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

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SECTION A. General description of project activity

A.1 Title of the project activity:

>>Apaqui run-of-river hydroelectric project
Version 6
October 2007

A.2. Description of the project activity:

>>The Apaquí project is a typical run-of-river project on Apaquí River. Although the design and permitted installed capacity is 45 MW, the operating production capacity level will be 36 MW producing an estimated 285 GWh/year. The present document details an evaluation carbon credit based on the licensed capacity of the power plant of 36 MW and estimated energy production transferred to the grid of 285 GWh/yr. Should the operating production of the power plant be increased in the future, no carbon credits will be claimed for the energy produced and transfer to the local grid in excess of the 285 GWh/yr.

The objectives of the Apaquí run-of-river hydroelectric project are to generate clean power, create employment, replace carbon intensive energy currently used and improve efficiency and competitiveness of Ecuadorian industry. The proposed project will result in emission reductions from the displacement of a combination of fossil fuel based capacity that would otherwise be generated and dispatched in Ecuador.

The proposed project activity is a renewable energy project in line with Ecuador's national policy of an optimum use of natural resources, which also includes a focus on reducing waste of energy. The project will hence contribute the sustainable development of Ecuador through:

- Use of local renewable energy resources (small hydro) to displace fossil fuel based power generation and thereby reduces CO_2 (carbon dioxide) emissions as well as associated emissions such as PM, SO_x and NO_x creating local and global air pollutants benefits.
- Contribute to the decline of diesel importation to Ecuador for electricity generation purposes.
- Adverse environmental impacts are limited. During the project impacts will be avoided and/or mitigated with a proper Environmental Management Plan and Emergency Response Plan.
- Generation 285 GWh of energy annually.
- The project will create specialized jobs for local entrepreneurs during the project construction as well as jobs for operators and maintenance crew during the operation of the power plant. Indirect jobs will also be created.
- No flooding is expected in the design of the plant hence the project will not emit methane (CH_4).
- The building that will be used to accommodate workers during construction will be donated to the local community.
- During the construction an infirmary for the workers will be set up. This infirmary will be available to local residents if an emergency occurs and the village hospital is too far to treat the emergency.
- Drinking water will also be made available to the local residents. At the present time drinking water is not available at the site of the project. Potable water will be made available for the project and by extent to the local residents.

The preliminary schedule for the Apaqui run-of-the-water hydroelectric plant can be found in Appendix 4. The starting date of the project is subject to change in light of bureaucratic procedures required for permitting and licensing of the project. The current stating date was readjusted for August the 15th, 2007.

A.3. Project participants:

>>

Name of party	Private and/or public entities project participants	Party wishes to be considered as project participant
Ecuador (Host)	Current Energy of Ecuador S.A.	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

>>

A.4.1.1. Host Party(ies):

>> Ecuador

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

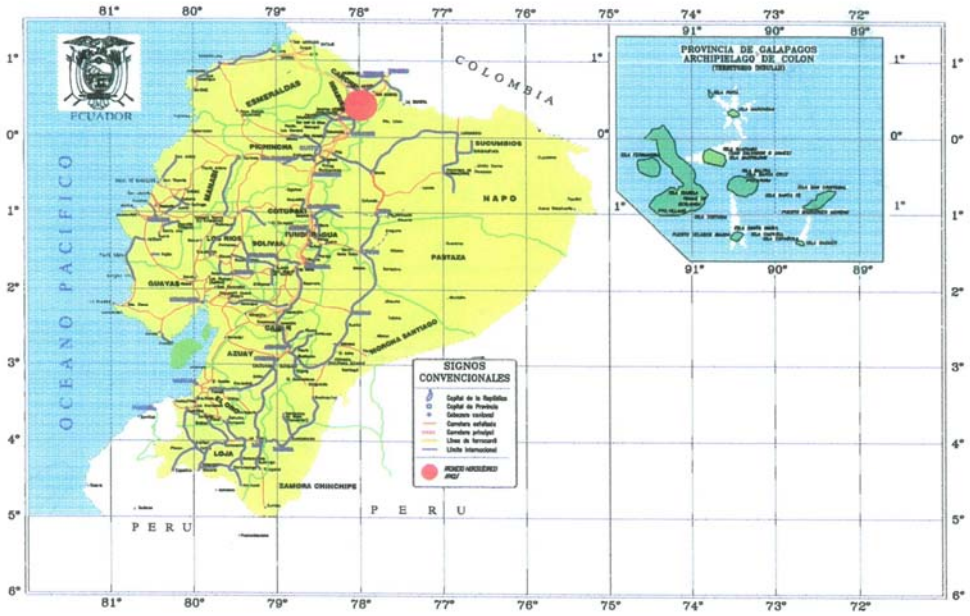
>> Carchi

A.4.1.3. City/Town/Community etc:

>> Pueblo de La Paz

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

>> The Apaquí Hydroelectric Project is located into the Province of Carchi, Region of Bolívar. A first order paved road unites the city of Quito with the zone of the project in the population of La Paz. From this point it is acceded by a way of third order, until the site of the Temple of La Paz and until the zone of the intake by a dirt road that will have to improve and to construct a branch of approximately 1,5 km.



The Apaqui power plant project is located at coordinates 0º 27´ 3´´ North and 77º 55´ 56.5´´ West

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

>> The project activity is a Greenfield run-of-river hydro power plant. The project activity falls in sectoral scope number 1: energy industries (renewable - /non-renewable sources) as per list of sectoral scopes (CDM- ACCR-06).

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

>> The Apaquí project is a typical run-of-river project that includes a derivation waterwheel, a sand separator of periodic washing, a tunnel of gravity conduction of 8.438 m of length, followed of a pressurized subterranean pipe of 708 m of length, a tunnel of pressure of 560 m length, a pressurized pipe 2,6 m in diameter and 1,124 m length, an open sky power house that lodges three generating units with Pelton type turbines with capacity of 15 MW each one, a substation of elevation of 13,8 to 138 kV, a 138 kV transmission line 14 km of length until the site of interconnection with the national system grid (SIN) and short sections of access roads to different works. The gross head of this power station is 580 m with a design flow rate of 9 m^3/s that will allow the installation of a maximum power of 45.000 kW. However, the production capacity level will remain at 36 MW producing an estimated 285 GWh/year. Initial estimations rate the power loss during transfer on the 14 km transmission line to be around 600 kW (200 kW on the line and 400 kW at the substations). The energy loss will be determined by measuring energy produced at Apaqui from the energy transfer to the grid.

The project activity includes the provision of the following offshore equipment:
- Pelton turbines
- Spherical valves
- Generators
- Electrical and mechanical auxiliary equipment
- Transformers;
- Circuit breakers
- Switches;
- Equipment of high tension;
- Transmission line structures, conductors, etc.

Specifications of the installed equipment

Turbines spec data

3 X 15MW horizontal, 3 Jets, Pelton turbines.

Wheel details: 1350 mm diameter; operating at 720 RPM

Efficiency (preliminary):

- at 100% load : 90.3 %,
- at 75 % load :90.7 %,
- at 50 % load : 90.2 %,
- at 25 % load: 89.3 %.

Unit flow: approximately 3.1 m^3/s.

Generator spec data

3 synchronous generators with extended shaft and reinforced bearings; operating at 720 RPM

Power factor: 0.9.

Operating voltage: 6.9 kV +/- 5 %.

Power flow: 16.5 MVA.

Type IP 23 air cooling

Efficiency (preliminary):

- at 100 % load : 97.0 %,
- at 75 % load : 96.5 %,
- at 50 % load: 95.4 %,
- at 25 % load: 93.5 %.

Equipped with

3 spherical ball valves DN 650 PN 64 with soft sealing

Lubrication system and cooling water system for the bearings only.

Digital speed governors: Hydro Mipreg DGC 600c for synchronous operation.

With automatic voltage regulation and hydraulic power unit.

The project will also involve the transfer of know-how since part of the engineering, installation and supervision, project management and construction supervision will be carried out by an internationally renown foreign company and local Ecuadorian firms. The table of content of the proposed training can be found in Appendix 4. The complete documentation will be made available during the verification phase.

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

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Years	Annual estimate of emission reductions in tonnes of CO_2e
March, 2010 –February 2011	188,120
March, 2011 –February 2012	188,120
March, 2012 –February 2013	188,120
March, 2013 –February 2014	188,120
March, 2014 –February 2015	188,120
March, 2015 –February 2016	188,120
March, 2016 –February 2017	188,120
March, 2017 –February 2018	188,120
March, 2018 –February 2019	188,120
March, 2019 –February 2020	188,120
Total estimated reductions (tonnes of CO_2e)	**1,881,200**
Crediting period	10 years
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	188,120

A.4.5. Public funding of the project activity:

>> There is no public funding.

