Project design document form for small-scale CDM project activities

(Version 05.0)

Complete this form in accordance with the Attachment "Instructions for filling out the project design document form for small-scale CDM project activities" at the end of this form.

PROJECT DESIGN DOCUMENT (PDD)	
Title of the project activity	Las Palmas Small Hydroelectric Power Plant
Version number of the PDD	09
Completion date of the PDD	18/07/2014
Project participant(s)	GENERACIÓN DE ENERGÍA, S.A.S. – GEDEN S.A.S. ECOTERRAE GLOBAL SOLUTIONS, S.L.
Host Party	Colombia
Sectoral scope and selected methodology(ies), and where applicable, selected standardized baseline(s)	Sectoral Scope 1: Energy industries (renewable sources) AMS-I.D.: Grid connected renewable electricity generation (version 17.0)
Estimated amount of annual average GHG emission reductions	6 088 tCO_2e/y

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

Las Palmas Small Hydroelectric Power Plant Project (hereafter referred as the Project), which is developed by GENERACIÓN DE ENERGÍA, S.A.S. (hereafter referred as GEDEN SAS or the Project Owner) is located in the municipality of Santa Rosa de Osos, Antioquia Department, Colombia. The purpose of the Project is to utilize the water resources of the *Río Grande* River to generate electricity, which will be delivered to the national interconnection grid without CO_2 emissions.

The project is a run-of-river renewable small hydroelectric plant with an installed capacity of 2.8 MW. It is expected to generate approximately 16 556 MWh/yr of renewable electricity by means of naturally available potential energy in the form of hydraulic head (water level difference between the upstream and downstream of the barrage) and water (excess discharge being released to downstream of the barrage) available at the location.

Water diversion utilizing pressure pipe is adopted by the project, in which water is diverted to the power house to generate electricity. The Project is designed to deliver a discharge flow of 9.5 m^3/s with 29.3 meters of water head, with firm capacity of 2.8 MW. The project will contribute to reduce the CO_2 emissions in the Colombian grid from fossil fuel consumption for electricity generation, which would have occurred otherwise in the absence of the project activity.

Coherence and contribution to government policies

Las Palmas Hydroelectric Project is a small-scale hydroelectric power generation which complies with the framework of the energy sector policies of Colombia[1] in aspects related to renewable energy electricity generation and technological innovation. The project is also consistent with the objectives and policies established by the Regional Environment Management Plan, which is focused on the mitigation of climate change through the implementation of alternative energy projects and sustainable development technologies[2].

The project activity also clearly contributes to reach the objectives reflected in "*Visión Colombia II Centenario 2019*"[3], document which elaboration is guided by the PND (Planning National Department).

Moreover, in 2000, the Ministry of Environment of Colombia and the World Bank promoted the elaboration of the National Strategy for the Implementation of the CDM in Colombia, focused on the main sectors which can contribute to sustainable development of the country with the support of the Clean Development Mechanism[4].

According to the target sectors in this National Strategy for Implementation of the CDM in Colombia, the implementation of the small scale hydropower plants clearly fits the CDM, being one

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[1] National Energy Plan. http://www.siel.gov.co/siel/Portals/0/PLAN_ENERGETICO_NACIONAL_2007.pdf

[2] Regional Environment Management Plan, 2008-2033. (Plan Regional de Gestión Ambiental). http://www.cornare.gov.co/contenido.php?&id=556

[3] http://www.dnp.gov.co/PortalWeb/PolíticasdeEstado/VisiónColombia2019/tabid/92/Default.aspx

[4] Plan de Trabajo para el Mecanismo de Desarrollo Limpio. http://www1.minambiente.gov.co/viceministerios/ambiente/mitigacion_cambio_climatico/documentos/PlanTrabajoIPSE-Final.pdf

of the most suitable sectors to generate Certified Emission Reductions to Colombia (renewable energetic sector). In fact, the CDM initiative of Las Palmas hydroelectric project promotes the rational and efficient use of energy[5].

A.2. Location of project activity

A.2.1. Host Party

Colombia

A.2.2. Region/State/Province etc.

Department of Antioquia

A.2.3. City/Town/Community etc.

Municipality of Santa Rosa de Osos

A.2.4. Physical/Geographical location

The project activity is located in the river called Río Grande, in Antioquia Department. It is placed in the Santa Rosa de Osos municipality, at 7 km to the downtown of Santa Rosa de Osos.

The table below describes the coordinates of the project area and the place of the future powerhouse:

Table 1. Coordinates of the project area		
Coordinates	**X**	**Y**
Project area according to Environmental license (plane coordinates)	842.000 – 843.750 E	1’223.000 – 1’224.500 N
Future powerhouse site (UTM WGS84)	444 536	730 141
Future powerhouse site (geographic coordinates, decimals degrees)	6.60527	-75.501793
Future powerhouse site (geographic coordinates, degrees, minutes, seconds)	6º 36' 18.97"	-75º 30' 6.45"

[5] Law 697/2001. Diario Oficial 44573. http://www.lawea.org/documentos/Colombia_Ley_697.pdf

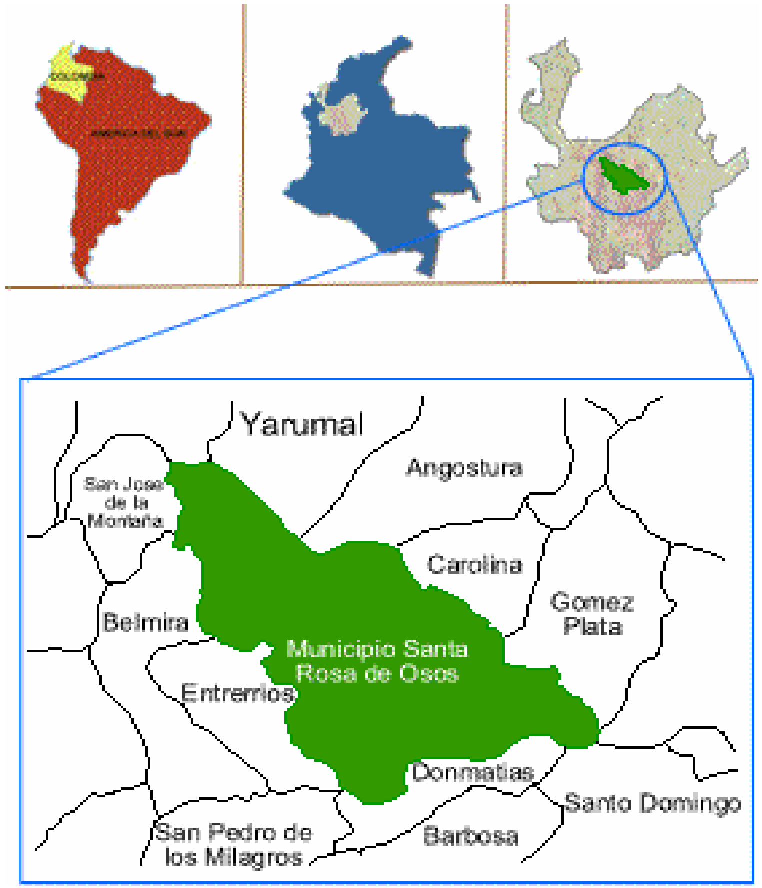

Figure 1. Municipality, department and country location

A.3. Technologies and/or measures

Las Palmas Hydroelectric project relies on commercial, environmentally safe and sounds technological packages as well as the required know-how for implementation, transferred to the host party through the appropriate commercial guarantees and support service packages established for the implementation of the project activity, and which are standard in hydro power development.

Technology applied to the project activity

The project activity is a run-of-river hydroelectric power project which involves the installation of two Francis Hydro turbine units with a cumulative installed capacity of 2.8 MW. It is estimated to have a yearly electricity generation of about 16 556 MWh. The project uses the Rio Grande water for electricity generation at a design flow rate of 9.5 m3/s. Water exiting the turbine will be discharged back to the Rio Grande River.

