Net Electricity Dispached to the Grid by unit):
http://www.cnd.com.pa/publico/mostrararchivosanual.php?despacho=GeneracionMensual&titulo=GENERACION MENSUAL
[3] Ministry of Finance and Economy; Estatistics: http://www.mef.gob.pa/cope/cee/cee_ge/c_ge.htm
[4] Ministry of Finance and Economy; Estatistics: http://www.mef.gob.pa/cope/cee/cee_ge/c_ge.htm
Installed capacity by CND: http://www.cnd.com.pa/publico/documentos/capacidad_instalada.pdf
[5] Ministry of Finance and Economy; Estatistics: http://www.mef.gob.pa/cope/cee/cee_ge/c_ge.htm
Installed capacity by CND: http://www.cnd.com.pa/publico/documentos/capacidad_instalada.pdf
Annual Report CND 2008 pages 44-46 and 69: http://www.cnd.com.pa/publico/mostrararchivosanual.php?despacho=CndAnual&titulo=ANUAL DEL CND

Legend:
Additional information/sources in comments inside the cell in EF calculation Spreadsheet supplied to the auditors along with the PDD

3) Fuel data

Table 3.1 NCV and EF_{CO2}

Parameter	Fuel			Unit []
	Bunker C (Residual Fuel Oil)	Diesel Marine	Diesel Light	
NCV i,y : Net caloric Valure[1]	**36,514**	**33,515**	**32,684**	kcal/gal
	0.1529	0.1403	0.1368	GJ/gal
	0.0404	0.0371	0.0362	GJ/l
	40.3902	37.0728	36.1536	GJ/m3
$EFCO_2$ m,i,y : Emission Factor[2]	**75,550**	**72,600**	**72,600**	kg/TJ
	0.0755	0.0726	0.0726	tCO2/GJ

Source:
[1] Plan de Expansón del SIN 2009-2023, p. 182/461 - Cuadro N° 8.1
[2] 2006 IPCC Guidelines for National GHG Inventories, Vol.2 Energy, Stationary Combustion - Table 2.2 - lower 95% confidence interval
[Bunker C = Residual Fuel Oil; Diesel Marine/Light = gas/diesel oil]
Legend
Parameters from the cited references
Parameters with converted units from the original units (cells in green)

Table 3.2: Fuel consumption by plant on the years 2007, 2008 and 2009

Unit	CND Code [1]	Fuel Type [2]	Fuel Efficiency (Gal/MWh)[3]	FCi,m,y - Fuel Consuption [5] (Gal)		
				2007	2008	2009
BAHIA LAS MINAS						
Bahia Las Minas 2	BLM2	Bunker (Residual Fuel Oil)	86.07	15,869,867	10,972,548	1,566,464
Bahia Las Minas 3	BLM3	Bunker (Residual Fuel Oil)	80.58	13,879,362	9,464,864	8,925,183
Bahia Las Minas 4	BLM4	Bunker (Residual Fuel Oil)	81.62	12,466,995	6,994,571	7,490,685
John Brown 5 (single cycle)	JB5	Diesel Marine	64.83	92,022	135,215	126,334
John Brown 6 (single cycle)	JB6	Diesel Marine	64.83	22,009	45,028	106,470
Bahia Las Minas 8 (single cycle)	BLM8	Diesel Marine	64.83	657,556	354,579	460,725
Ciclo Combinado = (JB5, JB6, BLM8 and BLM 9, operating in combined cycle)	Ciclo	Diesel Marine	64.83	35,297,115	20,110,062	22,322,088
COPESA	COPESA	Diesel [4]	72.22	4,647,033	5,204,537	1,134,376
PAN-AM	PAN_AM	Bunker (Residual Fuel Oil)	59.66	40,462,360	37,572,869	39,543,927
IDB/CATIVÁ (1-10) [4]	IDB	Bunker (Residual Fuel Oil)	59.55	-	4,144,374	29,094,573
TG PANAMÁ	EGESA	Diesel light	109.14	466,591	1,744,863	2,044,082
TERMICA CARIBE/El GIRAL (1-8)	T_caribe	Bunker (Residual Fuel Oil)	60.69	-	-	7,694,765
GENA/CATIVÁ II/ TERMOCOLON	GENA	Bunker (Residual Fuel Oil)	55	-	-	3,394,787
PACORA	PACORA	Bunker (Residual Fuel Oil)	57.1	21,753,313	23,597,362	24,959,769