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:

>> ACM0002 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources", version 6, 19 May 2006.

The approved baseline methodologies can be found at:
http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

The method itself can be found at: cdm.unfccc.int-method

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

>> This methodology was chosen because the project meets the applicability criterias:

- The Apaquí project activity is a grid-connected run-of-river power generation project, operating without any reservoir;
- The geographic and system boundaries for the relevant electricity grid (Ecuador) can be clearly identified and the information on the characteristics of the grid is available through official Ecuadorian agencies such as CONELEC (http://www.conelec.gov.ec/) and CENACE (CENACE.ORG.EC);
- The proposed project is not an activity that involves switching from fossil fuels to renewable energy at the site of the project activity;
- The last criteria of the methodology is met per default since the project does not involve *landfill gas activities* in any way.

The methodology was used in conjunction with the approved monitoring methodology as described in section B.4

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

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	Source	Gas	Included?	Justification/Explanation
BASELINE	Crude Oil	CO_2	Yes	As per methodology ACM0002/version 6
		CH_4	No	As per methodology ACM0002/version 6
		N_2O	No	As per methodology ACM0002/version 6
	Fuel Oil	CO_2	Yes	As per methodology ACM0002/version 6
		CH_4	No	As per methodology ACM0002/version 6
		N_2O	No	As per methodology ACM0002/version 6
	Diesel	CO_2	Yes	As per methodology ACM0002/version 6
		CH_4	No	As per methodology ACM0002/version 6
		N_2O	No	As per methodology ACM0002/version 6
	Naphtha	CO_2	Yes	As per methodology ACM0002/version 6
		CH_4	No	As per methodology ACM0002/version 6
		N_2O	No	As per methodology ACM0002/version 6
	Natural gas	CO_2	Yes	As per methodology ACM0002/version 6
		CH_4	No	As per methodology ACM0002/version 6
		N_2O	No	As per methodology ACM0002/version 6
	Hydro	CO_2	No	Carbon neutral
		CH_4	No	Carbon neutral
		N_2O	No	Carbon neutral
	Hydrocarbon residues	CO_2	Yes	As per methodology ACM0002/version 6
		CH_4	No	As per methodology ACM0002/version 6
		N_2O	No	As per methodology ACM0002/version 6
	Biomass	CO_2	No	Carbon neutral
		CH_4	No	Carbon neutral
		N_2O	No	Carbon neutral
PROJECT ACTIVITY	Run-of-river hydro	CO_2	No	Carbon neutral
		CH_4	No	Carbon neutral
		N_2O	No	Carbon neutral

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

>>>> As per approved consolidated baseline methodology ACM0002 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" the following is required:

- Demonstration of additionality as per version 03 of "Tool for the demonstration and assessment of additionality" available on the internet at
- "http://cdm.unfccc.int/methodologies/PAmethodologies/AdditionalityTools/Additionality_tool.pdf"
- Calculation of baseline: Since the Apaquí project activity does not modify or retrofit an existing generation facility, the baseline scenario is the following electricity delivered to the grid by the project 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 as per guidance provided in ACM0002/version 6, 19 May 2006 as described in section B.1.

Project boundary
1) Only CO_2 emissions from the electricity generation in fossil fuel fired power that is displaced due to the Apaquí project activity.

2) Spatial extent of the project boundary is Ecuador's national grid.
The project electricity system is Ecuador's national grid. The power plants of this grid are all connected and can be dispatched without significant transmission constraints.

Baseline
The baseline emission factor (EF_y) is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors.

STEP 1 Calculation of the Operating Margin emission factors ($EF_{OM,y}$)

The calculation of the Operating Margin emission factors ($EF_{OM,y}$) are based on one of the four following methods:
(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch Data Analysis OM, or
(d) Average OM.

Dispatch data analysis should be the first methodological choice however the information to use this method is unavailable.

The Simple OM method can only be used where the low-cost/must-run resources[1] constitute less than 50 % of the total grid generation in : 1) average of the five most recent years, or 2) based on long-term normals for hydroelectricity production.

The average emission rate method can only be used where low-cost/must run resources constitute more than 50% of the total grid generation and detailed data to apply the simple adjusted OM is not available and where detailed data to apply the dispatch data analysis OM is unavailable.

The Simple adjusted OM was selected since more than 50% of the total grid generation in Ecuador is constituted of low-cost/must run resources (CONSEJO NACIONAL DE ELECTRICIDAD).

The simple-adjusted OM factors will be calculated using (ex-ante) the full generation-weighted average for the most recent 3 years based on the most recent statistics available today.

[1] Low operating cost and must run resources typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation.

The simple adjusted OM emission factor ($EF_{OM,\ simple\ adjusted,\ y}$) is calculated as the generation-weighted average emissions per electricity unit (tCO_2/MU) of all generating sources serving the system, where the power sources (including imports) are separated in low-cost/must-run power sources (k) and other power sources (j):

$$EF_{OM,simple_adjusted,y} = (1-\lambda_Y) \bullet \frac{\sum_{i,j} F_{i,j,y} \bullet COEF_{i,j}}{\sum_{j} GEN_{j,y}} + \lambda_Y \bullet \frac{\sum_{i,k} F_{i,k,y} \bullet COEF_{i,k}}{\sum_{k} GENk_{k,y}}$$

where,
$F_{i,j,y}$ is the amount of fuel i consumed by relevant power sources j in year(s) y;
$F_{i,k,y}$ is the amount of fuel i consumed by relevant power sources k in year(s) y;
$GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source j;
$GENk_{k,y}$ is the electricity (MWh) delivered to the grid by source k;

$COEF_{i,j,y}$ is the CO_2 emission coefficient of fuel *i* (tCO_2/mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources *j* and the percent oxidation of the fuel in year(s) *y*. The following formula will be used as per ACM0002:

$$COEF_i = NCV_i \bullet EF_{CO2,i} \bullet OXID_i$$

$$\lambda_y = \frac{number\ of\ hours\ for\ which\ low-cost/must\ run\ sources\ are\ on\ marginal-run\ sources\ are\ on\ marginal}{8760\ hours\ per\ year}$$

STEP 2 Calculation of the Build Margin emission factor ($EF_{BM,y}$)
The Build Margin (BM) emission factor is calculated as the generation-weighted average emission factor (tCO_2/MWh) of a sample of power plants, as follows:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} * COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$

where $F_{i,m,y}COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described for the simple OM method for plants m.

Option 1 was chosen of the approved methodology to calculate de BM emission factor. The build Margin emission factor $EF_{BM,y}$ ex-ante was based on the most recent information available on plants already built for sample group *m* at the time of the PDD submission. The sample group *m* consists of the power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

STEP 3 Calculation of the baseline emission factor EF_y

The baseline emission factor is calculated as a weighted average of the Operating emission factor and the Build Margin emission factor:
$EF_y = w_{OM} * EF_{OM,y} + w_{BM} * EF_{BM,y}$

CORDELIM, a non-profit Ecuadorian organization created by Ecuador's National comity on climate, has established the emission factor for the Ecuadorian grid for 2003-2005 using the above-mentioned methodology. The complete document is available in Appendix 3 or on the Internet at http://cordelim.net/imagesFTP/108125.Emission_Factor_Ecuador_2003___2005__With_IPCC_2006_.pdf

The Operating Margin from 2003 to 2005 was calculated to 0,74673 tCO2/Mwh and the calculated Build Margin is: 0,57346 tCO2/Mwh.

The baseline emission factor is established at 0.66007 tonnes of CO_2/MWh.

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 proposed project will result in emission reductions from the displacement of a combination of fossil fuel based capacity that would otherwise be generated and dispatched in Ecuador.

As per the decision 17/cp.7 para 43, a CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the registered CDM project activity. As per methodology ACM0002, the project proponent is required to establish that the GHG emissions reductions due to the project activity are additional to those that would have occurred in the absence of the Apaquí project activity as per the latest version of the "Tool for the demonstration and assessment of additionality" as agreed by the CDM Executive Board. The version 3 labeled EB 29 was used in this case. Comparison with geothermal energy is irrelevant as no geothermal energy projects have been made in Ecuador (CONSEJO NACIONAL DE ELECTRICIDAD)..