Las Palmas project applies a state-of-the art hydropower generation technology. It is a mature and best practice technology that is adopted in similar project activities in Annex 1 countries. A run-of-river type hydroelectric power project such as designed for Las Palmas involves no flooded area so that it is commonly accepted to have little negative impact to the environment. It is concluded that the project activity applies an environmentally safe and sound technology.

The project activity is the first hydro power project for the project owner. The development of the project activity will introduce the technology to the project participant through the absorption of know-how on the installation of a hydro power plant and O&M skills to Generación de Energía S.A.S.

Transfer of Technology refers a broad set of processes, covering the flow of know-how, of experience and of equipment for mitigating and adapting to climate change amongst different stakeholders such as governments, private entities, financial institutions, non-governmental organizations (NGOs) and research/educational institutions. The major technology transfer in Las Palmas Hydroelectric project takes place because of the importation of the main facilities of the project, including turbines, generators and the necessary equipment to power generation.

A.4. Parties and project participants

Party involved (host) indicates host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Colombia (host)	GENERACIÓN DE ENERGÍA, S.A.S. (GEDEN SAS)	No
Spain	ECOTERRAE GLOBAL SOLUTIONS S.L.	No

A.5. Public funding of project activity

No public funding is involved in financing the project activity from countries included in Annex 1.

A.6. Debundling for project activity

According to paragraph 2 of Appendix C of "*Simplified Modalities and Procedures for small-scale CDM project activities*", 'debundling' is defined as the fragmentation of a large project activity into smaller parts. A small-scale project activity that is part of a large project activity is not eligible to use the simplified modalities and procedures for small-scale CDM project activities. According to paragraph 2 of Appendix C[6]:

> *"A proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:*
>
> - *With the same project participants;*
> - *In the same project category and technology/measure;*
> - *Registered within the previous 2 years; and*
> - *Whose project boundary is within 1 km of the project boundary of the proposed small- scale activity at the closest point"*

[6] Appendix C of the Simplified Modalities and Procedures for Small Scale CDM Project Activities http://cdm.unfccc.int/Projects/pac/howto/SmallScalePA/sscdebund.pdf

Las Palmas is not part of a larger CDM project activity or a debundled project activity. There is no registered small-scale CDM project activity or an application to register another small-scale CDM project activity in the same project category and technology/measure within 1 km of the project boundary. Therefore, the project can be considered as small scale CDM project activity.

SECTION B. Application of selected approved baseline and monitoring methodology and standardized baseline

B.1. Reference of methodology and standardized baseline

The following approved baseline and monitoring methodology is applicable to the project activity:

AMS.I.D: "**Grid connected renewable electricity generation" – Version 17**

Sectoral Scope: 1 - Energy industries (renewable / non-renewable sources)

Following tools and guidelines are also applicable:

- Methodological tool *"Tool to calculate the emission factor for an electricity system"* - for the calculation of emissions factor – Version 03
- "*General guidelines for SSC CDM methodologies*" – Version 20.0, (EB 76, annex 11)
- "*Guidelines on the demonstration of additionality of Small-Scale Project activities*" – version 09.0, (EB 68, annex 27)
- *"Non-binding best practice examples to demonstrate additionality for SSC project activities"* – EB 35, annex 34
- "*Guidelines on the assessment on investment analysis*" - Version 5 (EB 62, annex 5)

B.2. Project activity eligibility

Applicability conditions for AMS-I.D. Grid connected renewable electricity generation:

Table 2. Applicability conditions for AMS-I.D.

Applicability conditions	Project's fulfillment
1. This category comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass that supply electricity to a national or a regional grid	The project activity is a hydropower plant which will generate electricity that will displace electricity from the grid. Hence, this criterion is fulfilled by the project activity.
2. This methodology is applicable to project activities that (a) install a new power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project activity (Greenfield plant); (b) involve a capacity addition (c) involve a retrofit of (an) existing plant(s); or (d) involve a replacement of (an)	Las Palmas hydroelectric power project is a Greenfield plant: new power plant type at a site where there was no renewable energy power plant operating prior to the implementation of the project activity.

Table 2. Applicability conditions for AMS-I.D.	
Applicability conditions	**Project's fulfillment**
existing plant(s)	
3. Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology	The project activity is a run-of-river plant type which does not include reservoir.
4. In the case of biomass power plants, no other biomass types than renewable biomass are to be used in the project plant	The project activity is not a biomass power plant. This condition is not applicable to the project activity.
5. If the new unit has both renewable and non-renewable components (e.g., a wind/diesel unit), the eligibility limit of 15 MW for a small-scale CDM project activity applies only to the renewable component. If the new unit co-fires fossil fuel, the capacity of the entire unit shall not exceed the limit of 15 MW	The project activity does not employ non-renewable components. This condition is not applicable to the project activity.
6. Combined heat and power (co-generation) systems are not eligible under this category.	The proposed project activity is a hydropower plant, with no cogeneration units or systems. This condition is not applicable to the project activity.
7. In the case of project activities that involve the addition of renewable energy generation units at an existing renewable power generation facility, the added capacity of the units added by the project should be lower than 15 MW and should be physically distinct from the existing units.	The proposed project does not involve the addition of renewable energy generation units to an existing renewable power generation. Hence, this condition is not applicable to the project activity.
8. In the case of retrofit or replacement, to qualify as a small-scale project, the total output of the retrofitted or replacement unit shall not exceed the limit of 15 MW	The project activity is new plant which does not imply a retrofit or replacement. This condition is not applicable to the project activity.

Based on the above, the approved methodology AMS-I.D version 17 is applicable to the proposed project activity

B.3. Project boundary

According to AMS-I.D., v17, the project boundary encompasses the physical and geographical site of the renewable generation source. Therefore, the spatial extent of the project boundary includes the project power plant and all power plants connected physically to the Colombian electricity grid to which the proposed project is connected.

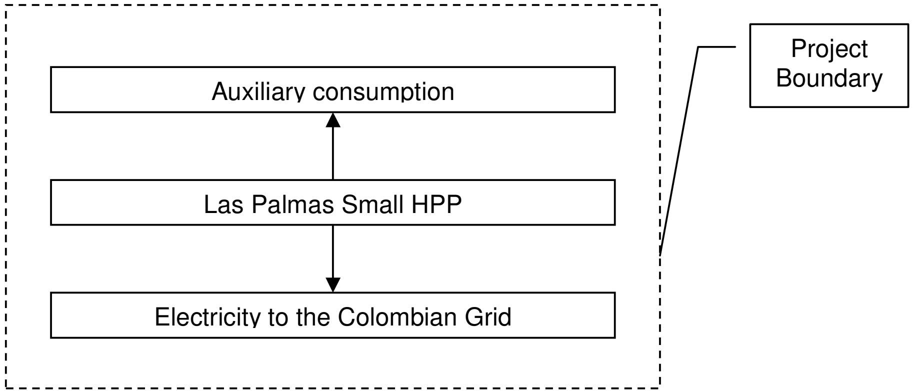

Figure 2. Project boundary

B.4. Establishment and description of baseline scenario

The applied methodology describes the baseline scenario as the 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 into the grid.

"Baseline emissions are the product of electrical energy baseline $EG_{BL,y}$ expressed in MWh of electricity produced by the renewable generating unit multiplied by the grid emission factor.

$$BE_y = EG_{BL,y} * EF_{CO_2,grid,y}$$

Where:

BE_y	*Baseline Emissions in year y (tCO_2)*
$EG_{BL,y}$	*Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y (MWh)*
$EF_{CO2,grid,y}$	*CO_2 emission factor of the grid in year y (tCO_2/MWh)*

The Emission Factor can be calculated in a transparent and conservative manner as follows:

(a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the 'Tool to calculate the Emission Factor for an electricity system'.

OR

(b) The weighted average emissions (in kg CO2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used."

The Emission Factor is calculated according to the manner (a) as the Combined Margin of the electricity system. Las Palmas hydroelectric power plant will supply electricity to the Colombian National Grid. In the absence of the project activity, the electricity generated by the Las Palmas Hydropower plant would be supplied from the Colombian National Grid.