Sources:
[1] http://www.cnd.com.pa/publico/mostrararchivosanual.php?despacho=GeneracionMensual&titulo=GENERACION MENSUAL
[2] http://www.mef.gob.pa/cope/cee/cee_ge/c_ge.htm
[3] Fuel Efficiency =Rendimiento: Plan de Expansón del SIN 2009-2023; page 142, Table 1.3: Sistema de Generación Existente sin Pequeñas Centrales.
[4] Considered to be Diesel Light as a simplification (conservative approach)
[5] Calculated using Fuel efficiency information and electricity generation for each year.
Legend:
Additional information/sources in comments inside the cell in EF calculation Spreadsheet supplied to the auditors along with the PDD

Annex 4

MONITORING INFORMATION

Annex 5

INVESTMENT ANALYSIS INFORMATION

Table 5.1: Project Activity Cash Flow (Pre-Tax and Nominal Terms)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
CAPEX	-117,613	-159,710	-113,946																					
Volumes (GWh)					479	479	479	479	479	479	479	479	479	479	0	0	0	0	0	0	0	0	0	0
Monomic Price					105	105	105	105	105	105	105	105	105	105	0	0	0	0	0	0	0	0	0	0
PPA Sales			**0**	**0**	**50,162**	**50,162**	**50,162**	**50,162**	**50,162**	**50,162**	**50,162**	**50,162**	**50,162**	**50,162**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Volumes (GWh)			149	597	119	119	119	119	119	119	119	119	119	119	597	597	597	597	597	597	597	597	597	597
Spot Market - Energy Price			120	125	112	88	95	93	95	95	96	97	98	99	100	102	103	105	106	108	110	112	113	115
Spot Energy sales			**17,872**	**74,690**	**13,330**	**10,461**	**11,292**	**11,045**	**11,226**	**11,285**	**11,370**	**11,476**	**11,600**	**11,742**	**59,892**	**60,729**	**61,611**	**62,537**	**63,503**	**64,503**	**65,537**	**66,605**	**67,704**	**68,839**
Capacity sold (MW)			109	109	29	29	29	29	29	29	29	29	29	29	109	109	109	109	109	109	109	109	109	109
Spot Market - Capacity Price			11	11	8	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spot Capacity Sales			**3,474**	**14,103**	**2,830**	**1,915**	**972**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total Sales			**21,346**	**88,793**	**66,322**	**62,538**	**62,426**	**61,207**	**61,388**	**61,447**	**61,532**	**61,638**	**61,762**	**61,904**	**59,892**	**60,729**	**61,611**	**62,537**	**63,503**	**64,503**	**65,537**	**66,605**	**67,704**	**68,839**
Transmission Costs			-781	-3,176	-3,236	-3,298	-3,364	-3,431	-3,496	-3,562	-3,630	-3,699	-3,769	-3,841	-3,914	-3,988	-4,064	-4,141	-4,220	-4,300	-4,382	-4,465	-4,550	-4,636
Regulatory contribution			-213	-888	-663	-625	-624	-612	-614	-614	-615	-616	-618	-619	-599	-607	-616	-625	-635	-645	-655	-666	-677	-688
O&M			-1,923	-1,956	-1,993	-2,031	-2,071	-2,113	-2,153	-2,194	-2,236	-2,278	-2,321	-2,365	-2,410	-2,456	-2,503	-2,550	-2,599	-2,648	-2,699	-2,750	-2,802	-2,855
Variable costs			-160	-649	-661	-674	-687	-701	-714	-728	-742	-756	-770	-785	-800	-815	-831	-846	-862	-879	-895	-913	-930	-948
Total Costs			-3,077	-6,668	-6,554	-6,628	-6,747	-6,857	-6,977	-7,099	-7,223	-7,349	-7,479	-7,610	-7,723	-7,867	-8,014	-8,163	-8,316	-8,472	-8,631	-8,794	-8,959	-9,128
Gross Margin			18,269	82,124	59,768	55,911	55,679	54,350	54,411	54,348	54,309	54,289	54,284	54,294	52,169	52,862	53,597	54,373	55,186	56,031	56,906	57,812	58,745	59,711
SG&A			-1,026	-1,043	-1,063	-1,083	-1,105	-1,127	-1,148	-1,170	-1,192	-1,215	-1,238	-1,262	-1,286	-1,310	-1,335	-1,360	-1,386	-1,412	-1,439	-1,467	-1,494	-1,523
EBITDA			17,243	81,081	58,706	54,827	54,575	53,223	53,263	53,178	53,117	53,074	53,046	53,032	50,883	51,552	52,262	53,013	53,800	54,618	55,467	56,345	57,250	58,188
FCF	**-117,613**	**-159,710**	**-98,120**	**75,834**	**60,545**	**55,146**	**54,595**	**53,334**	**53,259**	**53,185**	**53,122**	**53,077**	**53,048**	**53,034**	**51,060**	**51,497**	**52,204**	**52,951**	**53,736**	**54,551**	**55,397**	**56,273**	**57,176**	**58,111**

