Project design document form
(Version 11.0)

Complete this form in accordance with the instructions attached at the end of this form.

BASIC INFORMATION	
Title of the project activity	Hydro Electric Plant - Hidro Pantasma
Scale of the project activity	☐ Large-scale ☒ Small-scale
Version number of the PDD	06
Completion date of the PDD	15/09/2021
Project participants	Hidropantasma S.A.
Host Party	Nicaragua
Applied methodologies and standardized baselines	AMS-I.D. - Grid connected renewable electricity generation (Version 18.0). There is not standardized baseline applicable to this project.
Sectoral scopes	Sector scope (1): Energy industries
Estimated amount of annual average GHG emission reductions	30,862 tCO_2

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The Hydro Electric Plant - Hidro Pantasma project is a small run-of-river renewable hydroelectric plant with a total installed capacity of 14.4MW[1] (rated capacity of generators), located along the Pantasma river between the ground elevation lines 843 and 444 (left bank) above sea level, at 22 km north of the municipality of Jinotega (Department of Jinotega). The energy generated is sold and therefore distributed through the National Interconnected System of Nicaragua.

For the energy generation, the project is small-scale (having less than 15 MW of installed) and falls under UNFCCC sectoral scope 1 (Energy industries - renewable/non-renewable sources), type I renewable energy project, category I.D Grid Connected Renewable Energy Generation, according to the Appendix B of the Simplified Modalities and Procedures for Small Scale CDM Projects activities.

The project activity contemplates the production of clean hydroelectric power using a flow of water. The project collects the waters of the Pantasma River in the point 843 meters above sea level, driving the water flow through a Creager free-spillway diversion dam to an underground low-pressure steel pipeline network, through this, the water flow runs down-river until it reaches the project power house which holds two (2) Pelton turbines with their respective generators and valves. The electricity generated in the powerhouse is driven through a 11 km transmission line to the Asturias Substation where it enters the National Interconnected System of Nicaragua, and ultimately distributed to end consumers.

The project generates electricity for the Nicaraguan power grid with low emissions technology. The power plant has an effective capacity of 13.7 MW[2] (rated capacity of turbines), with a predicted power supply to the grid of 62,415 MWh[3] per year. Therefore, the baseline scenario is that 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. The project increases the supply of electricity to the grid, offsetting thermal generation with a renewable source of energy, and consequently reducing greenhouse gases emissions. The project reduces approx 30,862tCO2e per year. The project was implemented by Hidropantasma S.A., a private electric services company with the purpose of assuming the electric energy generation, transmission, and maintenance functions. The design engineering was developed by the engineering company Carbon Ingenieria, S.A. from Costa Rica, while the construction and installation was undertaken by Grupo Corporativo Saret.

The participants of the project recognize that this project activity is helping Nicaragua to fulfill its goals of promoting sustainable development. Furthermore, the project is in line with host-country specific CDM requirements because it:

- Contributes to local environmental sustainability.
- Contributes towards better working conditions and increases employment opportunities in the area where the project is located.
- Contributes towards better revenue distribution for helping to improve local and regional economic development.

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[1] This value is determined according to the provisions of “General guidelines to SSC CDM methodologies” in which the rated/installed capacity for renewable electricity generating units that involve turbine-generator systems shall be based on the installed/rated capacity of generator according to the manufacturer´s specification. Generator nameplate specification.

[2] This value corresponds to the maximum output of the system turbine-generator (the turbine capacity is smaller than the generator capacity) based on the installed/rated capacity of turbines according to the nameplate specification.

[3] Value determined considering a generating capacity of 13.7 MW (rated capacity of turbines), taking into account a reduction due to the parasitic load of electricity consumption needed by the plant to operate, reducing the output to 12.5 MW approximately (this is conservative).

- Contributes to development of technological capacity because all technology, man power and technical maintenance are provided locally in the country.
- Contributes to regional integration and connection with other economic sectors.
- Supports local development by providing access to roads and zones that were previously isolated.
- Reduction of 30,862 tCO2e per year contributing to prevent global warming.
- Aiding the Instituto Nicaraguense de Energia (INE) rural electrification projects, by improving the National Interconnected System of Nicaragua
- Contributes to diminish the amount of energy generation derived from the use of fossil fuels as a base.
- Increases the contribution of small scale hydroelectricity projects to electricity generation in the region, and therefore, it may encourage other similar companies that want to replicate this kind of projects.

A.2. Location of project activity

The project activity wasimplemented on the left bank of the Pantasma River, in the department of Jinotega, Nicaragua. The project site, where the works have been developed, is located at 250 km from Managua (Nicaragua's capital) and 22 km north of the city of Jinotega.

The coordinates for the project location (Cartesian coordinate system) are:

- Water intake (Lat: 13.2867°, Long: -86.0069°) (UTM: E 607,570 ; N 1,469,059.54)
- Power house (Lat: 13.3005°, Long: -85.9700°) (UTM: E 611,556 ; N 1,470,600.47)

The geographical project location is showed in the following figure:

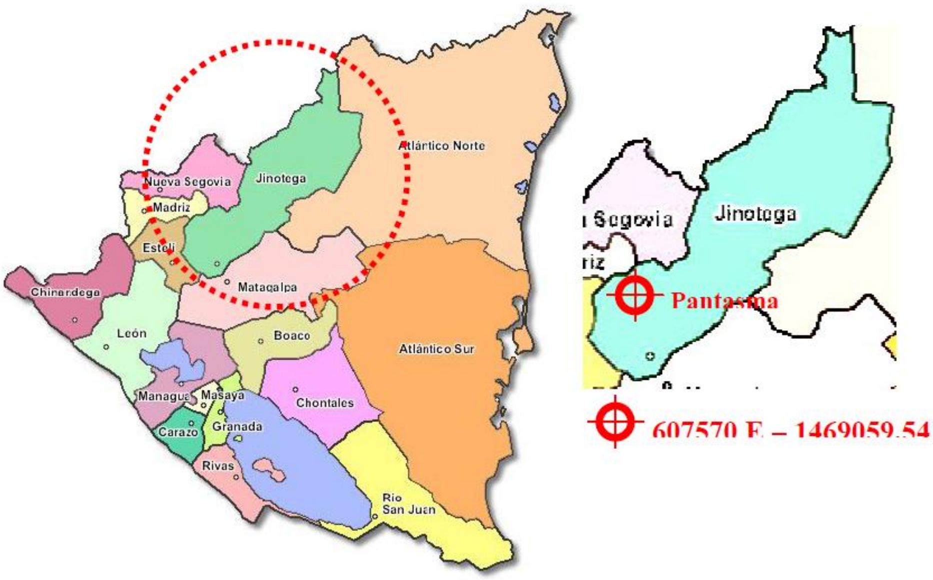

Figure 1: Location of the Hydro Electric Plant - Hidro Pantasma

A.3. Technologies/measures

The project uses a deviation of a percentage of the total Pantasma river water flow between the ground elevation lines 843 and 444 above sea level, in order to take advantage of approximately 374 meter net head and a water flow of 4m^3/s. With these resources, the project obtains an effective

capacity of 13.7 MW[4] (rated capacity of turbines) with an annual power supply estimated around 62,415 MW/h[5].

The project has the following characteristics:

Water capture (Intake): the water is obtained by a concrete diversion dam with a Creager-type uncontrolled spillway (with a lateral intake). The dam was constructed 19 meters high and 37.5 meters long, in order to contain a reservoir with a capacity of approximately 250,000 cubic meters of water. The design flow considered for discharge is 4.00 m^3/s, while the median river flow is 2.56 m^3/s. The dam has a bottom discharge gate of 2.5 m x 2.5 m in order to periodically clean the reservoir and maintain relatively low sediment levels. The 131 m long embankment dam was installed to complete the closure on the right bank.

Water conduction (from upstream to downstream): the water conduction was completed by a low-pressure pipe made of steel with a length of 2,329 m and a diameter of 1.5 m. The pipeline was buried, but a 460 m length fraction was used as a siphon to save a depression of 66 m; in addition, it has two steel aerial passages that are 25 m and 29 m in length. The water is then conducted through a horseshoe tunnel section 818 m long and 2.1 m wide. A surge tank of 34.15 m high and 5 m of internal diameter is located at the end of the flow. Finally, a penstock welded steel pipe 840 m long with a width of 1.25 m, followed by two welded steel strands that are 12.2 m by 0.85m conduct water to the turbines intake valves.

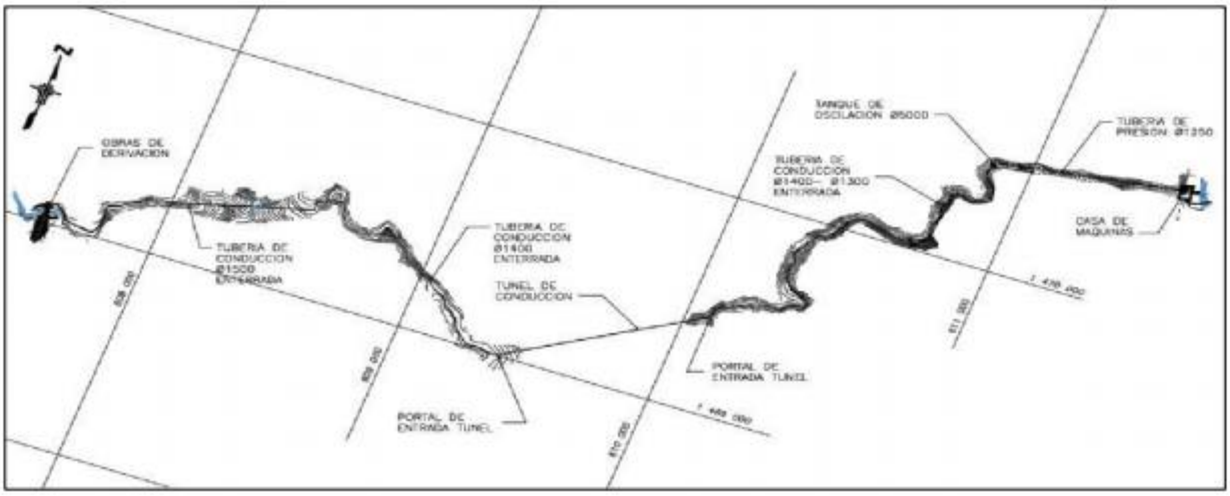

Figure 2: Technical project configuration

Power generation: At the end of the penstock is located the power house and is above the inundation levels of the stream (safe from flooding).

The power house has 2 horizontal axis Pelton type turbines (hydraulic reaction turbine in which the flow exits the turbine blades in an axial direction) connected to respective synchronous generators. The discharge is conducted by independent reinforced concrete channels for each unit of 2 m wide and 26.5 m length. A dissipation structure to return the water to the stream channel was constructed as well. The technical characteristics of the major equipment are presented in the following table.

[4] This value corresponds to the maximum output of the system turbine-generator (the turbine capacity is smaller than the generator capacity) based on the installed/rated capacity of turbines according to the nameplate specification.

[5] Value determined considering a generating capacity of 13.7 MW (rated capacity of turbines), taking into account a reduction due to the parasitic load of electricity consumption needed by the plant to operate, reducing the output to 12.5 MW approximately (this is conservative).

Table 1: Technical specifications of the major equipment

Turbines	Parameter
Manufacturer	KOSSLER GESELLSCHAFT m.b.H
Type	Pelton – PH2I - 1300/390
Number of turbines	2
Axis	Horizontal
Design Flow	2.00 m^3/s (each one)
Rated Output	6,860 kW (each one) [6]
Speed	600 rpm
Impeller diameter	1,300 mm
Design head	374 m
Turbine efficiency (at design flow)	89.9%
Generators	**Parameter**
Manufacturer	Voith
Number of generators	2
Rated Output	7,200 kW (each one) [7]
Voltage	13,800 V +/- 5%
Power factor	0.90
Frequency	60 Hz
Speed	600 rpm
Connection	Star – Neutral grounded
Efficiency 100% of rated output	97.13%

The capacity of the power plant is based on data from technical specifications provided by the manufacturer; the energy generation is confirmed by means of the Ministerial Agreement No. 2-DGERR-02-2010 emitted by the Ministry of Energy and Mining in which the effective capacity is limited to a maximum of 12,500 kW[8]. As such, the project developer obtains the Electric Energy Generation License only for this capacity. The expected lifetime of the main equipment and the project is 40 years.