As per above, the most conservative alternative scenario to the hydropower plant would be the connection to the Colombian National Grid. Hence, the construction and installation of the hydro power plant in Las Palmas will displace electricity from the National Grid, contributing to sustainability and to mitigation of Climate Change in the region.

Therefore, baseline scenario is one in which the electricity supplied by the project activity to the network would be generated by the plants currently connected to the grid and by new plants added to the system, based on the continuation of the current trend of adding capacity to the system. Both considerations are depicted in the Combined Margin, which is calculated as shown next.

B.5. Demonstration of additionality

As per the indicated in the methodology AMS-I. D *Grid connected renewable electricity generation* (version 17.0), the *general guidelines to SSC CDM methodologies* (version 20.0) has been used. For demonstrating additionality, the Guideline refers *to the applicable provisions for the demonstration of additionality for small-scale project activities provided in the Project Standard*.

Besides, the *CDM Project Standard* (version 06.0) indicates that the project participants shall apply the "Attachment A of Appendix B", which has been replaced by the *Guidelines on the demonstration of additionality of small-scale project activities* (version 09.0)[7]. In such cases, project participants should also follow the "Non-binding practice examples to demonstrate additionality for SSC project activities"[8].

According to the Guideline, the project participant shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the indicated barriers. In the following paragraphs it will be demonstrated that the main barrier for the project activity is to overcome the investment barrier: *a financially more viable alternative to the project activity would have led to higher emissions*.

In the absence of the project activity it is expected that electricity supplied by the project activity to the network would be generated by the plants currently connected to the grid and by new plants added to the system, based on the continuation of the current trend of adding capacity to the system.

Investment analysis

The *Non-binding practice examples to demonstrate additionality for SSC project activities* recommends the application of a Benchmark Analysis using national or global accounting practices and standards for such an analysis.

The *Guidelines on the assessment of investment analysis* (version 05)[9] indicates that the most suitable financial indicator for the project type and decision-making is the Internal Rate of Return (IRR). The IRR is the annualized effective compounded return rate which can be earned on the invested capital. A project is a good investment proposition if its IRR is greater than the rate of return that could be earned by alternate investments, in this case represented by the benchmark value. The project promoter has calculated the Project IRR for the project activity, without including the cost of financing expenditures (i.e. loan repayments and interest).

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[7] https://cdm.unfccc.int/Reference/Guidclarif/meth/methSSC_guid05.pdf

[8] http://cdm.unfccc.int/Reference/Guidclarif/ssc/methSSC_guid15_v01.pdf

[9] http://cdm.unfccc.int/Reference/Guidclarif/reg/reg_guid03.pdf

The table below presents the main data used in the IRR calculation of the project. The calculation was based on conservative assumptions all of which are listed below in order to maintain a transparent approach.

Table 3. Financial data used in project IRR calculation	
Initial investment cost	10 272 625 000 COP
Project life financial evaluation	20 years
Electricity tariff	111.91 COP/kWh
Power generation	16 556 MWh/year
Project IRR (without CER)	8.17%
Project IRR (with CER benefits)	9.59%

Calculations have considered the comparison of financial indicator selected for the project activity, with and without the forecasted incomes from the sale of CERs.

Following input values and assumptions were assumed at the time of the investment decision taken by the project developer:

- The cost of the plant and equipment were supplied by the project developer based on real quotations.
- Electricity price has been obtained from the information generated by the host country's electricity grid operator at the moment of the investment.
- Running costs were estimated by the project developer, including: cost of operation and maintenance, administration costs, regulatory cost, and insurances (insurances on assets and insurances on sales).
- Applied taxes have been considered in accordance with the provisions and circumstances under the current legislation in Colombia.
- The fee due to the water use is considered 0.5 COP/m^3 as per the Resolution 240 of 2004 from Ministry of Environment[10].

[10] RESOLUCION 240 DE 2004

- FAZNI (in Spanish, *Fondo de Apoyo Financiero para la Energizacion de las Zonas No Interconectadas*) has been taken into acount according to Law 1099 November of 2006.[11]

- Regulatory costs applicable to electricity generation in Colombia, CND-LAC-ASIC, according to the current legislation.[12]

- The CPI (Consume Price Index) is according to the statistic information obtained from the DANE (*Departamento Administrativo Nacional de Estadística*) for 2010.

Selection of appropriate benchmark.

The most suitable financial indicator for the investment analysis of the project activity is the Internal Rate of Return (IRR). The IRR is the annualized effective compounded return rate which can be earned on the invested capital. A project is a good investment proposition if its IRR is greater than the rate of return that could be earned by alternate investments, in this case represented by the benchmark value.

A financial/economic indicator must be identified as the most suitable for the project type and decision context. Benchmark analysis states that the return to be expected on an asset (or investment) must equal the return on an asset (or investment) with no risk plus the average market risk multiplied by the specific risk factor of said investment.According to the Annex A from the *Guidelines on the assessment on investment analysis*, v5, the default benchmark in real terms for energy industry projects in Colombia is 12.00%.

Comparison of Project IRR to benchmark

The project IRR is compared to the benchmark to examine the financial attractiveness of the project activity. The project IRR is estimated to be 8.17%, which is lower than the benchmark of 12.00% that is referred above. This low IRR compared to the hurdle rate indicates that the Project activity is not financially attractive without CDM assistance.

Hence, the investment required to implement the project activity without the estimated revenues from the CDM, results in an unattractive investment. The financial risks involved in the implementation of the project are very strong handicaps against the investment in this small scale hydropower plant. However, considering the extra revenues from the carbon credits, the estimated project IRR is increased up to 9.59%. Even project IRR values higher than the benchmark are reached in a favorable scenario of CER price.

The financial feasibility of the implementation of the project activity has been analyzed; the investment analysis developed to evaluate whether the project is feasible or not showed that, in the

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http://basedoc.superservicios.gov.co/ark-legal/ServletControl;jsessionid=CA7AFF8446642CB40ABADBE82176FD90?docId=d2a2c776-b7ad-45a4-9cd5-f2304fdacc9a&docName=r_mavdt_0240_2004.html&mimetype=application%2Fpdf&operacion=descargarVista.

[11] Law 1099 November of 2006. http://www.secretariasenado.gov.co/senado/basedoc/ley/2006/ley_1099_2006.html

[12] Resolution 81 of 2007 http://www.creg.gov.co/html/compila/docs/resolucion_creg_0081_2007.htm

Resolution 48 of 2008 http://www.creg.gov.co/html/compila/docs/resolucion_creg_0048_2008.htm absence of the CDM, the project activity will not be financially attractive and, thus, it would not occur. All input values used in the investment analysis were available at the time of decision-making.

Sensitivity analysis

A sensitivity analysis has been performed to determine in which scenarios the project activity would overtake the benchmark, indicating its viability. The project viability is evaluated through the increment ±10% and ±20% of the following parameters: annual power generation, total investment, electricity price O&M costs.

The fluctuation in the Project IRR for the different scenarios is shown on the following table and its corresponding graphs.

Table 4. Sensitivity analysis of Project IRR of Las Palmas

Parameter	-20%	-10%	Base case	+10%	+20%
Power Generation	4,42%	6,40%	**8,17%**	9,81%	11,33%
Total Investment	10,96%	9,45%	**8,17%**	7,08%	6,11%
Electricity Price	4,38%	6,38%	**8,17%**	9,82%	11,35%
O&M Costs	9,05%	8,62%	**8,17%**	7,73%	7,26%

Despite that the "Guidelines on the assessment on investment analysis" recommends that the *variations in the sensitivity analysis should at least cover a range of +10% and 10%,* it has been considered variations up to ±20% with the objective of demonstrate more strictly the unlikelihood of the occurrence of scenarios in which the project activity would pass the benchmark.

Conclusions:

The investor, a local small company, faces many obstacles to access to finance the project. The investment barrier is strong enough to make the project unattractive from the investor point of view, who, in the absence of the CDM, would not have got involved in the implementation of the project.

The benefits derived from the sale of CERs will alleviate the identified barriers that prevent the construction of the project attracting financiers who would normally not finance this kind of project without the CDM. The contribution of the selling of CER to the operating cash flows over time will be also essential to face any contingency, any unforeseen costs increase or any possible risk involved in the operation of the project during the first ten years, when the lack of experience could result in a reduction in the estimated return on investment.