The following issues will be developed to demonstrate additionality:
- Identification of alternatives to the project activity;
- Barrier analysis to determine whether the proposed project activity faces barriers that prevent the implementation of the this type of proposed activity and do not prevent the implementation of at least one of the alternatives;
- Common practice analysis; and
- Impact of registration of the proposed project activity as a CDM project activity.

According to the additionality tool, the Apaquí project activity's additionality is demonstrated in the step-by-step approach below:

Step 1 – Identification of alternatives to the project activity consistent with current laws and regulations

Step 1 of the demonstration of additionality requires that realistic and credible alternatives to the project activity be presented. Three alternatives to the Apaquí project activity were identified.

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

Alternative 1 – Apaquí project activity: run-of-river hydroelectric project not undertaken as a CDM project activity

In this alternative, the Apaquí project activity is connected to the Ecuadorian grid; hence, displacing 36 MW of electricity of the grid's mix as this project activity has no project GHG emissions.

Current Energy Ecuador may implement the Apaquí project activity to generate and sell power to the grid without considering the CDM component of the project. Nevertheless, as it will be developed in step 2 the project without the carbon credits would not be financially appealing to the investors.

Alternative 2 – Thermal power plant project.

In this alternative the project developer chooses to build a thermal power plant to generate the same quantity of electricity as the Apaquí power project.

Alternative 3 – Continuation of the current situation – no project activity

In this alternative the Apaquí project does not happen resulting in the continued grid mix of the northern grid i.e. there is no displacement of electricity in the grid mix.

Sub-step 1b. Enforcement of applicable laws and regulations:

All three alternatives are in compliance with all applicable legal and regulatory requirements.

Step 2 – Investment analysis
This step is not used as step 3 was chosen for analysis.

Step 3 – Barrier analysis

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

Apaquí and other similar projects in Ecuador are currently facing investment barriers due to the financial crisis of Ecuador's electrical sector.

1. Business risk in Electricity generation due to late or partial payments from distribution companies.

Distribution companies comprise most of the demand in Ecuador. Distribution companies have not fully honoured payment contracts with generation companies for the energy acquired on the Wholesale Electricity Market. According to a CENACE report[2], during the period of April 1999 to September 2003, the total debt of Ecuadorian distribution companies to the Wholesale Electricity Market (MEM) including legal interests and penalties was over 984 million dollars. This debt can be explained through two realities:

a) Technical and non-technical energy losses.
According to CONELEC's 2005 statistics (available online at http://www.conelec.gov.ec/downloads/Estadistica_05_pdf.zip), during 2005 total distribution losses in Ecuador were of 23.87 % of which 10.10 % are due to technical losses and 13.77 are due to non-technical losses. Table B.1 shows the monthly losses for 2005.

Table B.1 Distribution company monthly losses in 2005

Month	Available to distributor (MWh)	Total technical losses (MWh)	Total technical losses (%)	Total non-technical losses (MWh)	Total non-technical losses (%)	Total distributor loss (MWh)	Total distributor loss (%)
Jan	1,058,602	107,081	10.12	158,605	14.98	265,685	25.1
Feb	943,787	91,262	9.67	95,716	10.14	186,978	19.81
March	1,062,742	108,243	10.19	166,735	15.69	274,977	25.87
April	1,068,170	108,942	10.2	164,529	15.40	273,471	25.6
May	1,057,301	107,759	10.19	149,370	14.13	257,129	24.32
June	1,010,728	100,993	9.99	116,004	11.48	216,997	21.47
July	1,022,581	103,307	10.1	147,036	14.38	250,343	24.48
Aug	1,029,592	104,903	10.19	142,115	13.8	247,018	23.99
Sept	1,017,699	101,098	9.93	129,574	12.73	230,672	22.67
Oct	1,014,885	102,770	10.13	126,929	12.51	229,699	22.63
Nov	997,286	100,221	10.05	133,402	13.38	233,623	23.43
Dec	1,063,644	109,897	10.33	170,400	16.02	280,297	26.35
Total	**12,347,016**	**1,246,475**	**10.1**	**1,700,414**	**13.77**	**2,946,889**	**23.87**

Source: CONELEC 2005 statistics

The non-technical losses generally come from problems at the administrative and managerial levels of distributions companies.

b) Low collection rates of distribution companies

Distribution companies in Ecuador have low collection rates. They do not always obtain full payment from their clients. Table B.2 shows the collections rates for different distribution companies.

[2] CIERRE DE CUENTAS DEL MERCADO ELÉCTRICO MAYORISTA, PERÍODO ABRIL 1999 – SEPTIEMBRE 2003, diciembre 2005

Table B.2 Collection rates by distribution company, 2005

Company	Collection (%)
Ambato	99
Azogues	100
Bolivar	100
Centro Sur	100
Cotopaxi	100
El Oro	10
Manabi	19
Norte	89
Quito	23
Riobamba	100
Sta. Elena	
Sur	7
Total	**64**

Source: CONELEC 2005 statistics

2. Lack of incentives for investment in energy generation by the private sector

The current situation regarding the late or partial payments of distribution companies to generation companies discourages private capital investment in energy generation projects. Without obtaining a governmental payment guaranties private investors are not willing to risk their capital in generation projects aiming to sell to the electricity market. The table B.3 below shows the collection rate of Ecuadorian generation companies for 2005.

Table B.3. Collection rates by generation companies in 2005

Company	Rate (%)
CATEG-G	59
Elecaustro	59
Electroguayas	35
Electroquil	51
EMAAP-Q	82
Hidroagoyán	94
Hidronación	57
Hidropaute	33
Intervisa	54
Machala Power	63
Termoesmeralda	46
Termopichincha	42
Ulysseas	53
Total	**47**

Source: CONELEC 2005 statistics

3. Barriers to financing

Ecuadorian financial entities and multilateral banks see risks in the electrical sector of Ecuador due to the high debt rate of the distribution companies and their inability to pay generation companies. This creates an important barrier for obtaining long-term financing for power generation projects in Ecuador.

Power generation projects involve high capital costs, long return periods and 7 to 9 year credits even more so for hydroelectric projects. Local banks operate with a maximum of 5 years for their credits and do not grant sufficient long-term credits especially for power generation projects. Long-term financing from international source would be required for hydroelectric project. The country risk limits the Ecuadorian capacity to attract long-term-financing.

3a. Country risk

The Ecuadorian country risk can be measured by the sovereign rating of International Credit Rating Agencies. Table B4 compare Fitch current Ecuadorian sovereign rating with those of other Latin American countries as of January 2005. Rates for Fitch increase from D to A, also increasing from 1 letter to three letters (i.e. from A to AAA). It can be appreciated that Fitch rating are low for Ecuador.

Table B.4. Country sovereign rating

Country	LTFC	Outlook
Chile	A	Stable
Aruba	BBB	Stable
Mexico	BBB	Stable
El Salvador	BB+	Stable
Guatemala	BB+	Stable
Panama	BB+	Stable
Peru	BB+	Stable
Brazil	BB	Stable
Colombia	BB	Positive
Costa Rica	BB	Stable
Venezuela	BB-	Stable
Jamaica	B+	Stable
Uruguay	B+	Positive
Dominican Republic	B	Positive
Suriname	B	Stable
Bolivia	B-	Negative
Ecuador	B-	Negative

Country	LTFC	Outlook
Argentina	RD	N/A
France	AAA	stable
Germany	AAA	stable
USA	AAA	stable

Source: www.fitchratings.com

4. Prevailing practices are barriers

The prevailing practices of Ecuadorian distribution companies of non-payment or late-payments to generation companies slows investors to risk their capital in projects aiming to sell energy to the Ecuadorian electricity market.

5. Institutional barriers

The permitting and licensing bureaucratic processes for hydroelectric projects take more time than for thermal projects because of the hydrology involved. The permitting and licensing procedures add up delays and costs of the project, impacting of profitability and schedule of the project. The specific experience of the Apaqui project is a good example of delays on schedule due to administrative procedures.

6. Hydrological risk

Hydrology risk is present for the Apaqui since no reservoir is considered. Since there are no mitigation options to low inflow period, the project is fully exposed to meteorological and hydrological risks. Political risks also affect hydrological aspect of project. Public water usage for irrigation, human usage and flood-control might affect the Apaqui power project operations and profitability.