Power transmission: The electrical substation is located close to the power house in an area of about 10 m of length by 10 m of width. In the courtyard is located the transformers and the switching equipment required for the connection to the electrical network. Given the characteristics of the net, two generators are used in a synchronous continuous operation, which allow the regulation of the line voltage and supply the reactive power required. The equipment is geared with a static excitation system brushless (which requires less maintenance). The synchronization of the two units with the National Interconnected System of Nicaragua is manual and/or automatic as a function of voltage, frequency and phase sequence. The connection of the stator of each generator is star type with neutral grounded.

A 11 km transmission line with a voltage of 69 kV connects the project with the Asturias substation. The National Dispatch Center (a division of Enatrel) confirms the quantity of energy to be delivered by the project activity; Enatrel is in charge of the central control point of the meter readings.

Project monitoring technology

Energy measurement is carried out through bidirectional energy meters of 0.2 accuracy, which comply with standards ANSI C12.20-1998 "American national standard for electrical meters, 0.2 and

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[6] Nameplate specification.

[7] Nameplate specification.

[8] Value determined considering a generating capacity of 13.7 MW (rated capacity of turbines which is smaller than the generators capacity), taking into account a reduction due to the parasitic load of electricity consumption needed by the plant to operate, reducing the output to approximately 12.5 MW (this is conservative).

0.5 accuracy classes for current classes 2 and 20" and IEC 62053-22 "Electricity metering equipment (a.c), Static meters for active energy (classes 0.2 S and 0.5 S)". The power meters were installed in the substation which is the commercial boundary of the power plant. One meter is used as a main measurement device while the other meter is used as a back-up system. The meters are connected to an automatic control system through a communication network which allows its access for visualization of energy measures, and by modem, to the electrical distributing company. Data storage is made by internal memory. The internal memory in the acquired meters is able to record the history of measured values during several months. The long term data archiving is made by data transfer to a local PC by telemetry/telephone or to the control centre managed by the operator by specific communication channel (telephone line/modem). Data is backed-up every month in magnetic media and stored for verification. Only software authorized is available to handle monitored information. The meters were installed on a protection panel with sealed door and cover to avoid possible manipulation by non-authorized personnel.

A small power plant was installed at the power house to act as a back-up electricity system only for emergencies (e.g. during power shortages or the shutdown of the plant).

Baseline Scenario

As per the applicable methodology, a Greenfield power plant is defined as "*a new renewable energy power plant that is constructed and operated at a site where no renewable energy power plant was operated prior to the implementation of the project activity*".

As the project activity falls under the definition of a Greenfield power plant, the baseline scenario as per applied methodology is the following:
"*The baseline scenario is that 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*."

Hence, pre-project scenario and baseline scenario are the same.

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Nicaragua (host) ratified the Kyoto Protocol on 1999	Hidropantasma S.A. (Private Company)	No

A.5. Public funding of project activity

The project activity does not involve the use of public funding.

A.6. History of project activity

1. The PP hereby Confirms that:
   (a) The CDM project activity was neither registered as a CDM project activity nor included as a component project activity (CPA) in a registered CDM programme of activities (PoA); and
   (b) At the registration time the CDM project activity was not a project activity that has been deregistered.

2. The PP would like to Declare that:
   (a) The CDM project activity was not a CPA that has been excluded from a registered CDM PoA;
   (b) The project was not "A registered CDM project activity or a CPA under a registered CDM PoA whose crediting period has or has not expired (hereinafter referred to as former project) exists in the same geographical location as the proposed CDM project activity".

3. Since the declaration on 2(a) or 2(b) above is negative thus no further demonstration required.

A.7. Debundling

Appendix C of the simplified Modalities and Procedures for small scale CDM project activities states that "Debundling" is defined as the fragmentation of a large project activity into smaller parts. In addition, establishes that a project activity can 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; and
- 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.

After a review of the small scale CDM project activities registered or under application to register at the website http://cdm.unfccc.int/Projects/projsearch.html, considering as host country Nicaragua in the searcher, the project participant has determined that the project "Hydro Eletric Plant - Hidro Pantasma" is not a debundled component of a large project activity, as there are not a small scale CDM project activity registered within the previous 2 years or application to register of another small scale CDM project activity with the same project participant, in the same project category and technology/measure and whose project boundary is within one kilometer radius of this project activity. Thus, the project participant confirms that the project "Hydro Eletric Plant - Hidro Pantasma" is not a part of any large project, and therefore is not a debundled component of a large project activity.

SECTION B. Application of methodologies and standardized baselines

B.1. References to methodologies and standardized baselines

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

- Type I.D. (Reference AMS-I.D.) – "*Grid connected renewable electricity generation*" – Version 18.0. For the power generation using renewable sources that supply electricity to and/or displace electricity from an electricity distribution system[9].

Also, following the AMS-I.D. version 18.0 guidelines, it is applied for the renewal of the crediting period:

- Methodological Tool07 "*Tool to calculate the emission factor for an electricity system*" - for the calculation of emissions factor – Version 07.0[10].
- Methodological Tool03 "*Tool to calculate project or leakage CO2 emissions from fossil fuel combustion*" - for the calculation of project emissions from fossil fuel combustion – Version 3.0[11].
- Methodological Tool11 "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" - Version 03.0.1[12].

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[9] https://cdm.unfccc.int/methodologies/DB/W3TINZ7KKWCK7L8WTXFQQOFQQH4SBK

[10] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf/history_view

[11] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v3.pdf/history_view

[12] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-11-v3.0.1.pdf/history_view

B.2. Applicability of methodologies and standardized baselines

Appendix B of the simplified M&P for small-scale CDM project activities provides indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories. As per the M&P, the project activity falls under the following approved small scale methodology: AMS-I.D. - “Grid connected renewable electricity generation” – for the renewable energy generation. The project activity is in compliance with the applicability conditions of the approved baseline methodology in the context since:

<table>
<tr><th>No.</th><th>Technology /Measure as per AMS.I.D - Version 18</th><th>Measure of project activity</th></tr>
<tr><td>1</td><td>This methodology comprises renewable energy generation units, such as photovoltaic, hydro, tidal/wave, wind, geothermal and renewable biomass:
a. Supplying electricity to a national or a regional grid; or
b. Supplying electricity to an identified consumer facility via national/regional grid through a contractual arrangement such as wheeling.</td><td>The project activity is a small run-of-river hydroelectric plant and the energy generated is delivered to the National Interconnected System of Nicaragua.</td></tr>
<tr><td>2</td><td>Illustration of respective situations under which each of the methodology (i.e. AMS-I.D.: Grid connected renewable electricity generation”, “AMS-I.F.: Renewable electricity generation for captive use and mini-grid” and “AMS-I.A.: Electricity generation by the user) applies is included in Table below.
Table 1 Scope of AMS-I.D., AMS-I.F. and AMS-I.A. based on project types
<table>
<tr><th></th><th>Project type</th><th>AMS-I.A.</th><th>AMS-I.D.</th><th>AMS-I.F.</th></tr>
<tr><td>1</td><td>Project supplies electricity to a national/regional grid</td><td></td><td>√</td><td></td></tr>
<tr><td>2</td><td>Project displaces grid electricity consumption (e.g. grid import) and/or captive fossil fuel electricity generation at the user end (excess electricity may be supplied to a grid)</td><td></td><td></td><td>√</td></tr>
<tr><td>3</td><td>Project supplies electricity to an identified consumer facility via national/regional grid (through a contractual arrangement such as wheeling)</td><td></td><td>√</td><td></td></tr>
<tr><td>4</td><td>Project supplies electricity to a mini grid[1] system where in the baseline all generators use exclusively fuel oil and/or diesel fuel</td><td></td><td></td><td>√</td></tr>
<tr><td>5</td><td>Project supplies electricity to household users (included in the project boundary) located in off grid areas</td><td>√</td><td></td><td></td></tr>
</table></td><td>As the project activity supplies the energy generated to the National Interconnected System of Nicaragua, this meets the condition “Project supplies electricity to a national/regional grid”, therefore the most suitable methodology is AMS-I.D.</td></tr>
<tr><td>3</td><td>This methodology is applicable to project activities that:
a. Install a Greenfield plant;
b. Involve a capacity addition in (an) existing plant(s);
c. Involve a retrofit of (an) existing plant(s); or
d. Involve a replacement of (an) existing plant(s)</td><td>The Project activity consists of the installation of 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).</td></tr>
<tr><td>4</td><td>Hydro power plants with reservoirs that satisfy at least one of the following conditions are eligible to apply this methodology:
a. The project activity is implemented in an existing reservoir with no change in the volume of reservoir;
b. The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the project emissions section, is greater than 4 W/m^2;
c. The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the project emissions section, is greater than 4 W/m^2.</td><td>The project activity consists of the installation of a new small run-of-river hydroelectric plant which results in a new small reservoir whose power density is 58.19 W/m2 (this value has been determined on section B.6.3).</td></tr>
<tr><td>5</td><td>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</td><td>The project activity does not consider the installation of a power plant (unit) with both</td></tr>
</table>

	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	renewable and non-renewable components.
6	Combined heat and power (co-generation) systems are not eligible under this category.	The project activity is not a combined heat and power (co-generation) system.
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 project activity does not consider the addition of renewable energy generation units at an existing renewable power generation facility.
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 does not consider the retrofit or replacement of any unit.
9	In the case of landfill gas, waste gas, wastewater treatment and agro-industries projects, recovered methane emissions are eligible under a relevant Type III category. If the recovered methane is used for electricity generation for supply to a grid then the baseline for the electricity component shall be in accordance with procedure prescribed under this methodology. If the recovered methane is used for heat generation or cogeneration other applicable Type-I methodologies such as "AMS-I.C.: Thermal energy production with or without electricity" shall be explored.	The Project activity is a small run-of-river hydroelectric plant and is not a landfill gas, waste gas, wastewater treatment and agro-industries projects or recovered methane emissions project. Hence the criteria is not applicable to the project activity.
10	In case biomass is sourced from dedicated plantations, the applicability criteria in the tool "Project emissions from cultivation of biomass" shall apply.	The Project activity is a small run-of-river hydroelectric plant and is not a biomass project. Hence the criteria is not applicable to the project activity.

In addition, the project activity has an output capacity lower than 15MW, since the total installed capacity is 14.4 MW, therefore is in compliance with the small scale criteria.

B.3. Project boundary, sources and greenhouse gases (GHGs)

According to AMS.I.D Version 18.0, the spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system that the CDM project power plant is connected to. A representation of the project boundary can be seen in the figure below.