The construction and operation of the Las Palmas Small Hydroelectric Power Plant will directly contribute to reduce GHG emissions to the atmosphere additionally to what would happen in the absence of the CDM.

Prior CDM Consideration

The PDD was made publicly available for Global Stakeholders Comments prior to the starting date of the project activity, as indicated in the table below, which clearly indicates that the benefits of the CDM were seriously considered in the decision to process with the project activity.

Table 5. CDM implementation calendar of the Project	
Activities to achieve CDM	
Milestone	**Date**
Board resolution adopted to consider the project as CDM project activity	30/06/2009
Non-objection letter issued by Colombian DNA for the project	11/09/2009
Prior consideration of the CDM - Communication to UNFCCC	30/11/2009
Shareholders meeting in which investment decision was taken considering CDM benefits	08/03/2010
Proposal from the DOE for validation services	21/04/2010
DOE contracting	08/04/2011
Starting of Global Stakeholders Comments	18/11/2011
Implementation of the Project	
Date of signature of the contract for Civil Works - *Starting Date*	24/05/2012
Purchase of the main equipment for the Project activity – turbines	31/12/2012
Date of construction starting	02/09/2013
Commissioning date (expected)	01/10/2014

According to the Glossary of terms of the UNFCCC, the ‘starting date’ coincides with the *date which the project participants have committed to expenditures related to the implementation of the project*. The date of the signature of the contract for Civil Works has been chosen.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

In accordance to the applicable Small Scale Methodology, AMS-I.D, version 17, emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y$$

Where:

ER_y Emissions reductions in year y (tCO_2e/y)

BE_y Baseline Emissions in year y (tCO_2e/y)

PE_y Project Emissions in year y (tCO_2e/y)

LE_y Leakage emissions in year y (tCO_2e/y)

Project emissions

For the following categories of project activities, project emissions have to be considered following the procedure described in the most recent version of ACM0002.

- Emissions related to the operation of geothermal power plants (e.g. non-condensable gases, electricity/fossil fuel consumption)
- Emissions from water reservoirs of hydro power plants

As the proposed project activity consists of the construction, implementation and operation of a hydropower plant without water reservoirs, the emissions due to the project activity are considering as zero.

$$PE_y = 0 \ tCO_2 / y$$

Leakage Emissions

In accordance to the applicable methodology, leakages are to be considered *"if the energy generating equipment is transferred from another activity or if the existing equipment is transferred to another activity"*. Since there is no transfer of equipment from or to the project activity, leakages are equal to zero.

$$LE_y = 0 \, tCO_2 / year$$

Baseline emissions

According to the applicable methodology AMS-I.D, Baseline emissions are the product of electrical energy baseline $EG_{BL,y}$ expressed in MWh of electricity produced by the renewable generating unit multiplied by the grid emission factor.

$$BE_y = EG_{BL,y} * EF_{CO_2,grid,y}$$

Where:

BE_y Baseline Emissions in year y (tCO_2)

$EG_{BL,y}$ Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y (MWh)

$EF_{CO2,grid,y}$ CO_2 emission factor of the grid in year y (tCO_2/MWh)

B.6.2. Data and parameters fixed ex ante

Data / Parameter	$EF_{grid,CM,y}$
Unit	tCO_2/MWh
Description	Combined Margin CO2 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".
Source of data	Calculation carried out by the Project Participant in accordance with the "Tool to calculate the emission factor for an electricity system" The emissions factor calculated will consider the parameters presented by the Energy and Mining Planning Unit ("UPME") of the Ministry of Mines and Energy delegated by the Ministry of Environment, Housing and Territorial development ("MAVDT") to carry out such calculation.
Value(s) applied	0.36777
Choice of data or Measurement methods and procedures	The Combined Margin is calculated through a weighted-average formula, considering both the EFgrid,OM-y and the *EFgrid,BM,y* and the weights *wOM* (default 0.5 for the first crediting period and 0.25 for the second and third crediting periods) and *wBM* (default 0.5 for the first crediting period and 0.75 for the second and third crediting periods).
Purpose of data	Calculation of baseline emissions.
Additional comment	Parameters used for the calculation of the grid's emission factor are presented in Appendix 4.

Data / Parameter	$EF_{grid,OM,y}$
Unit	tCO_2/MWh
Description	CO2 Operating Margin emission factor of the grid, in a year y
Source of data	Calculation carried out by the Project Participant in accordance with the "Tool to calculate the emission factor for an electricity system" The emissions factor calculated took in consideration the parameters presented by the Energy and Mining Planning Unit ("UPME") of the Ministry of Mines and Energy delegated by the Ministry of Environment, Housing and Territorial development ("MAVDT") to carry out such calculation.
Value(s) applied	0.54340
Choice of data or Measurement methods and procedures	According procedures established by "Tool to calculate the emission factor for an electricity system".
Purpose of data	Calculation of baseline emissions.
Additional comment	Parameters used for the calculation of the grid's emission factor are presented in Appendix 4.

Data / Parameter	$EF_{grid,BM,y}$
Unit	tCO_2/MWh
Description	CO2 Build Margin emission factor of the grid, in a year y

Source of data	Calculation carried out by the Project Participant in accordance with the "Tool to calculate the emission factor for an electricity system" The emissions factor calculated took in consideration the parameters presented by the Energy and Mining Planning Unit ("UPME") of the Ministry of Mines and Energy delegated by the Ministry of Environment, Housing and Territorial development ("MAVDT") to carry out such calculation.
Value(s) applied	0.19215
Choice of data or Measurement methods and procedures	According procedures established by "Tool to calculate the emission factor for an electricity system".
Purpose of data	Calculation of baseline emissions.
Additional comment	Parameters used for the calculation of the grid's emission factor are presented in Appendix 4.

B.6.3. Ex ante calculation of emission reductions

According to the "**Tool to calculate the emission factor for an electricity system**" the Project participants shall apply the following six steps:

STEP 1. Identify the relevant electricity systems;
STEP 2. Choose whether to include off-grid power plants in the project electricity system (optional);
STEP 3. Select a method to determine the operating margin (OM);
STEP 4. Calculate the operating margin emission factor according to the selected method;
STEP 5. Calculate the build margin (BM) emission factor;

STEP 6. Calculate the combined margin (CM) emissions factor

Step 1: Identify the relevant electricity systems

For determining the electricity emission factors, the relevant project electricity system is the **Colombian National Interconnected System.**

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

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.

Option I is chosen for the project activity according to the Colombian National Interconnected System and available data to calculate both Operating and Build margin.

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

The calculation of the operating margin emission factor (EFgrid,OM,y) is based on one of the following methods which are described under Step 4:

(a) Simple OM; or

(b) Simple adjusted OM; or

(c) Dispatch data analysis OM; or

(d) Average OM.

The OM shall be calculated using the **Simple adjusted method** (b). Since low-cost/must-run resources constitute more than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production.

This decision was taken based on the data requirements and the information availability from the official sources, in this case the UPME (Unidad de Planeación Minero Energética – in a free translation "Mining and Energy Planning Unit") and National Dispatch Center (XM).

For the simple adjusted OM, the emission factor can be calculated using any of the following data vintages:

• *Ex ante* option: If the *ex ante* option is chosen, the emission factor is determined once at the validation stage, thus no monitoring and recalculation of the emissions factor during the crediting period is not required. For grid power plants, use a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation. For off-grid power plants, use a single calendar year within the five most recent calendar years prior to the time of submission of the CDM-PDD for validation.

• *Ex post* option: If the *ex post* option is chosen, the emission factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring. If the data required calculating the emission factor for year *y* is usually only available later than six months after the end of year y, alternatively the emission factor of the previous year y-1 may be used. If the data is usually only available 18 months after the end of year *y*, the emission factor of the year proceeding the previous year *y*-2 may be used.

The same data vintage (*y*, *y*-1 or *y*-2) should be used throughout all crediting periods.