Sub-step 3b. Show that the identified barriers would not impede the implementation of at least one of the alternatives (exception of the proposed projects):

Hydro projects are more capital intensive, have larger up-front costs and longer recovery times than thermal projects. Also, they take longer to build and are subject to specific risks (geological for example). Therefore, they are more strongly impacted than thermal projects by the barriers described above. Some of the barriers (such as hydrological risk and long term financing) do not apply at all to thermal power generation project. The barriers identified in sub-step 3a would not impede the implementation of the alternatives 2 and 3 listed in sub-step 1.

Step 4 – Common practice analysis

Sub-step 4a. Analyze other activities similar to the proposed project activity

Ecuador has one of the highest hydraulic potential in Latin America. However, only around 10% of this potential is currently being used. High initial investment costs and long return periods of hydroelectric generation projects contribute to the lack of these projects in Ecuador. The difficult access to long-term credit and the financial problems facing hydroelectricity in Ecuador have caused the demand for electricity to be met by thermal and State-funded hydroelectric projects. According to CONELEC (CONSEJO NACIONAL DE ELECTRICIDAD), from 1996 to 2006, 961 MW of thermal generation have been added to the interconnected national system (SNI) as compared with 297 MW of hydroelectric generation corresponding to governmental initiatives or CDM projects. The following table shows the hydroelectric projects entirely financed through governmental public agency such as the national Fondo de Solidaridad, (Solidarity Fund) (http://www.fondodesolidaridad.gov.ec/) and the more regional CEDEGE (Comision de Estudios para el Desarrollo de la Cuenca del Rio Guayas y peninsula Santa Elena, http://www.cedege.gov.ec) . The project promoters for these projects are companies created and fully owned by those governmental funds. Further more, the activities of the CEDEGE are geographically limited to a specific part of Ecuador.

Table B.5 Hydroelectric project funded by governmental funding

Hydroelectric project	Year of start-up	Project promoter	Govermental fund used
Central Hidroeléctrica Marcel Laniado de Wind	1999	Hidronacion S.A.	CEDEGE
Central Hidroeléctrica Agoyán	1999	Hidroagoyán S.A.	*Fondo de solidaridad*

The company Hydropaute also received financing from the Fondo de Solidaridad governmental fund to build the Paute hydroelectric project in 1983. Hydropaute was a state-owned company at the time of the construction of the Paute project.

Projects initiated by private entreprise that managed to attract private investment to acquire the required financing were the projects that were recognized as CDM activities.

Table B.6 Hydroelectric project realized as CDM activity

Hydro project	Year of start-up	CDM activity?	Project promoter
Sibimbe	2006	Yes	Hidalgo & Hidalgo
Calope	2007	Yes	Enermax
Abanico	2006	Yes	Hidroabanico

The common practice for hydroelectric projects is therefore either:

- Complete funding from governmental fund (Solidarity fund or regional development fund)
- Private investment of CDM registered projects

Currrent Energy of Ecuador is a private company and cannot therefore benefit from governmental funding such as the Solidarity Fund. The Apaqui projected is not located within the zone of influence of the CEDEGE and cannot received funding by this governmental commission. The Apaqui project is operating with private investments.

Impact of CDM registration

Emission revenues are fundamental to the Apaquí project activity as they constitute a long-term contract for hard currency revenue stream from outside Ecuador mitigating country risk. The benefits and incentives derived from registration of the project as a CDM are:

- The project activity will reduce GHG emissions and atmospheric air pollution
- The flow of finances through CDM will help potential project profitability
- The CDM will improve the project's internal rate of return and improve compensation for potential project risks such as payments from distributors but also including hydrological, meteorological, political and administrative delays and procedures; this will then attract new investors.

Since all the above steps are satisfied, the Apaquí project activity is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

>>The UNFCCC/CCNUCC methodology ACM0002 is prescribed for the Apaqui power plant project in light of the project specifics:

- run-of-river hydro power plants
- connected to local grid
- new project / no existing installations
- geographic and system boundaries are clearly defined by national Ecuadorian grid system

ACM0002 suggest 4 different methodologies to calculate the OM:

The c) dispatch data analysis should be the first methodological choice if possible, but to use this methodology, ex post dispatch data are necessary. Unfortunately ex post dispatch data are not public available in Ecuador, hence this OM methodologies cannot be used.

The (a) simple OM methodology can only be used if the low-cost/most run resources (all renewable energy and the electricity import from Colombia) are less than 50 % of the total grid generation. In Ecuador the low-cost/must run resources are higher than 50 %, and therefore this methodology is not applicable.

The d) average OM methodology can only be used when there is no dispatch data from the last 3 years public available. In Ecuador these data are available and therefore the b) simple adjusted OM methodology is used.

b) Simple adjusted OM methodology

The Simple adjusted OM methodology used for the last three years the generation weighed average emissions per electricity unit (tCO2/MWh) of all generating sources serving the system, where the power sources – including imports – are separated in low-cost/must run power sources (*k*) and other power sources (*j*).

The Ecuadorian CDM agency CORDELIM has established the national 2003-2005 electricity generation emission factor based on the ACM0002 version 6 methodology, using the adequate simple adjusted OM methodology. This PDD directly uses the official national 2003-2005 emission factor.

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

Data / Parameter:	Ecuadorian CO_2 emission factor
Data unit:	Tonnes CO_2 /MWh
Description:	Emission factor for the Ecuadorian electricity grid (2003-2005)
Source of data used:	CORDELIM & Eco-Alianzas Estatégicsa Cia. Ltda.
Value applied:	0,66007
Justification of the choice of data or description of measurement methods and procedures actually applied :	CORDELIM has established the Ecuadorian 2003-2005 emission factor based on the methodology ACM0002/ver 6 of the UNFCCC/CCNUCC using the simple adjusted operating margin method. Recognised data from the 1996 revised IPCC guideline, the IPCC Good Practice Guidance and data from local agency (CONELEC, CENACE)
Any comment:	CORDELIM emission factor evaluation document is in Appendix 3 of this PDD and at http://cordelim.net/imagesFTP/108125.Emission_Factor_Ecuador_2003___2005__With_IPCC_2006_.pdf

Data / Parameter:	Net Energy transferred to the grid by Apaqui hydro power plant
Data unit:	MWh
Description:	Net annual energy transfer to the grid by Apaqui hydropower plant
Source of data used:	Current Energy of Ecuador S.A. project document
Value applied:	285 000
Justification of the choice of data or description of measurement methods and procedures actually applied :	Value based on engineering project evaluation.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

>>Since the project is a renewable power project there are no project emissions.

The baseline emissions were calculated at 0.66007 tonnes of CO_2/MWh as the approved consolidated methodology ACM0002 by Cordelim. Please refer to sub-step B.4 of the PDD.

As per the approved consolidated methodology ACM0002 no leakage emissions is expected.

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

>> These estimations are based on an annual power generation of 285 000 MWh.

Year	Estimation of project activity emissions (tonnes of CO_2e)	Estimation of baseline emissions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of overall emission reductions (tonnes of CO_2e)
2010-2011	0	188,120	0	188,120
2011-2012	0	188,120	0	188,120
2012-2013	0	188,120	0	188,120
2013-2014	0	188,120	0	188,120
2014-2015	0	188,120	0	188,120
2015-2016	0	188,120	0	188,120
2016-2017	0	188,120	0	188,120
2017-2018	0	188,120	0	188,120
2018-2019	0	188,120	0	188,120
2019-2020	0	188,120	0	188,120
Total (tonnes of CO_2e)	**0**	**1,881,200**		**1,881,200**

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

B.7.1 Data and parameters monitored:

Data / Parameter:	Net energy transfer to the grid by Apaqui hydropower plant
Data unit:	MWh
Description:	Net energy transfer to the grid by Apaqui hydropower plant
Source of data to be used:	Apaqui DCS control system / CONELEC control system
Value of data applied for the purpose of calculating expected emission reductions in section B.5	285,000 MWh annually. No additional carbon credit will be claimed for energy transferred to the grid above this value by the Apaqui power plant during any of the ten years of the project. The energy transferred to grid as measured by CONELEC/Apaqui will equal the energy produced by the power plant minus the energy loss during transmission on the 14 km transfer line.
Description of measurement methods and procedures to be applied:	Energy produced will be measured by power meter and DCS control system of the power plant.

QA/QC procedures to be applied:	Power meter will be calibrated and verified regularly. The value of the energy transferred to grid (after transmission loss) will be verified by CONELEC The calibration procedures will comply with CONELEC regulation 004/03, section 4 found at: http://www.conelec.gov.ec/downloads/normativas/REGULACION CONELEC - 004-03 SISTEMAS DE MEDICION COMERCIAL PARA LOS AGENTES DEL MEM.doc
Any comment:	Data, including but not limited to calibration registers, monitored values, maintenance log, etc., will be archived for a minimum period of two years after the end of the project life. Energy transfer is equal to energy produced minus transmission loss because of governmental objective of favouring renewable energy to meet the energy demand.