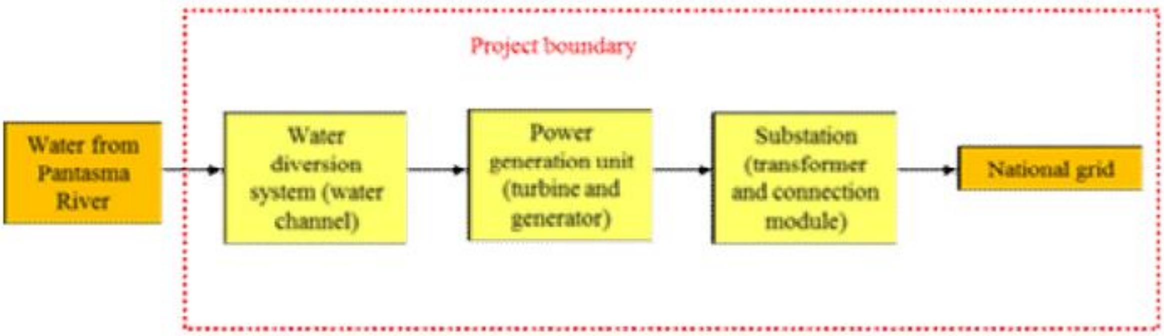

Figure 3: Project boundary definition

The baseline includes emissions related to the electricity produced by the facilities and power plants to be displaced by the proposed project. This involves emissions from displaced fossil fuel used in the power plants connected to the National Interconnected system of Nicaragua. In terms of greenhouse gases emissions, the project boundary considers the CO_2.

	Source	GHG	Included?	Justification/Explanation
Baseline	Energy generation in the National Interconnected system of Nicaragua	CO_2	Included	According to AMS.I.D, only CO_2 emissions from electricity generation using fossil fuels should be accounted for.
		CH_4	Excluded	Only CO_2 emissions are taken into account
		N_2O	Excluded	Only CO_2 emissions are taken into account
Project activity	Energy generation in Pantasma hydroelectric plant	CO_2	Excluded	The emissions are excluded according to AMS.I.D. (There will be only renewable energy generation).
		CH_4	Excluded	The emissions are excluded according to AMS.I.D. (There will be only renewable energy generation).
		N_2O	Excluded	The emissions are excluded according to AMS.I.D. (There will be only renewable energy generation).

There are no greenhouse gas emissions occurring within the proposed CDM project activity boundary as a result of the implementation of the proposed CDM project activity that contribute more than 1% of the overall expected average annual emissions reductions and which are not addressed by the applied methodology.

B.4. Establishment and description of baseline scenario

For the second crediting period, the continued validity of the original baseline has been assessed, following the stepwise procedure, according to the Tool11 "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" (version 03.0.1).

Step 1: Assess the validity of the current baseline for the next crediting period.

Step 1.1: Assess compliance of the current baseline with relevant mandatory national and/or sectoral policies.

For the renewal of the crediting period, no new national and/or sectoral policies are affecting the baseline scenario. In the absence of the project activity, electricity would still have been partly generated by fossil fuel power plants or by the addition of new fossil fuel power plants connected to the grid[13]. Also, considering that renewable energy projects have lower costs in the margin, they are always dispatched.

The national and sectoral policies relevant to the baseline scenario are: Law 272 of 1998 "Law of the Electrical Industry" and Law 554 of 2005 "Law of Energy Stability". These laws regulate the electricity sector in Nicaragua determining aspects regarding the operation and expansion of electric generation in the Nicaraguan system. These laws have been reformed in recent years, as well as Law No. 271, which together with Law No. 272 constitute the legal framework for the regulatory agency and for the Electricity Industry, and Laws No. 443, No. 467 and No. 532, which cover matters related to renewable energy sources. These recent reforms suggest that Nicaragua is trying to

[13] Ministerio de Minas y Energía, 2018. Electricity Generation Expansion Plan – Source: http://www.mem.gob.ni/wp-content/uploads/2019/05/Plan-de-Expansion-de-la-Generacion-Electrica-de-2019-2033.pdf

maintain an updated regulatory framework, integrating non-conventional renewable resources to its regulatory framework, advancing in the energy transition[14].

It can be said that the project complies with the current regulations dealing with renewable sources of power generation. Specifically, the project activity is not affected by the body of actual main regulations.

In order to construct and operate the hydroelectric plant and deliver electricity to the grid, there are several instances that are directly involved to control that the project is implemented in accordance with the regulation and legal requirements as briefly explained in the following summaries:

- **Ministry of Environment and Natural Resources (Marena):** is the entity in charge of the compliance with the environmental regulation in Nicaragua and is responsible for the implementation of strategies and programs for municipal development and for the control of polluting activities. Among other aspects, the law establishes the principles and requirements for those activities that could cause impact in the environment.

  According with the Decree 45-94, 1994 the project activity (energy generation over 5MW) requires an Environmental Permission; therefore, it was necessary to do an Environmental Impact Assessment which was approved by Administrative Resolution DGCA-028- 2008R on March 3, 2010, emitted by Marena. In addition, in its reports on the implementation of socio-environmental activities, compliance with the requirements of the environmental authority can be evidenced[15].

- **Ministry of Energy and Mining (MEM):** by means of the Ministerial Agreement No. 2-DGERR-02-2010, the project developer obtains the Electric Energy Generation License. The project received from the Ministry of Promotion, Industry and Trade the water concession to take advantage of the Pantasma River waters, Ministerial agreement DGRN-PAA-001-2006, licenses still valid. Likewise, the project developer received other permissions necessary for the construction of the power plant.

- **Nicaraguan Energy Institute (INE):** as the regulating entity, assures that all regulatory requirements are met. It also measures annually the capacity of the power plants and supports energy planning.

- **National Load Dispatch Center (CNDC):** is the entity in charge of the administration of the Nicaraguan electricity market (MEN) and the operation of the National Interconnected System (SIN).

Since the project is being operated in a highly regulated market that is controlled by a series of public and private actors, compliance with all applicable laws and regulatory requirements is supervised and can be guaranteed.

Therefore, it can be concluded that the fundamental elements of the baseline have not changed since the project was first registered, and the market structure, main regulatory framework, and functioning remains the same.

Step 1.2: Assess the impact of circumstances.

At the time of requesting renewal of the crediting period on the current baseline emissions, no impact of circumstances prevail. It can be concluded that the conditions used to determine the baseline emissions in the previous crediting period are still valid.

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[14] Instituto Nicaragüense de Energía (INE) – Source: https://www.ine.gob.ni/index.php/marco-regulatorio/ and https://www.ine.gob.ni/index.php/electricidad/normativas/

[15] See report on the implementation of socio-environmental activities during the operation process, 2021.

Recent laws which promote renewable energy sources have not modified the price structure and energy availability of the Law of Energy Stability of 2005, moreover Hidro Pantasma has a fixed price with no indexation under a contract signed for 15 years with DISSUR and DISNORTE. The enactment of the renewable energy sources law has not enhanced the continuation of the baseline scenario at the time of validation.

Step 1.3: Assess whether the continuation of use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewal is requested.

Since the baseline scenario identified at the validation is the continuation of the current practice, i.e. the electricity would be supplied by the power grid in the absence of the project activity, and the baseline did not consider the use of any existing equipment by the project, because in the absence of the project activity the energy generated would have been generated by the operation of grid-connected power plants and by the addition of new generation sources to the grid, this step is not applicable.

Step 1.4: Assessment of the validity of the data and parameters.

Relevant data and parameters, as the build and operating margin emission factors for the combined margin emission factor, were updated for the second crediting period according to the TOOL07 - Tool to calculate the emission factor for an electricity system - version 7.0. This update includes Grid Emission Factor and all values used in its calculation (fossil fuel emission factors etc). Application of Steps 1.1, 1.2, 1.3 and 1.4 above confirmed that the current baseline remains valid for the second crediting period; even though, some data and fixed parameters needed to be updated due to changes presented above. In this context step 2 is assessed below.

Step 2: Update the current baseline and the data and parameters.

Step 2.1: Update the current baseline*.*

Baseline emissions for the second crediting period have been updated in accordance with the stated above in step 1.4, without reassessing the current baseline, based on the latest approved version of the methodology AMS-I.D. (version 18.0). This update was applied in the context of the sectoral policies and circumstances that are applicable at the time of requesting for renewal of the crediting period, which have not changed as to affect the project dispatch.

Step 2.2: Update the data and parameters.

As said in step 1.4, the parameters regarding the grid emission factor calculation have been updated for this second crediting period using TOOL07 - Tool to calculate the emission factor for an electricity system - version 7.0. The build margin emission factor was updated for the second crediting period applying the ex-ante option, and the same way, the operating margin emission factor was revaluated applying the ex-ante option. More details can be seen in section B.6 and B.7 (updated monitoring parameters).

B.5. Demonstration of additionality

CDM prior consideration.

After seriously considering the benefits of the CDM in the decision to proceed with the project activity, the project developer developed continuing and real actions to secure CDM status in parallel to its implementation. In the following table is presented a detailed timeline for the project.

Table 2: Project timeline

CDM Actions prior to the project start date / Continuing actions to secure the CDM project status	
Date	**Key event**
15/05/2009	The potential to include the CDM income was indicated to Hidropantasma S.A. by power utility DISNORTEDISSUR.
05/07/2010	A proposal to develop the CDM component of the project, from the CDM developer Nordteco was received
29/07/2010	A proposal to develop the CDM component of the project, from the CDM developer Geo Ingeniería S.A was received.
01/08/2010	The first draft mandate letter from BCIE (Banco Centroamericano de Integración Económica) was prepared, including CERs as a possible output of the Pantasma hydroelectric project.
10/10/2010	The CDM developer was introduced to Hidropantasma S.A. by the project's manager.
05/11/2010	The project owner (Hidropantasma S.A.) signed a contract of consultancy with Alianza Estrategica Environmental Business and Technologies Ltda - Business Development Group S.A. (CDM Developer) for the PDD development
02/12/2010	The project owner notified the UNFCCC Secretariat and the local DNA of the commencement of the project activity and their intention to seek the CDM status[16].
12/01/2011	The Board of Directors decided to start applying for CDM to obtain the carbon credits of the project and its benefits.
18/01/2011	The Project Idea Note for the project "Pantasma 13 MW hydroelectric project" was submitted to the local Designated National Authority of Nicaragua to request the "No Objection Letter".
28/02/2011	The project developer received a letter from the BCIE (Banco Centroamericano de Integración Económica) indicating the approval of the main construction loan considering the revenues of the carbon credits to be generated.
30/03/2011	Signature of the Turn Key Contract between Hidropantasma S.A. and the technical developer Saret de Costa Rica S.A. This is considered the project starting date.
28/07/2011	The cooperation agreement between the Ministry of environment and national resources –MARENA- and Hidropantasma S.A. was signed, in order to promote the CDM component of the project.
28/07/2011	The project developer received from the local Designated National Authority the "No Objection Letter" for the project.
23/09/2011	The CDM local stakeholder consultation has been developed and their inputs (comments from the stakeholders) considered in the PDD
12/11/2011	Publication of the PDD on the UNFCCC website for Global Stakeholder Process.
09/01/2012	The DOE performed the on-site assessment of the project.
01/01/2013	Expected date to start operation with Pantasma hydroelectric power plant.

Additionality analysis.

According to the "Guidelines on the demonstration of additionality of small-scale project activities" version 09.0, project participants are required to provide an explanation to show that the project activity would not have occurred in the absence of the CDM due to at least one of the barriers identified. Evidence to why the proposed project is additional has to be offered under the following categories of barriers: (a) investment, (b) technological, (c) prevailing practice and (d) other barriers. For the project activity a barrier analysis is carried out in order to demonstrate project additionality, and was done based on information from the time when the decision was taken considering the context situations and information from the project sponsors and official sources. Of the barriers listed above, the project participant has decided to demonstrate the additionality of the project activity by investment barrier as is shown below.

Investment barrier:

[16] The national and sectoral policies relevant to the baseline scenario are: Law 272 of 1998 "Law of the Electrical Industry" and Law 554 of 2005 "Law of Energy Stability". These laws regulate the electricity sector in Nicaragua determining aspects regarding the operation and expansion of electric generation in the Nicaraguan system.