For this project the ***Ex ante* option** has been chosen in order to use a fixed emission factor (there will be no need monitoring and recalculating the emission factor during the crediting period) given the availability of public information of 3-year generation-weighted average from official sources. Therefore this parameter remains unchangeable over all the crediting period.

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

The simple adjusted OM emission factor (EFgrid,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 (the Option B is not possible since: a) the necessary data for Option A is available):

$$EF_{grid,OM-adj,y} = \left(1-\lambda_y\right)\cdot\frac{\sum_m EG_{m,y}\times EF_{EL,m,y}}{\sum_m EG_{m,y}} + \lambda_y\cdot\frac{\sum_k EG_{k,y}\times EF_{EL,k,y}}{\sum_k EG_{k,y}}$$

Where:

EFgrid,OM-adj,y = Simple adjusted operating margin CO2 emission factor in year *y* (tCO2/MWh)
λy = Factor expressing the percentage of time when low-cost/must-run power units are on the margin in year *y*
EGm,y = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
EGk,y = Net quantity of electricity generated and delivered to the grid by power unit *k* in year *y* (MWh)
EFEL,m,y = CO2 emission factor of power unit *m* in year *y* (tCO2/MWh)
EFEL,k,y = CO2 emission factor of power unit *k* in year *y* (tCO2/MWh)
m = All grid power units serving the grid in year *y* except low-cost/must-run power units
k = All low-cost/must run grid power units serving the grid in year *y*
y = The relevant year as per the data vintage chosen in Step 3

EFEL,m,y, EFEL,k,y, EGm,y and EGk,y should be determined using the same procedures as those for the parameters EFEL,m,y and EGm,y in Option A of the simple OM method.

Determination of EFEL,m,y

According to the option A2 of the Tool; the emission factor of each power unit *m* is determined based on the CO2 emission factor of the fuel type used and the efficiency of the power unit, as follows (the Option A1 is not possible considering the unavailability of the information regarding fuel consumption data of each thermal power plant connected to the grid - this information is not public):

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y}\cdot 3.6}{\eta_{m,y}}$$

Where:

EFEL,m,y = CO2 emission factor of power unit m in year *y* (tCO2/MWh)
EFCO2,m,i,y = Average CO2 emission factor of fuel type *i* used in power unit *m* in year *y* (tCO2/GJ)
ηm,y = Average net energy conversion efficiency of power unit *m* in year *y* (ratio)
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.

Where several fuel types are used in a power unit, it has been used the fuel type with the lowest CO2 emission factor for EFCO2,m,i,y.

Selected option to calculate the emission factor of each plant is based on the efficiency of the different power plants in the Colombian power grid.

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} \cdot 3.6}{\eta_{m,y}} = HR_m \cdot EF_{CO_2,m,j,y}$$

HRm = Heat Rate, inverse of the efficiency of power unit *m* (MBTU/MWh), (GJ/MWh)

EFCO2,m,i,y = average CO2 emission factor of fuel type *i*, used in power unit *m*, in year *y* (tCO2/GJ)

Data and calculations for the emission factor of each power unit are included in the Annex 3: Baseline Information.

For cogeneration power plants, according to the option A3, due to only data on electricity generation is available, an emission factor of 0 tCO2/MWh has been assumed as a simple and conservative approach.

Determination of EGm,y and EGk,y

For grid power plants, EGm,y and EGk,y should be determined as per the provisions in the monitoring tables. All net electricity imports have been considered low-cost/must-run units *k*.

The parameter λy is defined as follows:

$$\lambda_y(\%) = \frac{\text{number of hours low-cost/must-run sources are on margin in year y}}{\text{8 760 hours per year}}$$

According to the methodology Lambda (λ*y*) should be calculated as follows:

Step i) Plot a **load duration curve**. Collect chronological load data (typically in MW) for each hour of the year *y*, and sort the load data from the highest to the lowest MW level. Plot MW against 8 760 hours in the year, in descending order.

Step ii) Collect eletricity generation data from each power plant / unit. Calculate the total annual generation (in MWh) from low-cost/must-run power plants / units (i.e. Σk EGk,y).

Step iii) Fill the load duration curve. Plot a horizontal line across the load duration curve such that the area under the curve (MW times hours) equals the total generation (in MWh) from low-cost/must-run power plants / units (i.e. Σk EGk,y).

Step iv) Determine the "Number of hours for which low-cost/must-run sources are on the margin in year *y*". First, locate the intersection of the horizontal line plotted in Step (iii) and the load duration curve plotted in step (i). 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.

All necessary data to calculate the Operating Margin emission factor are available in official sources such as National Dispatch Centre (XM) and UPME (*Unidad de Planeación Minero*

Energética). The information used corresponds to the last available information required to calculate the update of the national emission factor by official sources. Below we have the result:

***EFgrid,OM,y =* 0.54340**

Step 5: Calculate the build margin (BM) emission factor

In terms of vintage of data, project participants can choose between one of the following options:

Option 1: For the first crediting period, calculate the build margin emission factor ex ante based on the most recent information available on units already built for sample group *m* at the time of CDM-PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Option 2: For the first crediting period, the build margin emission factor shall be updated annually, *ex post*, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated *ex ante*, as described in Option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

Build Margin emission factor has been calculated based on the Option 1, ex-ante.

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

(a) Identify the set of five power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently (SET5-units) and determine their annual electricity generation (AEGSET-5-units, in MWh);

(b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEGtotal, in MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEGtotal (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) (SET≥20%) and determine their annual electricity generation (AEGSET-≥20%, in MWh);

(c) From SET5-units and SET≥20% select the set of power units that comprises the larger annual electricity generation (SETsample);

Identify the date when the power units in SETsample started to supply electricity to the grid.

If none of the power units in SETsample started to supply electricity to the grid more than 10 years ago, then use SETsample to calculate the build margin.

The calculation method should be chosen according to the set of power units that comprises the larger annual generation.

The option that corresponds to the highest annual generation will be chosen from the two alternatives: the energy produced by the 5 most modern power stations in Colombia or the most recent power stations generating the 20% of the electricity. If 20% falls on part capacity of a unit, that unit is fully included in the calculation.

The Build Margin emission factor is therefore calculated based on the 20% of the electricity generated, which is larger than the electricity generated by the five most recently built power units.

The build margin emission factor is the generated-weighted average emission factor (tCO2/MWh) of power units *m* during the most recent year *y* for which electricity generation data is available.

The following formula was used to calculate the build margin emission factor:

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

Where:

EFgrid,BM,y = Build margin CO2 emission factor in year *y* (tCO2/MWh);
EGm,y = Net quantity of electricity generated and delivered to the grid by power unit m in year *y* (MWh);
EFEL,m,y = CO2 emission factor of power unit m in year *y* (tCO2/MWh);
m = Power units included in the build margin;

y = Most recent historical year for which electricity generation data is available.

The CO2 emission factor of each power unit *m* (EFEL,m,y) should be determined as per the guidance in Step 4 (a) for the simple OM, using options A1, A2 or A3, using for *y* the most recent historical year for which electricity generation data is available, and using for *m* the power units included in the build margin. Below we have the result:

***EFgrid,BM,y =* 0.19215**

Step 6 : Calculate the combined margin emissions factor

The calculation of the combined margin (CM) emission factor (EFgrid,CM,y) is based on one of the following methods:

(a) Weighted average CM; or

(b) Simplified CM.

For the project activity the method applicable is:

(a) Weighted average CM

The combined margin emissions factor is calculated as follows:

EFgrid,CM,y = EFgrid,OM,y x wOM + EFgrid,BM,y x wBM

Where:

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year *y* (tCO_2/MWh)

$EF_{grid,OM,y}$ = Operating margin CO_2 emission factor in year *y* (tCO_2/MWh)

w_{OM} = Weighting of operating margin emissions factor (%)

w_{BM} = Weighting of build margin emissions factor (%)

Considering that the project activity is based on SHPs, the calculation of the combined margin emissions factor shall use the following default values for w_{OM} and w_{BM}:

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 period.