B.7.2 Description of the monitoring plan:

>> The objective of the monitoring plan is to enable APAQUI project activity to have a clear, credible and accurate set of monitoring, evaluation and verification procedures for greenhouse gas emission reduction.

The general conditions established for metering, recording, meter reading, meter inspections, tests and calibration and communication shall be as per the arrangement between the grid authority and Current Energy of Ecuador S.A.

As part of the refurbishing project, the Apaqui hydroelectric plant will be equipped with state of the art DCS control systems. These integrated systems will measure, record, report monitored and control key parameters such as total power generated and total power transferred to the grid.

The project activity's revenue is based on the energy units transferred to the grid as measured by the power meters at the battery limit of the Apaqui hydroelectric plant. These power meters will therefore perform the monitoring and verification. These meters will be calibrated and tested at regular intervals so that their accuracy can be validated. The calibration procedures will comply with CONELEC regulation 004/03, section 4 found at :http://www.conelec.gov.ec/downloads/normativas/REGULACION CONELEC - 004-03 SISTEMAS DE MEDICION COMERCIAL PARA LOS AGENTES DEL MEM.doc

The Apaqui power plant CDM project is based on a yearly energy production of 285 000 MWh. The carbon credits will be evaluated based on measured energy transferred to the grid, after transmission loss. No additional carbon credit will be claimed for energy produced above this value by the Apaqui power plant during any of the ten years of the project. The monitoring of the project will include the compliance of the project activities to this limit.

The local energy authority agencies (CENACE, CONELEC) publish yearly reports regarding the power generation within the boundaries of the study. Therefore, authentic data related to the power generation in the Ecuador grid is ensured. The reports made available by these agencies detail the required information for all type of generation like hydro and thermal installed within the boundaries of the study. This enables an accurate baseline calculation for a given year.

The general monitoring principles are based on:

- Frequency;
- Reliability;

- Registration and reporting.

Frequency of monitoring

Current Energy of Ecuador S.A. installations at Apaqui include metering equipment at battery limit. The measurements are recorded on a continuous basis through the integrated control system.

Reliability

The quantity of emission reduction is proportional to the net energy transferred from the project to the grid. The energy meter reading at battery limit is the final value from the project side. Theses metering instruments will be procured from reputed manufacturers and integrated to the control systems. The metering instruments will be calibrated as per manufacturer recommendations to insure reliability. A calibration registry will be maintained for these instruments to keep historical calibration information to document reliability.

Registration and reporting

The integrated DCS control system allows for on-line electronic data registration. Back-up and archives will be prepared as part of Current Energy of Ecuador S.A. data control procedures. By report type, daily, weekly and monthly generation reports are prepared. CONELEC grid authority also monitors the power transfer to the grid for validation.

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)

>> This baseline was completed in February 2007 by SNC-Lavalin Environment Inc
2271 Fernand-Lafontaine
Longueuil, Quebec
Canada J4G 2R7
Tel: 1- 450-651-6710
Fax:. 1-450-651-0885
E-mail: Jeanluc.allard@snclavalin.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:

>>August 15th , 2007

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

>> 50 years

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

10 years

C.2.1. Renewable crediting period

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

>> not applicable

C.2.1.2. Length of the first crediting period:

>> not applicable

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>> March, 1st ,2010

C.2.2.2. Length:

>> 10 years

SECTION D. Environmental impacts

>>

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

>>The environmental impact assessment suggests that globally the project has medium relative magnitude and a moderate intensity on the environment during the construction phase. During the operational phase it was established that the project has a low relative magnitude and low intensity, which means that in the area of direct influence minimal changes are expected and no special corrective measures are necessary to recuperate the conditions of the affected area. In this sense, the project is environmental viable with the implementation of mitigation measures.

In the construction phase the biotic, socioeconomic and cultural components are the most affected with a medium relative magnitude and moderate intensity while the physical component presents a medium relative magnitude and a low intensity. The infrastructure will have low magnitude and intensity.

In the operational phase the only component that will be negatively affected is the biotic component, which presented a medium relative magnitude and moderate intensity. This is due to the Apaquí river flow that will be reduced intermittently considering the direct area of influence.

The physical, infrastructure, socioeconomic and cultural components were qualified as receiving positive impacts from the Apaquí project.

To mitigate the negative impacts, an environmental management plan was elaborated as a guide to fulfill with the principles of conservation, improvement, defense of natural resources during the construction and operational phases. Current Energy of Ecuador S.A. is responsible for the implementation of all the programs of the Environmental Management Plan under the direct supervision of CONELEC (Ecuador's National Electrical Council).

The Environmental Management Plan of Apaquí project seeks:
- to assure that the biotic and abiotic resources are taken care of like capital assets;
- to assure that the life span of the project in terms of environmental sustainability;
- to correct in time the environmental impacts that could damage the following components: social, soil, air, fauna and flora.
- to permit that the population to be part of the environmental monitoring;
- to promote the flow of economic investment necessary to execute the project.

The following programs are an integral part of the environmental management plan:
- - Environmental control program;
- - Program of cultural values protection;
- - Capacity building program;
- - Occupational health and security program;
- - Management of camp site, offices and warehouses
- - Waste management program;
- - Equipment and machinery maintenance program;
- - Road maintenance program;
- - Environmental signaling program;

- - Geotechnical management program
- - Water management program (quantity and quality);
- - Ecological restoration and vegetation management program;
- - Program of retirement and demobilization;
- - Community relations program;
- - Emergency plan;
- - Environmental monitoring and auditing plan;

The complete environmental impact assessment study is available. The EIA has been approved by local environmental authorities.

The project licence of operation, delivered by CONELEC, is available in Spanish. A certificate of authorization is presented in appendix 4.

The DNA validation certificate can also be found in Appendix 4.

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:

>> Not applicable.

SECTION E. Stakeholders' comments

>>

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

>> A public meeting with the community was held on Thursday, February 1st, 2007. The meeting was announced in local newspaper publication. The announcement, published in the February 1st 2007 edition of La Hora, is available in Spanish. The meeting was filmed to ensure that all comments be taken into account. A summary of this meeting can be found in items E2 and E3 of this document.

Consultations were also held with local stakeholders such as CONELEC, CENACE, the Ministry of the Environment and the Ministry of Energy on January 31st 2007. The minutes of this meeting is available in Spanish.

E.2. Summary of the comments received:

>>The local community raised questions about local job creation, the access to potable water, the Kyoto Protocol and financing of the project.

The public and stakeholders showed a positive attitude and a high level of acceptance towards the development of the Apaquí project.

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

>> In response to the question raised by local communities, it was made clear that especially during the construction part of the project roughly 500 direct jobs were created and about 1000 indirect jobs. Local job creation will be prioritized specially for jobs that do not required any specialized skill. It was assured that the local community where the project is taking place will have access to the potable water. It was explained to the community that the mechanisms of the Kyoto Protocol permit the reduction of GHG emissions in developing countries and that locally these countries are benefited not only by new investments but also by the reduction of other atmospheric pollutants such as SOx, NOx and particulates.

Appendix 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Current Energy of Ecuador S.A.
Street/P.O.Box:	Río Yaupi N31-53 y Mariana de Jesús
Building:	
City:	Quito
State/Region:	
Postfix/ZIP:	
Country:	Ecuador
Telephone:	+593 2 2230 170
FAX:	+593 2 2555 412
E-Mail:	galo@currentenergyofecuador.com
URL:	
Represented by:	Galo Valencia C
Title:	
Salutation:	Mr.
Last Name:	Valencia
Middle Name:	
First Name:	Galo
Department:	
Mobile:	
Direct FAX:	+593 2 2555 412
Direct tel:	+593 2 2230 170
Personal E-Mail:	galo@currentenergyofecuador.com

Organization:	Current Energy of Ecuador S.A.
Street/P.O.Box:	Río Yaupi N31-53 y Mariana de Jesús
Building:	
City:	Quito
State/Region:	
Postfix/ZIP:	
Country:	Ecuador
Telephone:	
FAX:	
E-Mail:	llandsman@mindspring.com
URL:	
Represented by:	Mark Pomeranz
Title:	
Salutation:	Mr.
Last Name:	Pomeranz
Middle Name:	
First Name:	Mark
Department:	
Mobile:	

Direct FAX:	
Direct tel:	
Personal E-Mail:	llandsman@mindspring.com

Appendix 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding for this project

Appendix 3

BASELINE INFORMATION

Emission Factor - Ecuadorian Electricity Grid, (2003 – 2005)

The Emission Factor is calculated by "CORDELIM" in collaboration with "Eco-Alianzas Estratégicas Cia. Ltda." using the Methodology ACM0002 / Ver 6.