The run-of-river projects are not the least-cost options for grid electricity production in terms of investment per Megawatt given its small generation capacity and relatively high investment costs derived from dam intakes, water conduction pipes, and water-to-wire packages. In addition, the run-of-river projects cannot provide firm and reliable energy to the system since they face problems due to shortages of water availability as a result of weather conditions such as "El Niño". Likewise, the low quantities of energy that can be delivered by this kind of projects results in lower prices in comparison with big projects that can acquire compromises to provide firm supply. Thus, the high dependency of the water availability and the cost-benefit relation associated with small scale generation, are discouraging investment in small hydroelectric generation. This situation is shown in the document “Generation Plan Expansion 2010 – 2017”, where only one hydro project with power capacity lower than 15 MW is considered in the country, being Pantasma. As a result of the previous conditions, the development of this type of projects faces adverse conditions to assure their financing.

In Nicaragua, renewable energy projects, especially small hydroelectric projects, face barriers during their technical definition, multiple uncertainties, long lead times, securing of permits (both operational and environmental), etc. This situation often extends the length of time required for the project developer to reach financial closure before construction and implementation can take place. During pre-investment activity, different types of initial assumptions used in assessing the projects (electricity market price trends, demand and supply behavior, regulatory context, etc.) are prone to suffer changes. Therefore, project developers have to continuously adjust their project evaluation models with the purpose of determining the economic/financial viability of their projects. As a result, most projects that initiate this cycle do not survive and are not implemented. The reality of several small hydroelectric projects being developed indicates that during the time between the initial concept and the financial execution, many project developers are not able to sustain their activity, resulting in a low percentage of completion of investment activities associated to small hydro projects. The situation above is due to rapidly changing electricity sector conditions in the country as well as lack of financing.

The electricity sector in Nicaragua operates under a de-regulated market-oriented system, where to invest in a power generation project is an individual project developer’s decision based on their own criteria. Nevertheless, at the country the evolution of the energy generation infrastructure is determined by the Ministry of Energy and Mines –MEM-. The plan of the MEM is very useful for potential investors and project developers since it gives an idea of the main places for installing generation plants and identified the potential sites for power generation. However, this plan highlights the large hydro generation capacities (over 15 MW), which are the most common type of new hydro generation at Nicaragua (Pantasma is the smaller hydro power plant to be installed in the plan).

Considering the national circumstances of the dispatch of electricity at Nicaragua, in the absence of Pantasma hydroelectric project, the electricity generation that would not be generated through a renewable project such as the proposed project activity would indeed be generated by an increased usage factor of the operation of gridconnected power plants and by the addition of new generation sources, as reflected in the combined margin calculations. Currently, Pantasma hydroelectric project is expecting to produce approximately 62.4 GWh per year, which represents around 0.95 % of total current electricity generation at the country. In the absence of the proposed small scale renewable energy project, the viable alternative for the national interconnected system of Nicaragua would be to generate the equivalent of the electricity generated by Pantasma mostly with thermal generation plants which generate greenhouse gas emissions. Thus, the interconnected system does not depend on the energy generated by Pantasma and for the government’s evaluation of the electric system the project will represent only the 1,6% of the total energy to be added (according to the indicative plan of generation expansion 2010-2017 will be added new 729 MW). However, Pantasma hydroelectric project will pose a multiplier effect on the country since it will promote the investment of renewable energy generation and give way for other investor to replicate similar projects in order to eventually shift and balance Nicaragua’s current energy matrix.

According to the expansion plan, for Pantasma hydroelectric project the effective capacity of 12.5 MW[17] make it the smaller hydro power plant to be installed. From the point of view of the investment, this is an additional risk since the official sources are not referring the project site as a big potential power generation site and the investor takes its own criteria and analysis to face or not the implementation of this project, based on added values such as contribution to the sustainable development, improvement of the inhabitants conditions, better conditions for the construction, among others.

According to the document "Generation Plan Expansion 2010 – 2017", only one hydro project with power capacity lower than 15 MW is considered in the country, being Pantasma hydroelectric project. The following figure from the above-mentioned document shows the energy generation projects (including hydro projects) being developed in the country and their status.

BASE SCENARIO A, BOBOKE

GENERATION EXPANSION PLAN 2010-2017

TOTAL: 729 MW
RENEWABLE ENERGY SOURCES: 616 MW

PROJECTS	TYPE	INVESTORS	YEAR															
			2010		2011		2012		2013		2014		2015		2016		2017	
			I S	II S	I S	II S	I S	II S	I S	II S	I S	II S	I S	II S	I S	II S	I S	II S
Alabanisa (Bunker)	Thermoelectric	Alabanisa	73	40														
Amayo II	Wind Farm	Grupo Amayo	23															
San Jacinto	Geothermal	Polaris			36		36											
Boboké	Hidroelectric	MIXTO (BOT)												70				
Casitas	Geothermal	MIXTO							15				15					
Hidro Pantasma	Hidroelectric	FCC - SARET						12										
Larreynaga	Hidroelectric	ENEL							17									
Tumarin	Hidroelectric	MIXTO (BOT)									220							
EOLO	Wind Farm	EOLO					37											
Salto Y-Y	Hidroelectric	Cía CERVECERA										25						
El Hoyo	Geothermal	GEONICA									20							
Chiltepe	Geothermal	GEONICA											20					
Blue Power	Wind Farm	Blue Power					40											
Telica - El Ñajo	Geothermal	Non define										30						
TOTAL	**729**		**96**	**40**	**36**	**0**	**113**	**12**	**32**	**0**	**240**	**55**	**35**	**70**	**0**	**0**	**0**	**0**

RENEWABLE ENERGY SOURCES

Figure 4: Hydroelectric projects registered that are being developed in the country.

There is only one project with a capacity under 15 MW which is very low compared with those over this capacity. This represents that the identification and construction of small hydroelectric plants is not an attractive matter in Nicaragua neither an easy issue to be carried out by private investors. The situation above indicates that power plants with small capacities as Pantasma hydroelectric project, is not an attractive activity in Nicaragua regarding the construction of generation plants with capacities between 25 MW and more than 100 MW, which are also profitable and which implementation does not involve the risks identified in the construction of small hydroelectric plants. Hence, in Nicaragua, the implementation of hydroelectric plants with small generation installed capacities cannot be considered as a prevailing practice. Therefore, for Pantasma hydroelectric project, the financial viability was the main condition to continue with the project implementation, thus conditions as the expected energy sale price, the technical feasibility to produce energy and the availability of hydraulic flows to the new plant, were duly assessed.

[17] Value determined considering a generating capacity of 13.7 MW (rated capacity of turbines which is smaller than the generators capacity), taking into account a reduction due to the parasitic load of electricity consumption needed by the plant to operate, reducing the output to 12.5 MW approximately (this is conservative).

The assessment was based on the assumptions related to the expected electricity prices used to incorporate the revenues from electricity sales into the financial analysis. These conditions were based on the expected behavior of electricity prices in the Nicaraguan Electricity Market. In addition, the Internal Rate of Return (IRR) evaluation was linked to the projected electricity generation from the proposed project, which was directly related to the expected water flow rate in the river and the amount of electricity that this water flow could produce in the plant. In the national context, small-scale projects such as Pantasma hydroelectric plant face significant barriers to obtain financing for its implementation. Local financial institutions in Nicaragua are generally seeking higher project IRRs in order to grant credit approval since this way they minimize their exposure against debt default on behalf of the loan receiving party. Hence, the project developers realize it is imperative to consider Pantasma hydroelectric project as a CDM project since the benefits of the CERs income would serve to overcome the minimum IRR threshold required by financial institutions to approve a loan.

For the project, the company has invested in the installation of all infrastructure necessary to conduct the water down to the power house, the acquisition of a turbine and generator for electricity generation and equipment to control all operation parameters. The following table shows a detailed description of the project cost.

Table 3: Installation costs of Pantasma hydroelectric project

Installation of Pantasma hydroelectric project	
Costs	**Total estimated cost (US $)**
Land, Easements and Rights of Way	770,000
Construction Costs	33,216,394
Construction Management and Supervision	488,000
Development Costs	2,526,359
Working Capital and Reserve	2,357,941
Financial Costs	2,268,700
Contingencies	1,660,806
Total cost estimated	43,288,200

The yearly operation and maintenance costs for the project activity are:

Table 4: Project cost considering the information provided by the project manager

Yearly operation and maintenance costs at Pantasma hydroelectric project	
Costs (yearly value determined as the average of 15 years)	**Total estimated cost (US $)**
Fixed Costs, Labor, Administration and Variable Costs (yearly average)	277,261
Major Maintenance $200,000 expected every 5 years (yearly average)	40,000
Insurance & Bonding (yearly average)	240,713
Social & Environmental Expenses (yearly average)	22,243
Property & Local Taxes (yearly average) [18]	44,895
Total cost estimated	625,112

Because of the high cost of the project, the project developer could not use a capital structure of 100% equity. The project developer decided to start applying for CDM to decrease the risk of investment return and to enable the financing. As a result, the project developer was able to obtain their funding through a loan agreement with development banks under a typical project finance

[18] The law in Nicaragua provide an income tax exemption for 7 years (since commercial operation) for renewable energy generation activities. Please refer to Page 3, Article 7, Section 3, of the document "LEY No. 532 PARA LA PROMOCION DE GENERACION ELECTRICA CON FUENTES RENOVABLES", for a more detailed explanation of the applicable income tax exemption according to the law which promotes renewable energy investment in the Republic of Nicaragua.

scheme with 66.99% debt and 33.01% equity. The financial analysis for the return on equity and the debt service was calculated using the parameters and assumptions showed in the following table.

Table 5: Financial analysis assumptions.

Parameter	Value	Source/Comment
Electricity tariff (US/kWh)	0.1073	Contractual documents "PPA CONTRACT PANTASMA - DINORTE" & "PPA CONTRACT PANTASMA - DISSUR"
Discount rate	15%	Project manager
Load plant factor	0.57	Technical developer
Total investment (US$)	43,288,200	Project manager

The selection of the appropriate analysis method for this project activity is based on the benchmark analysis according to the "Guidelines on the assessment of investment analysis" and the "Tool for the demonstration and assessment of additionality". Therefore the most suitable financial evaluation is the internal rate of return (IRR) of the project when is compared to a benchmark IRR (this is based on parameters that are taken from financial indicators of the local market). IRR is estimated as per point 12 on the Guideline (where expected returns are appropriate benchmarks). The result of the project IRR is 11.97% when the sale of carbon credits is not considered into the project revenues (in a 15 years basis[19]). This IRR was lower than the benchmark rate of return required to move forward with the project development.

Point 16 of the guide allows calculating the financial benchmark using best financial practices and data sources that can be validated. Calculation of the benchmark was made according to the mentioned guides and tools which states that valid benchmarks shall be derived from the government bond rates, increased by a suitable risk premium to reflect private investment and/or the project type, as substantiated by an independent (financial) expert or documented by official publicly available financial data. Similar benchmark approach has been used in Nicaragua for other energy projects such as Amayo wind farm phase I and Phase II[20].

Considering the above, for the benchmark calculation has been considered an approach for the government bond rates of Nicaragua (which is the host country) and a suitable risk premium defined by an expert third part for Nicaragua. For the government bond rates a suitable reference is the average return rate (ARR) of the debt bonds of the Ministry of Finance and Public Credit of Nicaragua; this rate is chosen for competitive auctions (the financial market regulates the Competitive Auction, while the Non Competitive Auction relies directly in a fix rate given by the Central Bank of Nicaragua) on a five year maturity basis (longer period for auctions of the Nicaraguan Treasury Bonds results in higher return rates). In order to keep a conservative and representative approach for a relevant, representative and applicable ARR, the average rate has been taken for the first quarter of 2011, since this period is consistent with the CDM investment decision date). The average ARR for all competitive auctions within this period results in 4.1495%[21].