$EF_{grid,CM,y} = 0.54340 \times 0.5 + 0.19215 \times 0.5$

$$\mathbf{EF_{grid,CM,y} = 0.36777\ (tCO_2/MWh)}$$

Since:

$$EF_{grid,CM,y} = EF_{CO_2,grid,y}.$$

The Emission Reductions for this project activity are:

$$ER = BE_y - L_y - PE_y$$

The baseline emissions would be then proportional to the electricity delivered to the grid throughout the project's lifetime. Baseline emissions due to displacement of electricity are calculated by multiplying the electricity baseline emissions factor ($EF_{grid,CM,y}$) for the electricity generated by the project activity.

$$BE_y = EG_{BL,y} \cdot EF_{CO_2,grid,y}$$

The electricity energy generated ($EG_{BL,y}$) in the year *y* are estimated in 16 556 MWh/year.

So the baseline emissions are:

$$BE_y = 16\,556 \cdot 0.36777 = \mathbf{6\,088\ tCO_2e/year}$$

Thus all this, the Emission Reductions (ER) from the project activity are:

$$\mathbf{ER = 6\,088 - 0 - 0 = 6\,088\ tCO_2e/year}$$

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions (tCO_2 e)	Project emissions (tCO_2 e)	Leakage (tCO_2 e)	Emission reductions (tCO_2 e)
Year 1	6 088	0	0	6 088
Year 2	6 088	0	0	6 088
Year 3	6 088	0	0	6 088
Year 4	6 088	0	0	6 088
Year 5	6 088	0	0	6 088
Year 6	6 088	0	0	6 088
Year 7	6 088	0	0	6 088
Year 8	6 088	0	0	6 088
Year 9	6 088	0	0	6 088
Year 10	6 088	0	0	6 088
Total	60 880	0	0	60 880
Total number of crediting years	10			
Annual average over the crediting period	6 088	0	0	6 088

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter	$EG_{BL,y}$
Unit	MWh
Description	Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y
Source of data	Electricity meter
Value(s) applied	16 556 MWh/y
Measurement methods and procedures	Sales invoices will be used to cross check with the plant daily and monthly records.
Monitoring frequency	Continuous monitoring, monthly reported.
QA/QC procedures	Electricity meters will be calibrated according to the manufacturer's specification but at least once in three years. Data will be cross checked with the electricity sales invoices.
Purpose of data	Calculation of Emission Reductions
Additional comment	Data will be archived at least for two years after crediting period.

B.7.2. Sampling plan

N/A

B.7.3. Other elements of monitoring plan

An organization structure will be set up for the purpose of monitoring the project activity. According to the methodology, "*Monitoring plan shall consist of metering the net electricity supplied by the project activity to the grid. Measurement results shall be cross-checked with records for sold electricity. Hourly measurement and monthly recording are required*".

The following are the key items that are considered in the monitoring plan:

i) **Monitoring equipment and installation**

The only data required to be monitored is the electricity supplied to the grid by the project.

The main electricity meter for establishing the electricity delivered to the grid will be installed at the input end of the transmission line (i.e. at the output hydroelectric plant). This electricity meter will be the revenue meter that measures the quantity of electricity that the project will be paid for. As this meter provides the main CDM measurement, it will be the key part of the verification process. The meter has not been chosen yet, but it will be chosen and installed according to the regulation applicable at all events.

The technical characteristics of the meter which will be installed are:

- **Type of meter**:
  - Induction meter, single-phase three-wire (1-phase 3-wire), 120/240 V, 10 (100) A, cyclometer.
  - Induction meter, single-phase three-wire (1-phase 3-wire), 120/240 V, 1 to 2.5 (6 to 10) A, cyclometer.
  - Meter induction phase (3 phase 4 wire), 3 x 120/208 V, 1 to 2.5 (6 to 10), cyclometer.
- **Reference voltage**: 120/240 V for single-phase 3-wire (1-phase 3-wire) 120 V for single-phase 2-wire (1-phase 2-wire) and 120/208 V to three phase (3 phase 4 wire). 60 Hz frequency.
- **Losses**: the burden of each circuit voltage should be less than 2 watts / 8 VA. The burden of each circuit should be less than 2.5 VA for class 2 and 4 VA for class 1.
- **Isolation**: meter and their accessories shall be constructed so as not to lose any of its dielectric qualities under normal use conditions specified above and the various stresses to which they have to submit their respective circuits. The insulation shall withstand tests under normal and pulse electrical isolation between circuits indicated in the NTC 2288 (IEC-60521). After these tests should not be made changes in the error rate of the meters, larger than the measurement uncertainty.
- **Heating and fire**: the meter must meet the requirements of temperature rise under the standard NTC 2288 (IEC-60521).
- **Accuracy and precision**: the meter should be of accuracy class 1 or 2 and must meet all specified in paragraphs corresponding NTC 2288 (IEC-60521).
- **Starting current**: the meter should boot disk and rotate continuously rated voltage and frequency and power factor equal to 1, with a current value not exceeding stipulated for it in the NTC 2288 (IEC-60521) for type tests and routine and the NTC 2149 (IEC-60514) for acceptance testing.
- **Idle**: meters must meet the requirements of idling NTC established in 2288 (IEC-60521).
- **Regulation**: adjustment devices must be readily accessible and operable from the front of the meter, only removing the main cover of the same and should not be altered in the course of time by handling, transport, shock or vibration, the meters are exposed. A minimum setting the following devices: magnet brake, low load and inductive load. All control devices must be independent of each other, their mutual influence should be the minimum possible and except for inductive load adjustment, all must allow micrometric adjustment. Each device must have a clear and indelible marking in low or high relief indicating the direction of increase and decrease of the speed of the rotor disk and a legend indicating the type of setting you make. The meter that has been adjusted to allow adjustment margins indicated in the NTC 2288 (IEC - 60521). The adjustment and testing instructions and graphics of the curves of the error rate against displacement or number of turns of each adjuster should be provided.

Besides the meter will meet the characteristics as described in documents RA7-217[13], RA8-013 and RA8-030; applicable regulation in the host country.

ii) **Technological elements**

For the readings and reports of generated energy is required to install the measurement equipment at the substation of the power plant or in a place that from the technical point of view is highly recommended, these elements are comprised mainly of current transformers, transformers power and electronic meter, all calibrated by a legally registered entity and approved by regulators.

iii) **Central Reading and reports**

GEDEN SAS will read all boundaries using software registered trademarks provided by the manufacturer of the gauges. This software will consolidate the information to be reported daily to the National Dispatch Authority, through access to XM's online platform.

iv) **Procedure of data recording and archive**

- Electricity will be monitored using a continuous meter and recorded through the main meter.
- Grid Company will confirm the electricity transactions.
- Records of the meter readings and copies of sales receipts will be obtained to reflect the actual data of supplied electricity to the grid.
- Project owner will archive the data electronically until two years after the end of the crediting period.
- Quality assurance and Quality control will be applied: The quality of data generated by this project will be maintained through the development of an overarching monitoring system. This system may include procedures used to double check data, for staff training, meter calibration, accreditation of the facility completing calibration and the adherence to the relevant standards.

v) **Monitoring Management Structure**

An organization structure for monitoring Las Palmas is outlined in following figure. The project owner will appoint an executive to be responsible for monitoring of all parameters considered in section B.7.1, data acquisition and recording for CDM purposes. The monitoring organization structure includes the persons responsible for the monitoring work, data collection and storage and archiving as well as reporting. A plant Manager is assigned to take charge for supervising measurement and recording works, related to data collection (meter readings, sale receipts) that will be performed by operational staffs. The CDM manager is responsible for the overall data monitoring, verification process, calculating emission reductions and preparing a monitoring report to the companies' director as well as to a DOE.

[13] NORMAS DE MATERIALES PARA REDES AÉREASMEDIDORES DE INDUCCIÓN DE ENERGÍA ACTIVA CLASE 1 Y 2,MONOFÁSICOS (BIFILARES - TRIFILARES) Y TRIFÁSICOS

http://www.epm.com.co/site/portals/0/users/001/01/1/ra7-217.pdf.