The Emission factor is to be used freely crediting "CORDELIM" and "Eco-Alianzas Estratégicas Cia. Ltda."

Acknowledgement: The dispatch data used in this calculation has been provided with the gentle support of the "Power and Communications Sectors Modernization" Project (PROMEC, CONAM), and the National Electricity Dispatch Centre (CENACE).

The Calculation

The baseline emission factor is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors.

Calculating the Operating Margin

ACM0002 suggest 4 different methodologies to calculate the OM:

- Simple OM, or
- Simple adjusted OM, or
- Dispatch Data Analysis OM, or
- Average OM

The c) dispatch data analysis should be the first methodological choice if possible, but to use this methodology, ex post dispatch data are necessary. Unfortunately ex post dispatch data are not public available in Ecuador, hence we have to choose one of the three other OM methodologies.

The (a) simple OM methodology can only be used if the low-cost/most run resources (all renewable energy and the electricity import from Colombia) are less than 50 % of the total grid generation. In Ecuador the low-cost/must run resources are higher than 50 %, and therefore this methodology is not applicable.

The d) average OM methodology can only be used when there is no dispatch data from the last 3 years public available. In Ecuador these data are available and therefore the b) simple adjusted OM methodology is used.

b) Simple adjusted OM methodology

The Simple adjusted OM methodology is using dispatch data from the last three years and is calculated as the generation weighed average emissions per electricity unit (tCO_2/MWh) of all generating sources serving the system, where the power sources – including imports – are separated in low-cost/must run power sources (*k*) and other power sources (*j*).

$$EF_{OM,\,simple_adjusted,\,y} = (1-\lambda_y).\frac{\sum_{i,j} Fi,\,j,\,y.COEF_{i,\,j}}{\sum_{j} GEN_{j,y}} + \lambda_y.\frac{\sum_{i,k} Fi,\,k,\,y.COEF_{i,\,k}}{\sum_{k} GENk_{k,y}}$$

Where $F_{i,j,y}$ is the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *j* in year(s) *y*, *j* refers to the power sources delivering electricity to the grid and $COEF_{i,j,y}$ is the CO_2 emission coefficient of fuel *i* (tCO_2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources *j* and the percent oxidation of the fuel in year(s) *y*. $GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source *j*.

$F_{i,k,y}$, $COEF_{i,k}$ and GEN_k are various for plants *k*

The CO_2 emission coefficient $COEF_i$ is obtained as $COEF_i = NCV_i \cdot EFC_{O2,i} \cdot OXID_i$

Where: NCV_i is the net calorific value (energy content) per mass or volume unit of a fuel *i*, $OXID_i$ is the oxidation factor of the fuel (see page 1.24 in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories for default values), $EF_{CO2,i}$ is the CO2 emission factor per unit of energy of the fuel *i*.

Where available, local values of NCV_i and $EF_{CO2,i}$ should be used. If no such values are available, country-specific values (see e.g. IPCC Good Practice Guidance) are preferable to IPCC world-wide default values.

$$\lambda_y = \frac{number\ of\ hours\ per\ year\ for\ which\ low-cost/must-run\ sources\ are\ on\ margin}{8760\ hours\ per\ year}$$

Where lambda (λ_y) should be calculated as follows:

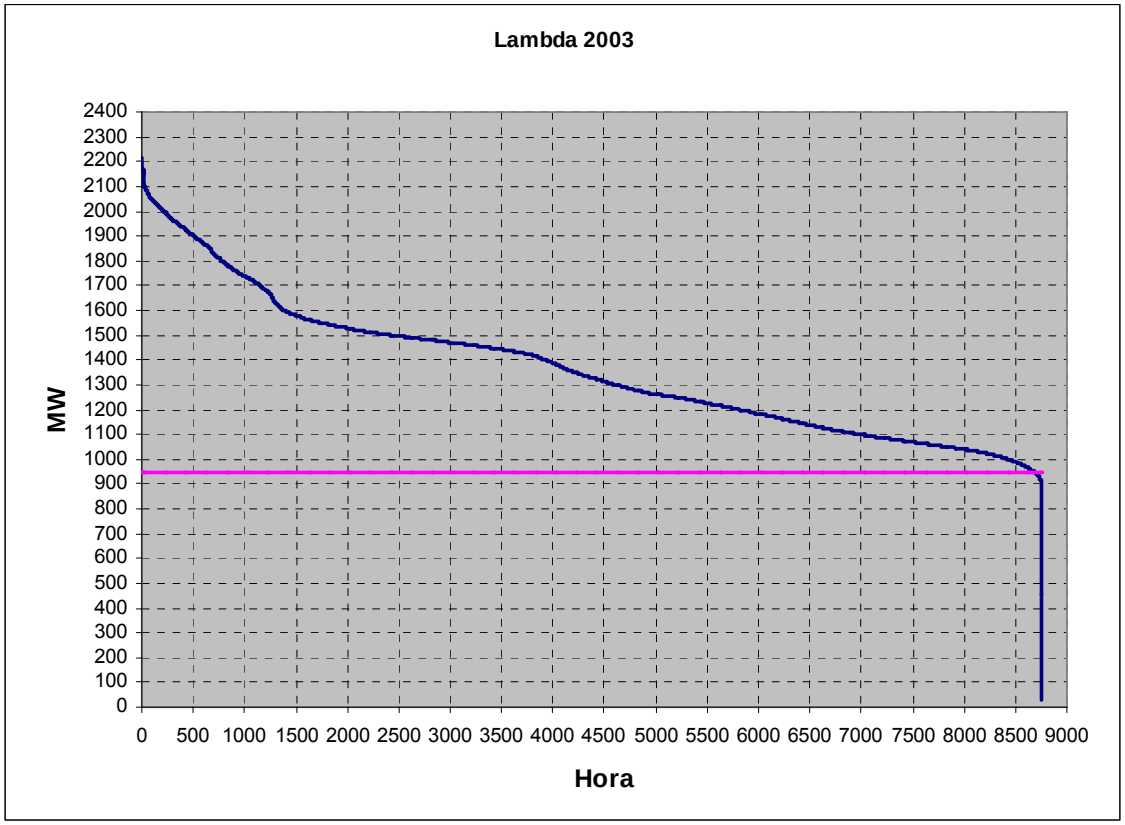
1. Plot a Load Duration Curve. Collect chronological load data (typically in MW) for each hour of a year, and sort load data from highest to lowest MW level. Plot MW against 8760 hours in the year, in descending order.
2. Organize Data by Generating Sources. Collect data for, and calculate total annual generation (in MWh) from low-cost/must-run resources (i.e. $\Sigma_k GEN_{k,y}$).
3. Fill Load Duration Curve. Plot a horizontal line across load duration curve such that the area under the curve (MW times hours) equals the total generation (in MWh) from low-cost/must-run resources (i.e. $\Sigma_k GEN_{k,y}$).
4. Determine the "Number of hours per year for which low-cost/must-run sources are on the margin". First, locate 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 lowcost/must-run sources do not appear on the margin and λ_y is equal to zero. Lambda (λ_y) is the calculated number of hours divided by 8760.