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[19] A shorter assessment period (15 years) has been chosen according to the paragraph 3 of the "Guidelines on the assessment on investment analysis" version 5, considering the validity of the PPA signed. As a shorter period has been chosen, a fair value of the project activity assets at the end of the assessment period has been included in the analysis (please refer to page 5-6, Clause III, Numeral 3.2, of support documents titled "PPA CONTRACT PANTASMA - DINORTE" & "PPA CONTRACT PANTASMA - DISSUR" for a detailed view of the PPA contract tenure which is for only 15 years). In addition, the Board of Directors of Hidropantasma S.A. will consider the alternative of selling of project after the PPA contract expires at year 15 since they do not have guarantee of subsequent business conditions (please refer the letter from president of Hidropantasma S.A. to the DOE audit team); The previous condition of sale of power generation assets is a common practice in the region as evidenced in the following cases(documents): TECO Energy's Asset Sale, Hidrotenencias Sale, Terra Acquires Blue Power and Duke Energy Asset Sale, among others.

[20] Amayo Phase II Wind Project PDD. http://cdm.unfccc.int/Projects/DB/DNV-CUK1317368497.17/view

[21] Competitive auction bonds, Ministry of Treasure and Public Credit of Nicaragua, Central Bank of Nicaragua (http://www.bcn.gob.ni/titulos_valores/subastas/letras%20MHCP/Resultados/2011/resultadosbonos1.pdf).

For the suitable risk premium to reflect private investment and/or the project type, in order to keep a conservative approach an increase of 9% has been applied according to the country risk premiums determined by the New York University - Leonard N. Stern School of Business[22]. The final value that will be used for the benchmark comparison is 13.15%. This value is in line with the minimum return rate required by the financing entity Banpro-Grupo Proamerica who has financed the project under an expected return rate of 13%.

When the incomes from the sale of CERs are included in the project cash flow, the project IRR is improved to 13.25% which is over the benchmark IRR. Thus, the inclusion of the CDM benefits helped the return to exceed the threshold to move forward on the project. The improvement from the CER to the operating cash flows over time was also seen as essential to provide some cushion to any unforeseen costs or risks involved in the operation of the project during the first ten years (where lack of experience could cause a reduction in the estimated return on investment). The access to the CDM is crucial for the project implementation and success. The next table shows project IRR final results.

Table 6: IRR of the project

Project Internal Rate of Return	IRR %
IRR without CERs revenues	11.97
IRR with CERs revenues	13.25
Benchmark IRR	13.15

And additional sensitive analysis has been performed to show when the project activity would pass the benchmark or become more favorable, considering reasonable variations of the critical assumptions. Main costs such as turnkey contract, operation and maintenance, energy tariff and annual electricity generation were considered for reasonable variations (+/-10%). The variation of the project IRR has been shown below:

Table 7: Sensitive analysis.

TK Contract	Project IRR without CERs
(+) 10%	10.64%
(-) 10%	13.52%
Fixed O&M Costs	Project IRR without CERs
(+) 10%	11.91%
(-) 10%	12.03%
Electricity Tariff ($/MWh)	Project IRR without CERs
(+) 10%	13.68%
(-) 10%	10.19%
Electricity Generation (GWh annually)	Project IRR without CERs
(+) 10%	13.68%
(-) 10%	10.19%

The sensitive analysis demonstrates that even considering a significant variation of the mentioned parameters, the project IRR will only reach the benchmark when:

- Construction costs are 10% less: this situation is not probable because there is a contract signed with the company Saret. TKC has been developed all considered equipment and work required to install the power plant, thus any money reduction is not possible to be included.

[22] New York University (http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/ctryprem.html).

- Electricity tariff increases 10%: Any possibilities of changing the electricity tariff could not occur because there is a Power Purchase Agreement signed by DISNORTE and DISSUR and the project company.
- Electricity Generation increases 10%: this is not possible because there is a PPA involved and the described power plan already has maximum established installed capacity by design. In addition, the plant is being constructed based on a specific design flow which defines the conduction pipe diameter, hereby signifying that any excess water cannot be utilized as the latter would ultimately overflow the dam and return to the normal course of the river.

The sensitivity analysis shows that it will not be possible to get the project IRR above the benchmark value without the CDM revenues. It is true that the project activity is not financially attractive without the CDM revenues, therefore the additional revenues from the CDM have helped to overcome the threshold to move forward with the project. In addition, the inclusion of the CDM component allowed to bring financers to the project such as the BCIE (Banco Centroamericano de Integración Económica) which approved the main construction loan considering the revenues of the carbon credits to be generated.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

Baseline Emissions.

For AMS.I.D Version 18.0, the baseline is the MWh produced by the renewable generating unit and delivered to the national grid multiplied by an emission factor (measured in tCO_2e/MWh) as follows:

$$BE_y = EG_{PJ,y}\ x\ EF_{grid,y}$$ **Equation (1)**

Where:

BE_y	Baseline emissions in the year y (tCO_2).
$EF_{grid,y}$	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” ($t\ CO_2/MWh$)
$EG_{PJ,y}$	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh)

Calculation of $EG_{PJ,y}$.

The net electricity export/supplied to a grid is the difference between the measured quantities of the grid electricity export and the import and is determined as the measured quantities of the grid electricity delivered to the grid minus the auxiliary electricity consumption, technical losses and electricity imports from the grid to each project power plant.

Calculation of $EF_{grid,y}$.

The emission factor must be calculated in a transparent and conservative manner as 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” version 07.0 The calculation will be based on data from an official source (where available) and made publicly available. According to the tool, the calculation of the emission factor is developed through the following six steps:

Step 1: Identifying the relevant electricity systems.

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

Step 1: Identifying the relevant electric power system.

The Nicaraguan electricity distribution network is composed by energy generators, transmission operators, net operators and traders. The net capacity of the national interconnected system is 1,072.59 MW the hydraulic generation represents 9.82 %, the thermal generation represents 64.8%, and the geothermal generation 8.16%, the wind generation 5.87% and the biomass 11.36%[23]. The national dispatch centre of charge (CNDC) of Nicaragua is responsible for issuing plans and assuring a reliable performance of the national grid. The following figure shows the distribution of the National Interconnected System of Nicaragua.

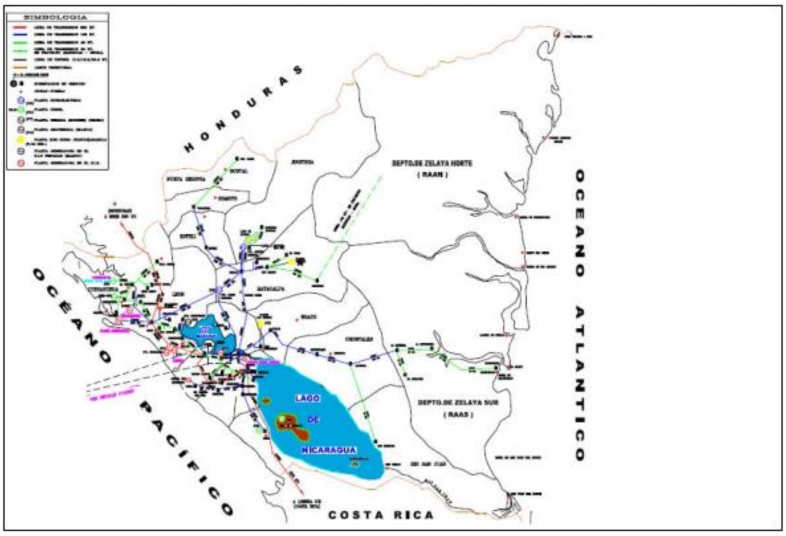

Figure 5: National Interconnected System of Nicaragua.

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

For this project, the Option I of the tool has been chosen, and therefore only grid power plants are included in the emission factor calculation.

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

For the selection of operating margin, the tool provides four alternative methods for calculating the operating margin emission factor: (a) Simple OM, (b) Simple adjusted OM, (c) Dispatch analysis or (d) Average OM. For the project the Operating Margin will be calculated using the simple method. This decision was made based on the current configuration of the National Interconnected System of Nicaragua in which the thermal generation represents 64.8%, the data requirements and the availability of information from official sources, in this case the CNDC and the Nicaraguan Energy Institute (Instituto Nicaragüense de la Energía). Using this method, the emission factor can be calculated using either of the two following data vintages:

- Ex-ante: based on the 3-year generation-weighted average by using the most recent data available at the time of submitting the PDD to the DOE for validation. If this option is used

[23] Private and public enterprises of the SIN, 2010- Nicaraguan Energy Institute (Instituto Nicaragüense de la Energía).

there will be no need for monitoring and recalculating the emission factor during the crediting period.

- Ex-post: The emission factor should be updated for the year in which the power plant displaces grid electricity. This emission factor should be updated annually for the rest of the crediting period during the monitoring. If the data required to calculate 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 the second credit period the ex-ante value has been chosen, and therefore the emission factor should not be updated for the year in which the power plant displaces electricity from the grid (applicable over the crediting period).

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

The simple OM emission factor is calculated as the generation-weighted average CO2 emissions per unit net electricity generation (tCO2/MWh) of all generating power plants serving the system, not including lowcost/must-run power plants/units. The simple OM may be calculated:

- *Option A:* Based on the net electricity generation and a CO2 emission factor of each power unit.
- *Option B:* Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

For the calculation, the information to determine the simple OM emission factor was available from official sources (public information), thus the option A has been chosen.

Option A - Calculation based on average efficiency and electricity generation of each plant: Under this option, the simple OM emission factor is calculated based on the net electricity generation of each power unit and an emission factor for each power unit, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_m EG_{m,y} \, . \, EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

Equation (2)

Where:

$EF_{grid,OMsimple,y}$	Simple operating margin CO_2 emission factor in year y (tCO_2/MWh).
$EG_{m,yy}$	Net quantity of electricity generated and delivered to the grid by power unit *m* in year y (MWh).
$EF_{EL,m,y}$	CO_2 emission factor of power unit m in year y (tCO_2/MWh).
m	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.

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

The emission factor of each power unit m should be determined as follows:

Option A1. If for a power unit m data on fuel consumption and electricity generation is available, the emission factor ($EF_{EL,m,y}$) should be determined as follows:

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \, . \, NCV_{i,y} \, . \, EF_{CO2,i,y}}{EG_{m,y}}$$

Equation (3)

Where:

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

Option A2. If for a power unit m only data on electricity generation and the fuel types used is available, the emission factor should be determined based on the CO2 emission factor of the fuel type used and the efficiency of the power unit, as follows:

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y}\ x\ 3.6}{n_{m,y}}$$

Equation (4)

Where:

$EF_{EL,m,y}$	CO_2 emission factor of power unit m in year y (tCO_2/MWh).
$EF_{CO2,m,i,y}$	Average CO2 emission factor of fuel type i used in power unit m in year y (t CO2/GJ).
$n_{m,y}$	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.
3.6	Conversion factor (GJ/MWh).

Option A3. If for a power unit m only data on electricity generation is available, an emission factor of 0 tCO2/MWh can be assumed as a simple and conservative approach.

Determination of $EG_{m,y}$

For grid power plants, $EG_{m,y}$ was determined as per the provisions in the monitoring tables. For this approach (simple OM), to calculate the operating margin, the subscript m refers to the power plants/units delivering electricity to the grid, not including low-cost/must-run power plants/units. Electricity import data was not included as no information was available.

The information needed to calculate the operating margin emission factor is available from official sources such as CNDC and the Nicaraguan Energy Institute (Instituto Nicaragüense de la Energía). The data used corresponds to the last available information necessary to calculate the update of the national emission factor by official sources.

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

For the first crediting period the BM emission factor was calculated based on the vintage of data under option 2 (updated annually, ex-post approach). The option was chosen in order to use recent and public information from official sources up to the year of registration of the project activity.

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.

Since this calculation corresponds to second crediting period, the build margin is calculated used option 1 (ex-ante), it means that the build margin emission factor is 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 build margin calculation select the group of generating plants m those are available. Identify the five most recently built power stations. Determine the most recent additions which represent 20% of generation. The option that comprises the larger annual generation should be chosen. Power plants registered as CDM project activities should be excluded from the sample group m as long as the power plants in the sample group are not older than 10 years. The option that corresponds to the highest annual generation will be chosen. The energy produced by the 5 most modern power stations in Colombia or the most recent power stations generating the 20% of the electricity.