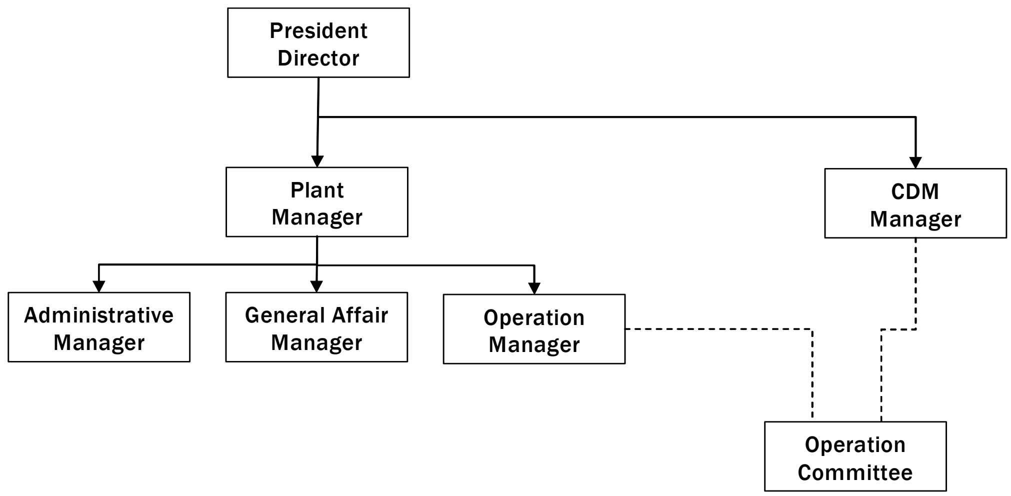

Figure 3. Monitoring management structure

vi) **Training**

In order to ensure a proper monitoring of emissions reductions as well as any leakage effects generated by the project activity, the staff from GEDEN SAS will be trained enabling them to undertake essential tasks in a reliable approach.

B.7.4. Date of completion of application of methodology and standardized baseline and contact information of responsible persons/ entities

Date of application of methodology is 18/07/2014 (completion date of the PDD v.09).

Contact information of responsible persons/entities

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Ecoterrae Global Solutions, S.L.

Calle Polonia 6, portal 1 bajo A. PC 41012 Seville, Spain.

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

24/05/2012 as per the signing date of the contract for the construction of the project.

C.1.2. Expected operational lifetime of project activity

25 years

C.2. Crediting period of project activity

C.2.1. Type of crediting period

Fixed

C.2.2. Start date of crediting period

01/10/2014

C.2.3. Length of crediting period

10 years

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

The project counts with all the required licenses, permits, concessions, and authorizations granted by the regional environmental authority (*Corporación Autónoma Regional del Centro de Antioquia, Corantioquia*[14]*)*. As per the Decree 1220 from April, 2005[15], no environmental license is required for the purpose of this project because the project activity consists of a hydroelectric power plant with installed capacity less than 10 MW. The Concession for water use, which is mandatory for the plant to generate electricity, has been obtained.

Las Palmas Hydroelectric Project employs run-of-the-river technology thus has minimal impacts on the surrounding environment compared those associated with thermoelectric plants or hydrological projects with large dams and reservoirs.

However, according to the Colombian legislation, it is necessary to obtain the Permit for Water Collecting. This license is the main authorization to build a hydroelectric power plant according to the characteristics of Las Palmas project. The Permit for Water Collecting is the authorization for the use and exploitation of water resources is grasped either from surface sources like rivers, streams, creeks, births, ditches, feints, etc.., or from underground sources like boreholes, either to collective or individual household, agricultural, livestock, irrigation, recreational, industrial, power generation, among others

This license has been processed with CORANTIOQUIA (*Corporación Autónoma Regional del centro de Antioquia)* which is the environmental local authority in the region of the project's location.

The project has obtained all the required permissions, and they are available to be checked by the DOE during validation process.

[14] http://www.corantioquia.gov.co/

[15] Ministerio de Ambiente, Vivienda y Desarrollo Territorial. Decreto Número 1220 de 2005. Arts. 8 & 9.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

In order to let the stakeholders realize the project situation and hear their opinions and recommendations on the project, the project owner invited stakeholders to take part in two meetings. On 7/04/2011 a meeting was arrange in the dependencies of the municipal council of Santa Rosa de Osos. The second meeting was carried out on 12/04/2011 in the rural district called *Vereda La Planta*. Local stakeholders were invited by means of publication of a notice in the municipal council bulletin board.

Figure 4. Stakeholders meeting (I)

Figure 5. Stakeholders meeting (II)

E.2. Summary of comments received

The positive assessment on the project was made by the stakeholders taking part in the reunion:

1. The project will generate electricity with the water resources of Rio Grande; it will mitigate the power lack of the area.

2. The project activity can provide job opportunities for the local residents during the construction and after the project is put into operation, and promote the local development of the third industry and relevant industries, thus the living standard of the local people will be improved.

3. They all support the project powerfully because it is helpful to the country and the masses. They hope that the project can be put into operation as soon as possible so as to produce benefits.

The comments received from stakeholders are summarized in the following points expressing their general opinions. The comments during the meeting were related to:

Table 6. Comments received during the meeting	
Name of the stakeholder	**Comment**
Leonel Arango	I hope this project will benefit the village with a good field for the sport of our youth.
German Darío Tamayo	I hope that this project will consider a new school for the benefit of our children
Luis A. Mazo Lopera	Collaboration for the educational institution
Livier Dario Gaviria A.	I hope the project will bring positive benefits to our village
Sergio M. Diaz Perez	Hope the company collaboration to work with the aqueduct and also to improve the school of the village
Heidy Sara Mazo Giraldo	It would be a good project because it contributes to development of the municipality and the community
Yolanda Elma Gomez Pérez	We hope the project to be constructed in the village implies productive actions, inter alia, a new school

The stakeholders also put forward the others following issues and suggestions:

1. The local residents should have a priority to get job opportunities during the construction and operation.

2. Although the impacts on water, air and noise environment during the construction are in a small scope and slight degree, the project owner should take the required measures of the environmental protection seriously to ensure that the production and living of the local people is not affected obviously.

3. The water and soil conservation should be conducted well; especially the vegetation should be recovered after the completion of the construction.

In conclusion, the stakeholders consider that the Las Palmas project will clearly contribute to the sustainable development of the region, will create employment and will improve the life quality in the region.

All questionnaires and the list of attendants were filed by the PP.

E.3. Report on consideration of comments received

No negative comments were received

SECTION F. Approval and authorization

Both Letter of Approval from the *Colombia* and *United Kingdom* DNA will be provided.

Appendix 1. Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	GENERACIÓN DE ENERGÍA, S.A.S.
Street/P.O. Box	Carrera 48 26 Sur 181 – LC 126 of 229
Building	209
City	Envigado
State/Region	Antioquia Department
Postcode	055422
Country	Colombia
Telephone	+57 315 507 85 43
Fax	-
E-mail	laspalmascdm@gmail.com
Website	-
Contact person	
Title	General Manger
Salutation	Mr.
Last name	Fernandez Salazar
Middle name	Alberto
First name	Carlos
Department	-
Mobile	+57 315 507 85 43
Direct fax	-
Direct tel.	-
Personal e-mail	laspalmascdm@gmail.com

Project participant and/or responsible person/ entity	☒ Project participant ☒ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	ECOTERRAE GLOBAL SOLUTIONS, SL
Street/P.O. Box	Calle Polonia 6, portal 1 bajo A
Building	
City	Sevilla
State/Region	Andalucía
Postcode	41012
Country	España
Telephone	+34 696 592 361
Fax	-
E-mail	info@ecoterrae.com
Website	www.ecoterrae.com
Contact person	
Title	General Manager
Salutation	Mr.
Last name	García Lázaro
Middle name	-
First name	Daniel
Department	-
Mobile	+34 696 592 361
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Appendix 2. Affirmation regarding public funding

No public funding has been involved in financing this project activity

Appendix 3. Applicability of methodology and standardized baseline

Appendix 4. Further background information on ex ante calculation of emission reductions

Ex ante calculation of the grid emission factor

The grid emission factor is determined according to the "Tool to calculate the emission factor for an electricity system", as a Combined Margin emission factor, consisting of the combination of the Operating Margin and the Build Margin emission factors. Following tables summarizes the grid emission factor calculation for ex ante estimation.

