Project design document form

(Version 10.1)

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

BASIC INFORMATION	
Title of the project activity	Queluz and Lavrinhas Renewable Energy Project
Scale of the project activity	☒ Large-scale ☐ Small-scale
Version number of the PDD	Version 02
Completion date of the PDD	15 December 2017
Project participants	Usina Paulista Queluz de Energia S.A. Usina Paulista Lavrinhas de Energia S.A AMBIO Participações Ltda
Host Party	Brazil
Applied methodologies and standardized baselines	ACM0002 – Large-scale Consolidated methodology: Grid-connected electricity generation from renewable sources, Version 17.0
Sectoral scopes linked to the applied methodologies	01 Energy industries (renewable - / non-renewable sources)
Estimated amount of annual average GHG emission reductions	102,843 tCO_2e/year

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The project activity consists of two new small hydroelectric plants (SHP) connected to the Interconnected National System grid. The total installed capacity is 60MW[1] and the project generates 374,928 MWh[2] each year. Both plants are located at the same river, reducing the environmental impacts and exploiting the most from the river's potential.

The Queluz and Lavrinhas SHPs are run-of-river plants, both of them don't have flooded areas and therefore do not contribute to GHG emissions. The installed capacity is 30MW for each one and both are located at Paraíba do Sul River. The project delivers renewable energy to the national grid, displacing fossil fuel consumption from fossil fuel thermal plants that would be running in the absence of the project activity. The operations of Queluz SHP and of Lavrinhas SHP started on 01/01/2012.

The project activity helps Brazil to fulfil its goals by promoting sustainable development, specially in two small towns as Queluz and Lavrinhas with an estimated population of 11,000 and 7,000 habitants, respectively. The main impacts are:

- Increasing employment opportunities in the area where the project is located, either for the implementation work or for the operation of the new facilities;
- Using clean, renewable and efficient technologies; and
- Increasing the offer of renewable energy in a developing country.

A.2. Location of project activity

Queluz and Lavrinhas SHPs are both located in the Southeast region, State of São Paulo, Brazil.

Queluz, municipality of Queluz.
Lavrinhas, municipality of Lavrinhas.

Located at the Paraíba do Sul River, São Paulo - Brazil
Geographical coordinates:
Queluz SHP - 22º33'S and 44º48'W
Lavrinhas SHP - 22º34'S and 44º52'W

A.3. Technologies/measures

Queluz and Lavrinhas Small Hydroelectric Plants (SHP) have total installed capacity of 60MW (30MW each) and the technology/ equipments descriptions are detailed below:

Table 1 - Technical turbines description		
	Queluz SHP	**Lavrinhas SHP**
Installed Capacity (MW)	2x15.0	2x15.0
Type	Kaplan	Kaplan
Rotation (rpm)	600	600
Efficiency (%)	98	98

Turbines Kaplan are better used in high-flow and low-head conditions for power production.

Table 2 - Technical generators description		
	Queluz SHP	**Lavrinhas SHP**
Type	Alstom	Alstom
Quantity	2	2

[1] http://www2.aneel.gov.br/cedoc/rea2004138.pdf, http://www2.aneel.gov.br/cedoc/rea2004139.pdf.

[2] http://eletrobras.com/pt/AreasdeAtuacao/programas/proinfa/res_aneel_65_04.pdf.

Frequency (Hz)	60	60
Nominal tension (kV)	6.9	6.9
Installed Capacity (MW)	15.0	15.0
Power Factor (%)	95	95

There are 10 (ten) energy meters, all of them of the models specified by the Chamber of Electric Energy Commercialization ("CCEE" from the Portuguese *Câmara de Comercialização de Energia Elétrica*).

Two meters are installed at the Queluz SHPP, two meters at Lavrinhas SHPP, four meters at Lavrinhas substation and the other two (principal and backup) are located at the Santa Cabeça substation ("Santa Cabeça SE").

Run-of-river projects are defined as "the projects where the river's dry season flow rate is the same or higher than the minimum required for the turbines" (Eletrobrás, 1999). In addition, run-of-river schemes do not include significant water storage, and must therefore make complete use of the water flow.

Both Power Plants are Small Hydroeletric Plants, by legal definition of the Brazilian Power Regulatory Agency (Agência Nacional de Energia Elétrica – ANEEL), resolution #652[3], issued on December 9th, 2003, small hydro in Brazil must have installed capacity greater than 1MW but not more than 30MW and with reservoir area less than 3km².

Both Queluz and Lavrinhas uses water from Paraíba do Sul River, with annual average flow rate 217 m³/s with a dam level of 29.6m and 28.4m, respectively. The head level for Queluz is 12.8m and for Lavrinhas is 13.0m.

The expected lifetime of equipments are over 30 years, according to national standards and small hydroelectric plants already operational.

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host)	Usina Paulista Queluz de Energia S.A.	No
	Usina Paulista Lavrinhas de Energia S.A	
	AMBIO Participações Ltda.	

A.5. Public funding of project activity

The project has not received Official Development Assistance (ODA) and any public funding from Parties included in Annex I of the UNFCCC.

A.6. History of project activity

Not applicable for the renewal of the crediting period.

A.7. Debundling

Not applicable.

[3] http://www2.aneel.gov.br/aplicacoes/leitura_arquivo/arquivos/res2003652.pdf.

SECTION B. Application of selected methodologies and standardized baselines

B.1. Reference to methodologies and standardized baselines

The proposed project activity falls under ACM0002 – Large-scale Consolidated methodology: Grid-connected electricity generation from renewable sources (Version 17.0)[4].