2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
597	597	597	597	597	597	597	597	597	597	597	597	597	597	597	597	597	597	597	597	597	597	597	597	597	597
117	119	121	123	125	127	128	130	132	133	135	137	138	140	142	144	145	147	149	151	153	155	157	159	160	162
70,012	**71,212**	**72,441**	**73,699**	**74,797**	**75,731**	**76,676**	**77,633**	**78,601**	**79,582**	**80,576**	**81,581**	**82,599**	**83,630**	**84,674**	**85,731**	**86,801**	**87,884**	**88,981**	**90,091**	**91,216**	**92,354**	**93,507**	**94,674**	**95,855**	**97,051**
109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
70,012	**71,212**	**72,441**	**73,699**	**74,797**	**75,731**	**76,676**	**77,633**	**78,601**	**79,582**	**80,576**	**81,581**	**82,599**	**83,630**	**84,674**	**85,731**	**86,801**	**87,884**	**88,981**	**90,091**	**91,216**	**92,354**	**93,507**	**94,674**	**95,855**	**97,051**
-4,725	-4,814	-4,906	-4,999	-5,094	-5,191	-5,289	-5,390	-5,492	-5,597	-5,703	-5,811	-5,922	-6,034	-6,149	-6,266	-6,385	-6,506	-6,630	-6,756	-6,884	-7,015	-7,148	-7,284	-7,422	-7,563
-700	-712	-724	-737	-748	-757	-767	-776	-786	-796	-806	-816	-826	-836	-847	-857	-868	-879	-890	-901	-912	-924	-935	-947	-959	-971
-2,910	-2,965	-3,021	-3,079	-3,137	-3,197	-3,257	-3,319	-3,382	-3,447	-3,512	-3,579	-3,647	-3,716	-3,787	-3,859	-3,932	-4,007	-4,083	-4,160	-4,240	-4,320	-4,402	-4,486	-4,571	-4,658
-966	-984	-1,003	-1,022	-1,041	-1,061	-1,081	-1,101	-1,122	-1,144	-1,165	-1,188	-1,210	-1,233	-1,257	-1,280	-1,305	-1,330	-1,355	-1,381	-1,407	-1,434	-1,461	-1,489	-1,517	-1,546
-9,300	-9,475	-9,654	-9,836	-10,020	-10,206	-10,395	-10,587	-10,783	-10,983	-11,186	-11,394	-11,605	-11,820	-12,039	-12,262	-12,490	-12,721	-12,957	-13,198	-13,443	-13,692	-13,946	-14,205	-14,469	-14,737
60,712	61,737	62,787	63,863	64,777	65,525	66,281	67,046	67,818	68,600	69,389	70,188	70,995	71,810	72,635	73,469	74,311	75,163	76,024	76,894	77,773	78,662	79,561	80,469	81,387	82,314
-1,552	-1,581	-1,611	-1,642	-1,673	-1,705	-1,737	-1,770	-1,804	-1,838	-1,873	-1,909	-1,945	-1,982	-2,020	-2,058	-2,097	-2,137	-2,178	-2,219	-2,261	-2,304	-2,348	-2,392	-2,438	-2,484
59,160	60,156	61,176	62,221	63,104	63,820	64,544	65,275	66,014	66,761	67,516	68,279	69,050	69,828	70,615	71,411	72,214	73,026	73,846	74,675	75,512	76,358	77,213	78,076	78,949	79,830
59,080	**60,074**	**61,092**	**62,135**	**63,031**	**63,761**	**64,484**	**65,215**	**65,954**	**66,700**	**67,454**	**68,216**	**68,986**	**69,764**	**70,551**	**71,345**	**72,148**	**72,959**	**73,779**	**74,607**	**75,443**	**76,289**	**77,143**	**78,005**	**78,877**	**79,758**

IRR (nominal USD)	**13.4%**