Table 7. Grid emission factor calculation				
Operating Margin Emission Factor				
	2008	**2009**	**2010**	
OM No Low cost/Must run	0.6436	0.6215	0.6022	
OM Low cost/Must run	0.0000	0.0000	0.0000	
Lambda	0.3113	0.0451	0.0203	
$EF_{OM\ Simple\ adjusted;y}$	0.4432	0.5935	0.5899	**TOTAL**
Generation [MWh]	54 112 552	55 641 481	56 572 103	166 326 136.04
$EF_{OM\ Simple\ adjusted\ 10,09,08}$	**0.54340**			tCO2/MWh
Build Margin Emission Factor				
$EF_{BM\ 10}$	**0.19215**			tCO2/MWh
Combined Margin Emission Factor				
EF_{CM} (weight 0.5)	**0.36777**			tCO2/MWh

Appendix 5. Further background information on monitoring plan

I. General introduction

Monitoring plan determines the target distribution and time arrangement of monitoring, to ensure the true, maintainable and measurable GHG of CDM project can be monitored, recorded and reported. This is the key procedure to determine the CERs. According to monitoring plan, monitoring system should be reliable, conservative and comprehensive, this system should have the function of data evaluation, measurement, and collection and monitoring, meanwhile provide true, reliable and conservative CERs monitoring and calculation process & result to DOE when doing the project verification. This procedure will ensure the authenticity of CERs from CO2 reduction to the CERs buyers.

The staffs that are responsible for monitoring should strictly follow the monitoring plan. They should effectively and truly report the project CERs.

II. Project integration management

The monitoring plan of the project will be executed by the project owner, meanwhile guided by ECOTERRAE GLOBAL SOLUTIONS, S.L., and verified by DOE. To ensure the smooth implementation of the monitoring plan, the project owner has established clear monitoring system.

The monitoring system of this project is shown in the follow figure:

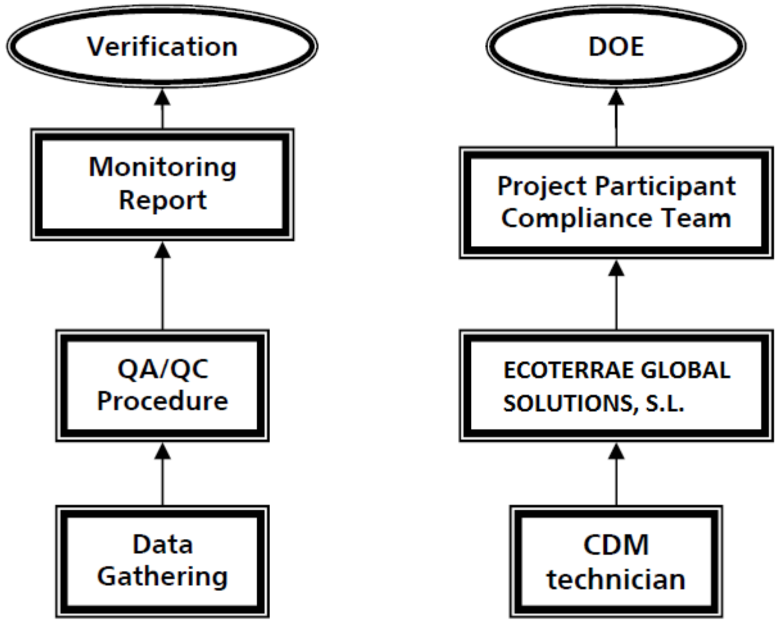

Figure 6. Monitoring system

III. Data to be monitored

This project mainly focuses on the monitoring of project electricity supply to the National Colombian Power Grid (EGy), i.e. the net electricity. The net electricity export/supplied to a grid is the difference between the measured quantities of the grid electricity export and the import. The electricity exported by the Project to the grid will be measured by electricity meter installed at the Transmission Substation and recorded per month.

Electricity transaction notes will be obtained as an additional check. Both of these data are provided by the Grid Company and will be double checked by each other. Calibration of meters should be implemented according to manufacturer instructions. And all the records should be documented and maintained by the project participants for DOE's verification.

IV. Monitoring procedure

The CDM monitoring of this project is mainly focused on the monitoring of electricity supply to Grid. Electricity supply to National Colombian Grid from this Project will be monitored by electricity meter installed at substation. The meter will be calibrated according to the manufacturer specifications to ensure its accuracy.

Electricity supply to National Colombian Grid from this project is monitored by electricity meter, which located in the substation. The data is stored both in Grid Company and in project owner. Records for sold/purchase electricity will be provided for double check each year.

Procedures for maintenance of the monitoring equipment and installations

The monitoring system will be maintained by the project owner periodically. Its precision will ensue any error occurred within the acceptable scale. Measuring equipment should be certified to national or IEC standards and calibrated according to the national standards and reference points or IEC standards and recalibrated at appropriate intervals according to manufacturer specifications, but at least once in 3 years.

Calculation of emission reductions

Emission reduction of the project will be calculated by ECOTERRAE GLOBAL SOLUTIONS, S.L., as participant of the project. To ensure the transparency and conservative, an excel table is used for calculation, with all relative data and calculate process provided. Meanwhile, source of default value is provided for DOE verification.

V. Management process

Quality Assurance & Quality Check

QA&QC, including data monitoring, maintenance and storage, will be modified according to operation status and verification requirement.

Data management systems

Data management systems are used to keep monitoring data. It is the key step in monitoring process. The emission reductions cannot be verified, if the monitoring data is not kept well.

The original data and the final results, as well as all the information and relative data will be kept electronically in the project boundary.

Procedures for review of reported results/data and for corrective actions

To guarantee the accuracy and rationality of the reported results/data for verification, the project participants should undertake the responsibility of internal review. All reported results/data should pass the internal review prior to submission to DOE.

Electronic copy of data recorded will be submitted to the project manager for the internal review. The objective of the internal review includes reliability of project operation, continuity of monitoring and accuracy of monitored data. The results of the internal review are able to be checked with the information published in the official web site of the operation coordinator of the National Interconnected System.

Moreover, all of the monitored data and results related to the internal review should be archived by the project owner and transparent for verification.

Verification of monitoring results

Verification of monitoring results is a necessary part of all CDM projects. The main purpose of verification is to verify the achievement of GHG reduction independently. The verification frequency of the project will be done based on the project participants' request.

ECOTERRAE GLOBAL SOLUTIONS, S.L., as the contactor of DOE verification, will be in charge of revising every monitoring plan according to the verification content.

Personnel training

The monitoring plan needs to be execute by qualified professionals, therefore project participants agree internally on a training programme.

The training programme will be carried by the relevant personnel on a periodic basis.

Efficiency evaluation

To assess whether the project can reach the efficiency anticipated on the PDD, the project participants evaluate the electricity delivered to the grid and project power generation at the end of every year.

The evaluation results will be stored as reference for next year.

Appendix 6. Summary of post registration changes

Not applicable

Document information

Version	*Date*	*Description*
05.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the project design document form for small-scale CDM project activities (these instructions supersede the "Guidelines for completing the project design document form for small-scale CDM project activities" (Version 01.1)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from *F-CDM-SSC-PDD* to *CDM-PDD-SSC-FORM*; • Editorial improvement.
04.1	11 April 2012	Editorial revision to change history box by adding EB meeting and annex numbers in the Date column.
04.0	13 March 2012	EB 66, Annex 9 Revision required to ensure consistency with the “Guidelines for completing the project design document form for small-scale CDM project activities”
03.0	15 December 2006	EB 28, Annex 34 • The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.
02.0	08 July 2005	EB 20, Annex 14 • The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
01.0	21 January 2003	EB 07, Annex 05 Initial adoption.

Decision Class: Regulatory
Document Type: Form
Business Function: Registration
Keywords: project design document, SSC project activities