The build margin emission factor was therefore calculated based on the 20% of the electricity generated. The build margin emission factor is the generated-weighted average emission factor (tCO2/MWh) of power units in sample group m during the most recent year y for which power generation data is available. The following formula was used to calculate the build margin emission factor:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y}\ x\ EF_{EL,m,y}}{\sum_m EG_{m,y}} \qquad \textbf{Equation (5)}$$

Where:

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

The emission factor for each of the power stations selected for calculating the build margin $EF_{EL,m,y}$ is produced in the same way as in the previous steps.

Step 6: Calculate the combined margin (CM) emission factor.

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

(a) Weighted average CM; or
(b) Simplified CM.

The weighted average CM method (option a) should be used as the preferred option. The simplified CM method (option b) can only be used if:

- The project activity is located in a Least Developed Country (LDC) or in a country with less than 10 registered projects at the starting date of validation; and
- The data requirements for the application of step 5 above cannot be met.

For the CM calculation, option a has been chosen, thus the combined margin emission factor is calculated as a weighted average of the operating margin (EF_{OM}) and build margin (EF_{BM}) emission factors.

$$EF_{grid,CM,y} = w_{OM}\ x\ EF_{grid,OM,y} + w_{BM}\ x\ EF_{grid,BM,y}$$ **Equation (6)**

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 one year y (tCO2/MWh).
ωOM	Weighting of operating margin emissions factor (%).
ωBM	Weighting of build margin emissions factor (%).

Generally a weighted coefficient of 50% is considered for both margins (ωOM y ωBM) for the first crediting period. In a second and third crediting period, a ωOM= 0.25 and ωBM= 0.75 would be considered, as mentioned in the tool to calculate the emission factor for an electricity system.

Project emissions.

The methodology AMS.I.D version 18.0 states for most renewable energy project activities, project emissions are zero (PEy = 0). However, since the project has a reservoir, the project emissions from water reservoirs of hydro power plants were considered, following the procedures described in the ACM0002. In addition, CO_2 emissions from on-site consumption of fossil fuels due to project activity were also considered using the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion” version 03.0.

According to ACM0002 version 20.0, project emissions must be calculated using the following equation:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y}$$ **Equation (7)**

Where:

PE_y	Project emissions in year y (tCO_2/yr).
$PE_{FF,y}$	Project emissions from fossil fuel consumption in year y (tCO_2/yr).
$PE_{GP,y}$	Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year y (tCO_{2e}/yr).
$PE_{HP,y}$	Project emissions from water reservoirs of hydro power plants in year y (tCO_{2e}/yr).

The project does not consider geothermal power plants, therefore $PE_{GP,y}$ is not considered.

Project emissions from fossil fuel consumption in year y ($PE_{FF,y}$).

For the project activity, the use of a backup electricity system only for emergencies has been considered (fossil fuel based), therefore the project emissions were considered. According to AMS.I.D version 18.0, CO_2 emissions from on-site consumption of fossil fuels due to project activity shall be calculated using the latest version of the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion” version 03.0.

According to the tool the CO_2 emissions from fossil fuel combustion in process are calculated based on the quantity of fuels combusted and the CO_2 emission coefficient of those fuels, as follows:

$$PE_{FC,j,y} = \sum_i FC_{i,j,y}\ x\ COEF_{i,y}$$ **Equation (8)**

Where:

$PE_{FC,j,y}$	CO_2 emissions from fossil fuel combustion in process j during the year y (tCO_2/yr).
$FC_{i,j,y}$	Quantity of fuel type i combusted in process j during the year y (mass or volume unit/yr).
$COEF_{i,y}$	CO_2 emission coefficient of fuel type i in year y (tCO_2/mass or volume unit).
i	Are the fuel types combusted in process j during the year y.

The CO_2 emission coefficient $COEF_{i,y}$ can be calculated using one of the following two Options, depending on the availability of data on the fossil fuel type i, as follows:

- Option A: The CO_2 emission coefficient COEF is calculated based on the chemical composition of the fossil fuel type i.
- Option B: The CO_2 emission coefficient COEF is calculated based on net calorific value and CO_2 emission factor of the fuel type i.

Tough option A is preferred, the information of the weighted average mass fraction of carbon in fuel type and the weighted average density are not available from official sources or from the fuel suppliers, then for this project the option B has been chosen. The CO2 emission coefficient COEF is calculated as follows:

$$COEF_{i,y} = NCV_{i,y}\ x\ EF_{CO2,i,y} \qquad \textbf{Equation (9)}$$

Where:

$COEF_{i,y}$	CO_2 emission coefficient of fuel type i in year y (tCO_2/mass or volume unit).
$NCV_{i,y}$	Is the weighted average net calorific value of the fuel type i in year y (GJ/mass or volume unit).
i	Are the fuel types combusted in process j during the year y.

As the operation of the back-up system will be only during emergencies, for previous calculation, the emissions due to fossil fuel combustion are zero.

Project emissions from water reservoirs of hydro power plants in year y (*$PE_{HP,y}$*)

According to ACM0002 version 20.0, the power density (PD) is calculated as follows:

$$PD = \frac{Cap_{pj} - Cap_{BL}}{A_{pj} - A_{BL}} \qquad \textbf{Equation (10)}$$

Where:

PD	Power density of the project activity (W/m[2]).
Cap_{pj}	Installed capacity of the hydro power plant after the implementation of the project activity (W).
Cap_{BL}	Installed capacity of the hydro power plant before the implementation of the project activity (W). For new hydro power plants, this value is zero.
A_{pj}	Area of the single or multiple reservoirs measured at the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2).
A_{BL}	Area of the single or multiple reservoirs measured at the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero.

For hydro power project activities that result in new single or multiple reservoirs, CH_4 and CO_2 emissions from the reservoirs must be estimated as follows:

(a) If the power density of the single or multiple reservoirs (PD) is greater than 4 W/m^2 and less than or equal to 10 W/m^2.

$$PE_{HP,y} = \frac{EF_{Res}\ x\ TEG_y}{1000} \quad \textbf{Equation (11)}$$

Where:

$PE_{HP,y}$	Project emissions from water reservoirs (tCO_2e/yr).
EF_{Res}	Default emission factor for emissions from reservoirs of hydro power plants in year y ($kgCO_2e/MWh$).
TEG_y	Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year y (MWh).

(b) If the power density of the project activity (PD) is greater than 10 W/m^2.

$$PE_{HP,y} = 0$$

As is demonstrated on section B.6.3, the power density for the project is greater than 10 W/m2 , thus the emissions due to the reservoir are zero.

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 zero.

Emission reductions.

The emission reductions are calculated as equal to the estimated baseline emissions $BE_{electricity,y}$.

$$ER_y = BE_y - PE_y - LE_y \quad \textbf{Equation (9)}$$

Where:

ER_y	Emission reductions in year y (tCO_2e/y).
BE_y	Baseline emissions in year y (tCO_2/y).
PE_y	Project emissions in year y (tCO_2e/y).
LE_y	Leakage emissions in year y ($t\ CO_2/y$).

The result of the application of the equations is presented in section B.6.3.

B.6.2. Data and parameters fixed ex ante

Data/Parameter	$EF_{grid,y}$
Data unit	t CO_2e/kWh
Description	CO2 emission factor of the grid electricity in year y
Source of data	-
Value(s) applied	494.5
Choice of data or measurement methods and procedures	As per the requirements in “Tool to calculate the emission factor for an electricity system”
Purpose of data	Calculation of baseline emissions
Additional comment	No comments

Data/Parameter	$EG_{m,y}$
Data unit	MWh
Description	Net electricity generated by power plant/unit m in year y.
Source of data	Government records from Nicaraguan Energy Institute (Instituto Nicaragüense de la Energía).
Value(s) applied	Please refer to Appendix 4.
Choice of data or measurement methods and procedures	The net electricity generated by power units is used to calculate the CO2 emission coefficients of the power plants in the grid, according to “Tool to calculate the emission factor for an electricity system” version 07.0. All information regarding the national interconnected system is handled and stored by Nicaraguan Energy Institute, it is checked at the web site: https://www.ine.gob.ni/index.php/electricidad/serie-historica/
Purpose of data	Calculation of baseline emissions
Additional comment	No comments

Data/Parameter	$FC_{i,m,y}$
Data unit	Mass or volume unit
Description	Amount of fossil fuel type i consumed by power plant/unit m in year y.
Source of data	Government records from Nicaraguan Energy Institute (Instituto Nicaragüense de la Energía).
Value(s) applied	Please refer to Appendix 4.
Choice of data or measurement methods and procedures	The amount of fossil fuels consumed by power plants/units is used to calculate the CO2 emission coefficients of the power plants in the grid, according to “Tool to calculate the emission factor for an electricity system” version 07.0. All information regarding the national interconnected system is handled and stored by Nicaraguan Energy Institute, it is checked at the web site: https://www.ine.gob.ni/index.php/electricidad/serie-historica/
Purpose of data	Calculation of baseline emissions
Additional comment	No comments.

Data/Parameter	$NCV_{i,y}$
Data unit	GJ/t
Description	Net calorific value (energy content) of fuel type i in year y
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories, Table 1.2 of Chapter 1 of Vol. 2 (Energy) (Default values at the lower limits of the 95% confidence intervals).
Value(s) applied	41.4 (Diesel oil) 39.8 (Fuel oil)
Choice of data or measurement methods and procedures	The net calorific value of fossil fuels consumed by power plants/units is used to calculate the CO2 emission coefficients of the power plants in the grid, according to “Tool to calculate the emission factor for an electricity system” version 07.0. According to the tools the IPCC default values are used. This is conservative.
Purpose of data	Calculation of baseline emissions.
Additional comment	No comments.

Data/Parameter	$EF_{CO2,i,y}$
Data unit	t CO_2/GJ
Description	CO_2 emission factor of fossil fuel type i used in power unit m in year y.
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories, Table 1.4 of Chapter 1 of Vol. 2 (Energy) (Default values at the lower limits of the 95% confidence intervals).
Value(s) applied	0.0726 (Diesel oil) 0.0755 (Fuel oil)
Choice of data or measurement methods and procedures	The CO_2 emission factor of fossil fuels consumed by power plants/units is used to calculate the CO_2 emission coefficients of the power plants in the grid, according to “Tool to calculate the emission factor for an electricity system” version 07.0. According to the tools the IPCC default values are used. This is conservative.
Purpose of data	Calculation of baseline emissions
Additional comment	No comments

B.6.3. Ex ante calculation of emission reductions

Baseline emissions

As prescribed in AMS.I.D baseline methodology, Version 18.0, the emission baseline will be the MWh produced by the renewable generating unit multiplied by an emission coefficient of the grid measured in tCO_2e/MWh.

According to the constriction report prepared by Carbon Ingenieria S.A., the MWh to be generated by the project plant are:

Table 8: Projected annual electricity generation.

Net capacity generation (MW)	12.5
Load plant (%)[24]	57%

[24] For a more detailed view of the projected plant factor derived from the hydrological flow studies and monthly average measurements, please refers the the final project design prepared by Carbón Ingeniería S.A. (Document 31- 1003C02-S-003-DOC).