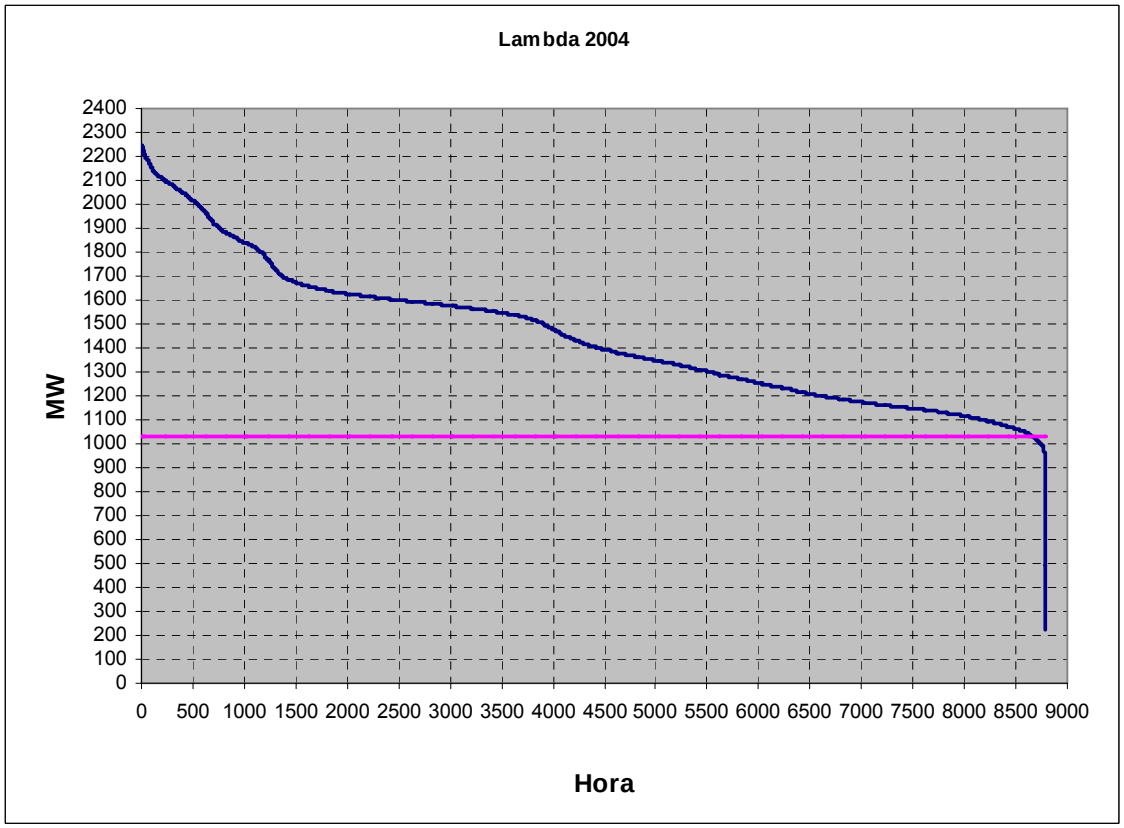
Fuel characteristics and dispatch values used in the calculation were taken from the following references and sources

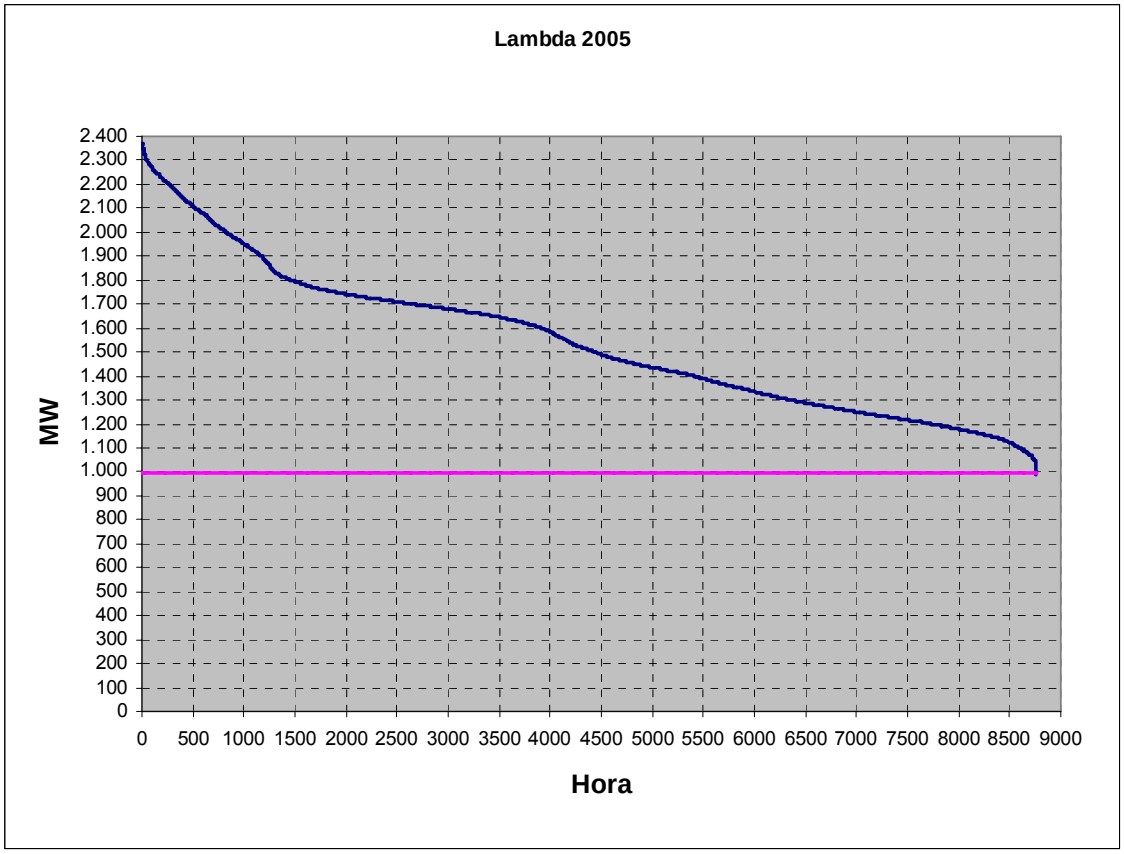
- The calorific values used are default values taken from the “2006 IPCC Guidelines for National Greenhouse Gas Inventories” and the “Greenhouse Gas assessment Handbook – A practical Guidance Document for the assessment of Project-level Greenhouse Gas Emissions – Global Environment Division, World bank, 1998”
- The fuel oxidation factors used are values taken from the “2006 IPCC Guidelines for National Greenhouse Gas Inventories”
- The Ecuadorian dispatch data from 2003 to 2005 are taken from “Estadística del sector eléctrico Ecuatoriano, año 2003, 2004 & 2005, CONELEC”
- The Exact Ecuadorian hourly dispatch data have been provided by CENACE

Ecuadorian Operating Margin:

Using the above guidelines and references, λ_y was calculated for each year as shown below:







And the Operating Margin from 2003 to 2005 was calculated to **0,74673 tCO_2/Mwh**

Calculating the Build Margin

The Build Margin is calculated as the generation-weighted average emission factor (tCO2/MWh) of a sample of power plants *m*, as follows:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$

Where $F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to the variables described above, for plants *m*.

Project participants shall choose between one of the following two options. The choice among the two options should be specified in the PDD, and cannot be changed during the crediting period.

Option 1:
Calculate the Build Margin emission factor $EF_{BM,y}$ *ex-ante* based on the most recent information available on plants already built for sample group *m* at the time of PDD submission. The sample group *m* consists of either the five power plants that have been built most recently or the power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently. Project participants should use from these two options that sample group that comprises the larger annual generation.

Option 2:
For the first crediting period, the Build Margin emission factor $EF_{BM,y}$ must be updated annually *ex-post* for the year in which actual project generation and associated emissions reductions occur. For subsequent crediting periods, $EF_{BM,y}$ should be calculated *ex-ante*, as described in option 1 above. The sample group *m* consists of either the five power plants that have been built most recently or the power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently. Project participants should use from these two options that sample group that comprises the larger annual generation.

Fuel characteristics and values used in the calculation were taken from the following references and sources:

- The calorific values used are default values taken from the "2006 IPCC Guidelines for National Greenhouse Gas Inventories" and the "Greenhouse Gas assessment Handbook – A practical Guidance Document for the assessment of Project-level Greenhouse Gas Emissions – Global Environment Division, World bank, 1998"
- The fuel oxidation factors used are values taken from the "2006 IPCC Guidelines for National Greenhouse Gas Inventories"
- The Ecuadorian dispatch data from 2003 to 2005 are taken from "Estadística del sector eléctrico Ecuatoriano, año 2003, 2004 & 2005, CONELEC"

Ecuadorian Build Margin

We have chosen the 1st option to calculate the Build Margin, using the power plant capacity additions in the electricity system that compromises 20 % of the most recent added system generation. This combination has been chosen because the data available are ex ante, and because the 20 % recently added system generation has a higher annual electricity generation than the 5 plants recently added to the system. (the 5 most recently added plants only generate 0,9 % of the total annual generation)

The calculated Build Margin is: **0,57346 tCO_2/Mwh**

Calculating the Emission Factor

The Emission Factor is a weighted average of the Operating Margin emission factor (*EFOM,y*) and the Build Margin emission factor (*EFBM,y*):

$$EFy = w_{OM} * EF_{OMy} + w_{BM} * EF_{BMy} = w_{BM} + EF_{BMy}$$

Where the weights w_{OM} and w_{BM}, by default, are 50% (i.e., $w_{OM} = w_{BM} = 0.5$), and $EF_{OM,y}$ and $EF_{BM,y}$ are expressed in tCO_2/MWh.