Operational hours per year	4,993
Annual electricity generation (MWh/y)	62,415
Accumulated net electricity exported to the grid (MWh)	62,415

As mentioned above, the emission factor is calculated considering an ex-ante approach, where the operating margin emission factor under the simple adjusted method ($EF_{OM\ simp\text{-}adj,y}$) results to be 0.6749 tCO_2/MWh and the build margin emission factor ($EF_{BM\ simp\text{-}adj,y}$) 0.4343 tCO_2/MWh. The resulting grid emission factor is determined by:

$$EF_{grid,CM,y} = w_{OM}\ x\ EF_{grid,OM,y} + w_{BM}\ x\ EF_{grid,BM,y} = 0.25\ x\ 0.6749 \frac{tCO_2}{MWh} + 0.75\ x\ 0.4343 \frac{tCO_2}{MWh} = \mathbf{0.4945}\ \boldsymbol{tCO_2/MWh}$$

So $BE_y = 62{,}415\ MWh\ x\ 0.4945 \frac{tCO_2}{MWh} = \mathbf{30{,}862}\ \boldsymbol{tCO_2}$

Project emissions

Project emissions from fossil fuel consumption in year y.

As described in section B.6.1, the operation of the back-up system will be only during emergencies, for previous calculation, the emissions due to fossil fuel combustion are zero, $PE_{FF,y}$ = 0.

Project emissions from water reservoirs of hydro power plants in year y.

The power density of the project activity has been determined according to the criteria established on section B.6.1. For the calculation, the following values are considered[25]:

Cap_{PJ} = 14,400,000 W and A_{PJ} = 247,449 m^2 (area determined at maximum water level[26]).

The power density value is 58.19 W/m^2, therefore according to the option b, as the power density of the project activity (PD) is greater than 10 W/m^2, project emission from reservoir is zero, $PE_{HP,y}$ = 0.

Leakage

In accordance to the methodology, leakage calculation is only required if the renewable energy technology equipment is transferred from another activity or to another activity. This is not the case of the proposed project, so leakages are not to be considered.

Emission reductions.

The emission reductions as a result of the project implementation are:

Table 9: Emission reduction calculation.

Annual Emission reductions calculation – Pantasma Hydroelectric Project	
Electricity to the grid (MWh/y)	62,415
EF (tCO_2e/MWh)	0.4945
Baseline emissions (tCO_2e/y)	30,862
Project Emissions (tCO_2e/MWh)	0

[25] Values determined by Carbón Ingeniería S.A. in the final project design. Document 1003CO2-DF-1001-REV0 “Plane- Reservoir plant”

[26] See .dwg file - topographic map.

Leakage (tCO_2e/MWh)	0
Net Emission Reductions (tCO_2e/y)	30,862

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

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
2020	30,862	0	0	30,862
2021	30,862	0	0	30,862
2022	30,862	0	0	30,862
2023	30,862	0	0	30,862
2024	30,862	0	0	30,862
2025	30,862	0	0	30,862
2026	30,862	0	0	30,862
Total	**216,031**	**0**	**0**	**216,031**
Total number of crediting years	7			
Annual average over the crediting period	30,862	0	0	30,862

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data/Parameter	$EG_{PJ,y}$
Data unit	MWh
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y
Source of data	Measurement by project participant (meters installed).
Value(s) applied	62,415[27] (for preliminary estimation only).
Measurement methods and procedures	This parameter should be either monitored using bi-directional energy meter or calculated as difference between (a) the quantity of electricity supplied by the project plant/unit to the grid; and (b) the quantity of electricity the project plant/unit from the grid. In case it is calculated then the following parameters shall be measured: (a) The quantity of electricity supplied by the project plant/unit to the grid; and (b) The quantity of electricity delivered to the project plant/unit from the grid
Monitoring frequency	Continuous monitoring, hourly measurement and at least monthly recording

[27] Value determined considering a generating capacity of 13.7 MW (rated capacity of turbines which is smaller than the generators capacity), taking into account a reduction due to the parasitic load of electricity consumption needed by the plant to operate, reducing the output to 12.5 MW approximately (this is conservative).

QA/QC procedures	Power meters are quite accurate. Moreover, the meters are calibrated periodically according to national standards and reference points (once every two years in accordance with the operating regulations of the Commercial Annex: Commercial Measurement System) or IEC standards and recalibrated at appropriate intervals according to manufacturer's specifications (at least once in three years). Data collected has low uncertainty levels and to guarantee its accuracy, it is cross-checked with the electricity sales receipts obtained from the grid trader/generator (where applicable, the lowest value is used for emission reductions calculation. This is conservative). For each power plant connected to the grid at the same point, the grid trader/generator delivered sales receipt separately (for each power plant). The accuracy of the meters as +/- % of the readings of kWh (measurement) is 0.2% (applicable to meters class 0.2)[28].
Purpose of data	Calculation of baseline emissions.
Additional comment	Data will be archived at least for two years after crediting period.

Data/Parameter	$FC_{i,j,y}$
Data unit	Mass or volume unit per year (e.g. ton/yr or m^3/yr).
Description	Quantity of fuel type i combusted in process j during the year y.
Source of data	Measurement by project participant.
Value(s) applied	0
Measurement methods and procedures	Continuous measurement of all fossil fuel feed into the process using volume meters and consumption/stock records, each filling of the backup electricity system is manually recorded by project participant.
Monitoring frequency	Continuous measurement.
QA/QC procedures	Results are recorded in a data log file (.xlsx). The meter is subject to regular maintenance and calibration as per the manufacturer's specifications (once every year). The uncertainty level of the data is low. The quantity is cross-checked with purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities are also cross-checked with available purchase invoices from the financial records.
Purpose of data	Calculation of project emissions.
Additional comment	No comments.

B.7.2. Sampling plan

No applicable.

B.7.3. Other elements of monitoring plan

The monitoring plan was implemented to ensure that the approved monitoring methodology AMS.I.D, Version 18.0 is correctly applied in order to enable the accurate and transparent determination of avoided emissions. The plan incorporated the QA/QC procedures and is described in Section B.7.1 above. The overall management structure responsible for project monitoring is as follows:

[28] For more information please refers the "Power meters product guide" of SIEMENS

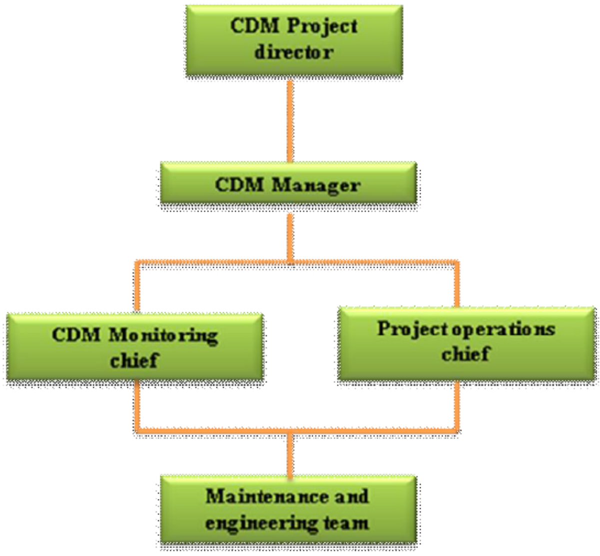

Figure 6: Metering scheme of the Hydro Electric Plant - Hidro Pantasma

Responsibility and CDM management: it is the maximum authority in the project. The executive board of the company is in charge of attending to this responsibility. The CDM manager is appointed at the company and whose responsibility is monitoring all CDM project related activities and organizing specific training.

The CDM Project Manager is responsible for overseeing the implementation of this procedure and provides information to the board related to the performance of the entire system. Competency requirements for the position of CDM Manager were defined and applied to ensure that the project manager is able to implement this procedure.

The CDM monitoring chief will have day to day responsibilities for checking instrumentation, record keeping, data handling and data processing, filing, reporting, organizing repair and maintenance of monitoring equipment and ensuring the monitoring plan is adhered to as indicated in the approved PDD. All calculations will be checked and signed by the CDM monitoring chief who will also be responsible for preparing and checking documents required for verification.

A Maintenance and Engineering team will report (only activities related with CDM monitoring matters) directly to the CDM monitoring chief.

The monitoring staff will receive technical training and safety training to minimize exposure to workplace hazards. At least one fully trained technical member of the monitoring team will be present on every shift.

Operational staff with existing responsibilities for energy generation monitoring at the power plant will receive additional training and will collaborate with the monitoring staff. A management level link will be established to ensure effective co-operation between operational staff and CDM monitoring staff. All relevant information, notes of meetings, data files, maintenance records, defect reports, hard copy and computerized records of monitoring will be kept at a designated location and arranged in an orderly and transparent manner to facilitate audit as and when is required. Responsibilities, procedures, methods, equipment types and specifications are to be described in detail in a specific CDM document.

On-line monitoring system: All key meters required to determine GHG emissions and emission reductions will be monitored from a central control point which will record meter readings at a pre-determined interval as specified in the project documents. These data will be used to continually update total emission reductions as long as the generating plant is in operation. Key meters will

measure the parameters listed in B.7.1 above. Data collected has low uncertainty levels and to guarantee its accuracy it will be cross checked with the electricity sales receipts obtained from the grid trader/generator (where applicable, the low value would be used for emission reductions calculation. This is conservative).

Calculation of emissions reductions: The data required for calculating baseline will be fed into a processor (spreadsheet application) which will calculate the emission reductions according to the formulae described above (B.6.1), using the defined default values. Access to the spreadsheet will be controlled for security. The process will include various checks, such as a comparison of total energy generated in the plant against the energy supplied to the grid indicated in the electricity sales receipts obtained from the grid operator. The data and documents will be regularly audited to ensure it is operating correctly.

Non-essential data: The on-line monitoring system will also record “non-essential” data. Such data is termed non-essential because it is not directly listed in the monitoring methodology, but it will constitute a means of corroborating the on-line system. Non-essential data will include measurements of net and gross output from generator, certificated conversion efficiency, fed water and any other data considered relevant to the project activity.

Accuracy and calibration of instruments: All meters will be operated and maintained as specified in the manufacturer specifications. All key meters will be subject to a quality control regime that will include regular maintenance and calibration. A record will be maintained showing the location and unique identification number of each meter, the calibration status of that meter (date of the last calibration and date of the next calibration) and who will develop the calibration service. Calibration certificates will be retained for all meters until two years after the end of the crediting period.

Archiving data: The online system will archive data automatically in a secure and retrievable storage format on a periodic basis (e.g. weekly basis). Calibration records will be archived in an accessible electronic format. These data will be stored until 2 years after the end of the crediting period.

Document control: The CDM Manager will implement a document control system to ensure that the current versions of necessary documents are available at the point of use. The CDM Monitoring manual will be made to guarantee the best practice and results in the monitoring implementation.

Preparation of monitoring report: The archived / live data will be used to prepare a periodic monitoring report to be submitted to the CDM EB for verification and issuance of CERs. A standard format for the monitoring report will be prepared prior to the submission of the first monitoring report.

Treatment of missing or corrupted data: Where data in the on-line system are corrupted or missing whilst the generator is operating (as shown, for example, by monitoring equipment failure) the missing data can be estimated by taking the lower value for the parameter in question in the hour before the error arose or the hour immediately after the system came on-line again. If there is evidence to suggest that both of these values are un-representative, the average from the previous 24 hours will be used. The error will be recorded in the daily log sheet and the occurrence of the error will be investigated and rectified as soon as possible. If the on-line system is compromised for more than 24 hours, data will be manually recorded. Any deficiencies in energy generated monitoring data will be rectified by back calculation from power sold.

Audit function and management review: The CDM Manager will arrange for an audit of the management system at least two times per year. The auditor will not be involved in the daily operation of the plant and if is necessary, may be sourced from a third party. The auditor will assess the implementation of the monitoring procedure and the preparation of the monitoring report. Audit findings, and steps taken to address findings will be recorded and reviewed in a management review meeting (convened at least annually) at which time the effectiveness of these procedures will be reviewed, and necessary changes implemented. The variable to be monitored was listed and described in Section B.7.1.

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

The project activity starting date is 30/03/2011. For the project has been established as a real action the signature of the Turn Key Contract between Hidropantasma S.A. and the technical developer Saret de Costa Rica S.A. The project participant decides to use this date as a starting date for the project activity, since this was the moment in which it has committed expenditures related to the implementation/construction of the power plant (this act indicates that a real action has begun).

C.2. Expected operational lifetime of project activity

40 years[29]

C.3. Crediting period of project activity

C.3.1. Type of crediting period

Renewable

C.3.2. Start date of crediting period

07/10/2020 (Second crediting period)

C.3.3. Duration of crediting period

7 years and 0 months (renewable)
07/10/2020 – 06/10/2027

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

The Law 217of 1996 – General Law of Environment and Natural Resources establishes the norms for the conservancy, protection, improvement and restoration of the environment and the natural resources, ensuring their use in the rational and sustainable way according to the national constitution. The Ministry of Environment and Natural Resources (Marena) is the entity in charge of the compliance with the environmental regulation in Nicaragua and is responsible for the implementation of strategies and programs for municipal development and for the control of polluting activities. Among other aspects, the law establishes the principles and requirements for those activities that could cause impact in the environment.

According with the legislation of Nicaragua[30], the activity being developed by Hidropantasma S.A. (energy generation over 5MW) requires an Environmental Permission; therefore, it was necessary to do an Environmental Impact Assessment. The company owner requested MSc Gerardo Silva Velasquez to update the Environmental Impact Assessment (EIA), in order to determine the environmental impact considering the stages of construction and operation of the proposed project and to get the Environmental Permission.

[29] Communicación from Kossler certifying the Expected lifetime of the main equipment, dated March 15, 2012.

[30] Decree 45-94, 1994 - Presidency of the Republic.

The company obtains their Enviromental Permission renovation by the Administrative Resolution DGCA-028- 2008R on March 3, 2010, emitted by Marena. In addition, by means of the Ministerial Agreement No. 2- DGERR-02-2010 emitted by the Ministry of Energy and Mining, the project developer obtains the Electric Energy Generation License. The project received from the Ministry of Promotion, Industry and Trade the water concession to take advantage of the Pantasma River waters, Ministerial agreement DGRN-PAA-001-2006. Likewise, the project developer received other permissions necessary for the construction of the power plant. The Environmental Plan includes a description of the main activities that will affect negative the implementation of the project (name of the activity, quantification of the environmental impact, contingency action, etc). Environmental impacts are considered during all project cycle phases, as mention:

Table 10: Project cycle phases.

Development phase	Construction phase	Operating phase
Feasibility study	Temporary facilities	Operation
Preliminary designs	Roads and main access	Maintenance
Final designs	Reservoir construction	Dispatch of energy
Land acquisition	Concrete dam construction	-
Hydrologic studies	Water conduction	-
-	Power house	-
-	Transmission line	-

According to this table, mayor environmental impacts take place during construction period that will last 24 months, after this all operation activities are going to be less harmful for the environment. Mayor impacts outlined in the EIA have been considered temporary; instead, Nicaragua will be benefit from having renewable energy producing electricity and helping to reduce GHG.

D.2. Environmental impact assessment

The EIA contains measures to ensure the correct environmental performance during construction and operation of the project. Prevention and mitigation measures will be implementing to minimize all the possible negative impacts that the project generates. In addition the prevention and mitigation activities will be in line with the country regulations and permits. The measures adopted in this project activity will result in the improvement of the environmental performance of the project activity. The possible environmental impacts of this project activity will be monitored by the local environment authority Marena.

Construction phase has been described as the most harmful activity for the environment; therefore, additional environmental measures will be taken into account, for example:

1. Noise: The major source of noise during the construction stage is machinery and transport vehicles used. This source is usually between 80 dB to 85 dB. The major source of noise during the operation stage would be mainly from the turbine and generator, which is expected to be between 70 dB to 88 dB. As a measure, machinery with low noise level has been selected during construction period. The equipment with high noise level is not working during the night. The implementation of these measures has effectively reduced the noise level during construction period. For the operation stage, equipment with low noise level will be used. Noise control measures like absorption and insulation will be taken during operation period. The power house used by this project will be set in a place with sound insulation function. Evergreen trees would be planted around the border of the plant, which will reduce the influence on the environment by the noise from the plant. Noise level for both day and night shall be in compliance with the requirements of national regulations.

2. Air Pollution: Dust and suspended solids were the main pollutants created during construction period. Requirements stipulated in national regulations and other regulations were strictly followed by the constructors. The stone and soil generated from digging activity were reused in the site, and

the permit to move and dispose the soil not used was requested. After any construction work, the site has been cleaned without delay, and the exposed land has been covered with vegetation. After these measures, the dust had been controlled effectively during construction period. There are not pollutants generated during operation period.

3. Wastewater: Industrial wastewater was not generated during construction period. The only wastewater to be generated during operation period would be domestic waters. The biological treatment plant is included in the project activity. All sewage will be treated according to the local regulations.

4. Solid waste: Solid wastes created during construction period were mainly soil from the digging activity and abandoned construction materials. These residues were disposed correctly following the regulations. There is no industrial solid waste considered to be generated during operation. Domestic garbage will be disposed into the landfill locally.

5. Ecological impact: The project is located within the area property of the company, and no additional land would be necessary. There is no rare plant and animals around the site, therefore this project will cause a small impact to ecological environment. The project possesses a certification of land use in which is indicated that is not prohibited the implementation of this kind of projects. The project complies with all the country's regulations in terms of environmental policies and has been approved by the local authorities.

As a result of the analysis, environmental impacts due to the implementation of the project activity are not considered significant.

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

A stakeholder consultation process was developed in order to invite local stakeholders to express their comments regarding the "Pantasma 13 MW hydroelectric project". According to the recommendations from the Ministry of Environment and Natural Resources (Marena), any CDM project must inviting local stakeholders to participate in a meeting in order to provide information of the project to them.

The invitation to the public consultation was published at the newspaper HOY on August, 2011 and the project summary was published at the Marena´s web site[31] for local consultation. In order to assure the participation of as many stakeholders as possible, the project developer organized the meeting with the participation of the government personnel. In addition, personal invitations were sent to community leaders, local people's, local authorities, committee representatives, media etc.

The meeting was held on September 23, 2011, at Escuela de Sacramento de Santa Maria de Pantasma, located in the Municipality of Jinotega and was attended by the project owner representatives, project consultant and the stakeholders described in the attendance list. During the meeting several presentations were made by the project owner and consultants who outlined the planned project activity in a non-technical manner (including environmental, social and technological considerations), climate change, the role of the Clean Development Mechanism and annual emission reductions potential. Also, the presentation was followed by an open period for questions and comments from the participants, as well as time for the respective answers from the project developers.

[31] Marena web page http://marena.gob.ni/descargas/cat_view/50-direccion-general-de-cambioclimatico?orderby=dmdatecounter&ascdesc=DESC

The main objective of the meeting was to clarify and inform the communities about the main characteristics of the project. In addition, the meeting allowed stakeholders invited to understand the basic concepts related to the project to be implemented considering the CDM and how the local communities living in the area around the project would be considered.

Figure 7: Stakeholders meeting.

All participants were dully registered in appropriate documents. A total of 50 persons from several institutions and communities attended the meeting. All opinions were collected by means of questionnaires fulfilled by the participants. All documents regarding the meeting are available for validation.

E.2. Summary of comments received

The consultation gave an opportunity for the stakeholders to fully understand the project and how they are going to be part of this. The comments received from representatives of the local communities are summarized in the following points expressing their general opinions. The comments during the meeting were related to:

Table 11: Comments received.

Participant	Comments summary
Oliver Castro (Manager of the Municipality of Jinotega)	Regarding the tunnel to be constructed: Will be the lands and natural resources affected by the tunnel? Do you have permission from the land owners? Where will be the disposal?
Anastacio Vallejo (Deputy Major of Jinotega)	Can the company (Pantasma) develop conferences regarding environmental education such as how not to contaminate?

In addition, the local stakeholders were asked to submit their opinion regarding to the project activity by completing a questionnaire handed out by the project developer. The survey shows the stakeholders believe that the proposed CDM project activity will have positive impacts on the local, ecological, environmental, employment, infrastructure, and social life. All stakeholders expressed their support for the proposed project. The complete information of each stakeholder will be provided to the DOE during the validation process.

E.3. Consideration of comments received

As a result, the comments received by local stakeholders were highly positive about the implementation of the project activity. During the meeting the project owner assured that:

Table 12: Summary of answers for comments received.

Comments summary	Summary of answers

Regarding the tunnel to be constructed: Will be the lands and natural resources affected by the tunnel? Do you have permission from the land owners? Where will be the disposal?	The lands and resources will not be affected, because the works will be developed 100m underground. For the same reason was not necessary to obtain permissions from land owners. In addition, all activities will be monitored in order to assure control over materials and the waste management.
Can the company (Pantasma) develop conferences regarding environmental education such as how not to contaminate?	Yes, the company has been defined an education program in which is included the environmental education.

In addition, during the meeting was informed that under the CDM, the project will receive a payment for the emissions reductions reached and part of these incomes will be used to develop social programs in conjunction with the municipalities.

SECTION F. Approval and authorization

The National Approval granted by the Ministry of Environmental and Natural Resources to, who is the Designated National Authority in Nicaragua, of 08 November 2012, and according to Nicaraguan legislation in this area, does not require to be renewed, since it is given once for the entire duration of the project.

Appendix 1. Contact information of project participants

Organization name	Hidropantasma S.A.
Country	Nicaragua
Address	Plaza España – Rotonda el Güegüense, Plaza Málaga, Módulo B12.
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Website	-
Contact person	Rodrigo Mantica

Appendix 2. Affirmation regarding public funding

No public funding has been involved in financing this project activity.

Appendix 3. Applicability of methodologies and standardized baselines

The grid emission factor is determined according to the Tool to calculate the emission factor for an electricity system, Version 07.0, as a combined margin emission factor, consisting of the combination of the operating margin and the build margin emission factors. The information used for it, is shown in the spreadsheet prepared by the project developer and available for validation. All information used is available at:

For net power generation and resources used at the National Interconnected System of Nicaragua: https://www.ine.gob.ni/index.php/electricidad/estadisticas-anuales/

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

The grid emission factor is determined according to the Tool to calculate the emission factor for an electricity system, Version 07.0, as a combined margin emission factor, consisting of the combination of the operating margin and the build margin emission factors. The information used for it, is provided in an organized way in the spreadsheet prepared by the project developer and available for validation. All information used for net generation ($EG_{m,y}$) and for resources used for energy generation ($FC_{i,m,y}$) at the National Interconnected System of Nicaragua is available at: https://www.ine.gob.ni/index.php/electricidad/estadisticas-anuales/

Appendix 5. Further background information on monitoring plan

No comments.

Appendix 6. Summary report of comments received from local stakeholders

No comments.

Appendix 7. Summary of post-registration changes

- **Corrections**

Turbine type: the registered PDD (19/12/2012, version 05) states as turbine type “Pelton – PH2/1300/390” which was determined during the plant design stage based on the “Technical proposal – Mechanical equipment – Final offer No. 020824-30B_Kossler”. However, the turbine type was updated to “Pelton – PH2I - 1300/390” according to the installed turbine nameplates.

Rated output capacity: the registered PDD (19/12/2012, version 05) states as turbine rated output capacity “6,547 kW (each one)” which was determined during the plant design stage based on the “Technical proposal – Mechanical equipment – Final offer No. 020824-30B_Kossler”. However, the turbine rated output capacity was updated to “6,860 kW (each one)” according to the installed turbine nameplates.

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Document information

Version	*Date*	*Description*
11.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN); • Make editorial improvements.
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the "CDM project standard for project activities" and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: • Ensure consistency with the "CDM project standard for project activities" (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the "Project design document form for small-scale CDM project activities" (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the "Standard: Applicability of sectoral scopes" (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • 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-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.

Version	*Date*	*Description*
04.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the project design document form for CDM project activities" (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

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