For wind and solar projects, the default weights are as follows: $w_{OM} = 0.75$ and $w_{BM} = 0.25$ (owing to their intermittent and non-dispatchable nature).

Alternative weights can be used, as long as $w_{OM} + w_{BM} = 1$, IF the project can justify it. Please se the ACM0002 for more information about alternative weights.

Emission Factors - Ecuadorian electricity grid, 2003 - 2005

Default CDM projects - using the default 50 % weights: **0,66007 tCO_2/MWh**

Wind and Solar projects – using 75 % OM and 25 % BM: **0,70340 tCO_2/MWh**

Appendix 4

ADDITIONAL INFORMATION

OFFICE NO. DE-06-1762

Quito, *September 28, 2006*

Mr.
Galo Valencia
General Manager
CURRENT ENERGY OF ECUADOR S.A.
Present-

Of my consideration:

For your consequent knowledge and aims, in continuation you have allowed me to transcribe the Resolution No. 236/06, adopted by the Director of CONELEC in session the 21st of September of 2006.

"To welcome the recommendation of the Commission Of Directory contained in memoriam N. CDCPL-06-042 of the 20th of September of 2006; and, in attention to the established in article 57 of the Regulation of Concessions, Permissions and Licenses for the Benefit of the Service of Electric Energy, the company CURRENT ENERGY OF ECUADOR is granted the Certificate of Permission for the execution and operation of the hydroelectric Project Apaqui, "including the associate Line of Transmission". This Project has the capacity of 36 MW and it is located in the Bolivar Corner of the Province of the Carchi ".

A term of 12 months is granted, counted from the emission of the Certificate of Permission, for the subscription of the corresponding Contract.

The text of the Certificate of Permission is approved.

To the present I am enclosing the respective Certificate of Permission.

Kindly,

Engineer Javier Astudillo F.
EXECUTIVE DIRECTOR

No. 83

THE NATIONAL ADVICE OF ELECTRICITY

CONELEC

Considering:

- That CURRENT ENERGY OF ECUADOR S.A. under protection of the Law of Regime of the Sector of Electricity and its Regulation of Concessions, Permissions and Licenses for the Presentation of the Electric Energy Service, has presented a request for the execution of the Project Hydroelectric, denominated Apaqui, of 36 MW, the same one that will develop in the was developed in the Bolivar Corner of the Province of the Carchi.

- That the request presented, after have been analyzed in the terms established in Article 57 literal b) of the Regulation of Concessions, Permissions and Licenses for the Presentation of the Electric Energy Service it has deserved the favorable information of the General Productivity of the Unit of Environmental Management and the Direction of Concessions, contents in memorandums No. PG-06_0733 of the 16th of August of 2006: No. UA-06-314 of the 29th of August of 2006 and No. UA-06-332 of the 7th of September of 2006: DC-06-292 of the 11th of September of 2006 and the Technical Report and of the Fulfillment of Requirements of 11 of September of 2006, respectively.

- Based on these legal, environmental and technical reports, personals by the Executive Direction by means of memorandum No. DE-06-516 of the 12th of September of 2006, the Commission of Directory for Concessions, Permissions and Licenses, by means of memorandum No. CDCPL-06-042 of the 20th of September of 2006, presented their reports for consideration of the Directory of CONELEC.

- That the Directory of CONELEC, welcoming the report presented by the Commission of Directory for Concessions, Permissions and Licenses, by means of Resolution No. 236/06 adopted in the session of the 21st of September of 2006, disputed to grant the Certificate of Permission to the company CURRENT ENERGY OF ECUADOR S.A.

In such virtue and in conformity with the established in the third interjection of the literal b) of Article 57 of the Regulation of Concessions, Permissions and Licenses for the Presentation of the Electric Energy Service, it confers the present.

CERTICICATE OF PERMISSION

In favor of CURRENT ENERGY OF ECUADOR S.A. for which it guarantees its exclusive right in respect to the requested permission, for the subscription of the Contract of Permission for the execution and operation of the Apaqui Project, as auto generator with sale of excessive [amenities]; including the associate Line of Transmission L/T.

The Holder of the present Permission should be subject to the conditions indicated to the reverse of this instrument.

Conditions:

1. It is establish as maximum term for the subscription of the Contract of Permission the period of twelve (12) months, counting from the emission of the present Certificate.

2. For the subscription of the Contract of Permission, it should previously present:

    - The updated Studies of Feasibility of the project and the associate L/T.

    - The Studies of Permanent Environmental Impact of the project of generation and the Line of Transmission, approved by CONELEC.

    - The permission of use of the water granted in favor of CURRENT ENERGY OF ECUADOR S.A.

    - The chronograms of construction and the value of the project of generation and of the L/T associate.

    - The Guarantee of Complement of Terms

3. In beginning of the construction of the hydroelectric Apaqui project and of the L/T associate will be suspended to the previous realization of the following events:

    - Subscription of the Contract of Permission

    - Presentation by CURRENT ENERGY OF ECUADOR S.A. and approval by CONELEC of the Final Designs of the Project and the L/T.

    - Presentation of the Environmental License of the Project and the L/T [emitids] by the competent Authority.

    - Presentation of the Permission for the connection to the National System of Transmission.

4. This Certificate does not constitute authority by part of CONELEC for the project of generation, could it connect to the National System of Transmission or to the installations of the Company of Distribution, nor for the use of these installations for the transportation of the power and energy.

The respective permissions with the connections will be transmitted and obtained by the applicant, under their entire responsibility.

5. This Certificate of Permission cannot be transferred to a third party, without the previous consent of CONELEC.

6. This Certificate of Permission does not implicate any responsibility to CONELEC of the designs of the project, nor the conditions of utility of land for the construction of the plant.

Given in Quito 27th of September of 2006.

Engineer Javier Astudillo F.

EXECUTIVE DIRECTOR

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AN-MDL Ecuador

Autoridad Nacional para el Mecanismo de Desarrollo Limpio

ministerio del ambiente
República del Ecuador

Quito, june 20,2007
Official Note N° 7003207 AN-MDL/MA

Mr.
Galo Valencia
President
CURRENT ENERGY OF ECUADOR S.A.
Present

Re: Letter of Approval for CDM project " Hidroeléctrica APAQUI"

As President of the CDM Designated National Authority of Ecuador, upon compliance by participants of Clean Development Mechanism Project "Hidroeléctrica APAQUI" located in the Province of Carchi, Cantón Bolívar, Republic of Ecuador with the provisions contained in the National Authority Procedure for the Issuance of Letters of Approval of CDM projects, published in Official Registry N° 86 of May 21, 2003 and upon the Favorable Technical Recommendation of the Validation Group, contained in Memorandum N° 7007083 AN-MDL-UCC, I hereby issue this National Approval Letter, certifying that:

- The Government of Ecuador ratified the Protocol of Kyoto via Executive Decree N° 1588 published in Official Registry N° 342 on December 20, 1999;
- The "Hidroeléctrica APAQUI" CDM Project contributes to the sustainable development of Ecuador;
- The participation of the proponents of the CDM project is voluntary

According to national and international procedures in effect, this Letter of Approval shall enter into effect upon the issuance of the favorable validation report by the Designated Operational Entity.

Sincerely,

Anita Alban Mora
MINISTER OF THE ENVIRONMENT
CDM-DNA PRESIDENT

fuc/jcv

Table of Content of Training plan
Construction and commissioning

Prepare Training Proposal for Community Development
Prepare Training Proposal for Operations
Develop Training structure

Job analysis
Determine Training Topics
Determine Training Modules
Prepare Database for Candidate Entry
Propose Local People to attend training Only for People working on the job site
Implement Trainee Evaluation system
Construction training / Community Development
Prepare Training Program and Schedule
Prepare On the Job Training Program and Schedule
Prepare Training Manuals
Execute Training In Class
Health, Safety And Environment Management Training
Execute On the Job Training
Operations Training / Commissioning Training
Prepare Training Program and Schedule
Prepare On the Job Training Program and Schedule

Execute Training In Class
Management Training