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

(a) "Tool to calculate the emission factor for an electricity system" (version 06.0)[5];

(b) "Tool for the demonstration and assessment of additionality" (version 07.0.0)[6];

(c) "Combined tool to identify the baseline scenario and demonstrate additionality" (version 07.0)[7];

(d) "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (version 03.0)[8];

(e) "Tool to determine the remaining lifetime of equipment" (version 01)[9];

(f) "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)[10];

(g) "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0)[11].

Since this PDD refers to the second crediting period of the project, the "Tool for the demonstration and assessment of additionality" and the "Combined tool to identify the baseline scenario and demonstrate additionality" are not applicable.

The "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" is also not applied to the project, since there are no GHG emissions from fossil fuel combustion in the project boundary.

B.2. Applicability of methodologies and standardized baselines

According to the sectoral scope list presented by UNFCCC, the project is related to sectoral scope 1: Energy industries (renewable - / non-renewable sources) and is the most characteristic methodology for large scale – this methodology is applicable to grid-connected renewable power generation project activities that involve additional electricity capacity.

ACM0002 is applicable to grid-connected renewable energy power generation project activities that:

(a) Install a Greenfield power plant;

(b) Involve a capacity addition to (an) existing plant(s);

(c) Involve a retrofit of (an) existing operating plants/units;

(d) Involve a rehabilitation of (an) existing plant(s)/unit(s); or

(e) Involve a replacement of (an) existing plant(s)/unit(s).

In the case of the proposed project activity, option (a) is applicable.

Moreover, the methodology is applicable under the following conditions:

(a) The project activity may include renewable energy power plant/unit of one of the following types: hydro power plant/unit with or without reservoir, wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit.

The project activity is the installation of two run-of-river hydro power plants.

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[4] https://cdm.unfccc.int/methodologies/DB/8W400U6E7LFHHYH2C4JR1RJWWO4PVN

[5] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v6.pdf

[6] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v7.0.0.pdf

[7] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-02-v7.0.pdf

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

[9] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-10-v1.pdf

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

[11] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v3.0.pdf

(b) In the case of capacity additions, retrofits, rehabilitations or replacements (except for wind, solar, wave or tidal power capacity addition projects) the existing plant/unit started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section, and no capacity expansion, retrofit, or rehabilitation of the plant/unit has been undertaken between the start of this minimum historical reference period and the implementation of the project activity.

Not applicable, since only new project/unit(s) is considered in the proposed project activity.

In case of hydro power plants, one of the following conditions shall apply:

(a) The project activity is implemented in an existing single or multiple reservoirs, with no change in the volume of any of the reservoirs; or

(b) The project activity is implemented in an existing single or multiple reservoirs, where the volume of the reservoir(s) is increased and the power density calculated using equation (3) is greater than 4 W/m²; or

(c) The project activity results in new single or multiple reservoirs and the power density calculated using equation (3) is greater than 4 W/m²; or

(d) The project activity is an integrated hydro power project involving multiple reservoirs, where the power density for any of the reservoirs, calculated using equation (3), is lower than or equal to 4 W/m², all of the following conditions shall apply:

(i) The power density calculated using the total installed capacity of the integrated project, as per equation (4), is greater than 4 W/m²;

(ii) Water flow between reservoirs is not used by any other hydropower unit which is not a part of the project activity;

(iii) Installed capacity of the power plant(s) with power density lower than or equal to 4 W/m² shall be:

a. Lower than or equal to 15 MW; and

b. Less than 10 per cent of the total installed capacity of integrated hydro power project.

The project activity results in new reservoirs and the power density is greater than 4 W/m², thus option (c) is applied. A detailed description of power density calculation is presented in section B.6.3 of this PDD.

In the case of integrated hydro power projects, project proponent shall:

(a) Demonstrate that water flow from upstream power plants/units spill directly to the downstream reservoir and that collectively constitute to the generation capacity of the integrated hydro power project; or

(b) Provide an analysis of the water balance covering the water fed to power units, with all possible combinations of reservoirs and without the construction of reservoirs. The purpose of water balance is to demonstrate the requirement of specific combination of reservoirs constructed under CDM project activity for the optimization of power output. This demonstration has to be carried out in the specific scenario of water availability in different seasons to optimize the water flow at the inlet of power units. Therefore this water balance will take into account seasonal flows from river, tributaries (if any), and rainfall for minimum five years prior to implementation of CDM project activity.

Not applicable, since the project activity is not an integrated project type.

The methodology is not applicable to:

(a) Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site;

Not applicable, since the hydropower plant is a grid-connected power project.

(b) Biomass fired power plants/units;

Not applicable, since the project activity is a hydropower type.

In the case of retrofits, rehabilitations, replacements, or capacity additions, this methodology is only applicable if the most plausible baseline scenario, as a result of the identification of baseline scenario, is “the continuation of the current situation, that is to use the power generation equipment that was already in use prior to the implementation of the project activity and undertaking business as usual maintenance”.

Not applicable, since only new project/unit(s) is considered in the proposed project activity.

In addition, the applicability conditions included in the tools referred to below apply.

Considering explanations above, the project activity follows the applicability conditions established in ACM0002.

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

As described in ACM0002 methodology, the spatial extent of the project boundary includes the project power plants and all power plants connected physically to the electricity system that the CDM project power plants is connected to.

The greenhouse gases and emission sources included in or excluded from the project boundary are shown in the below table.

Source		GHGs	Included?	Justification/Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity.	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project activity	For dry or flash steam geothermal power plants, emissions of CH_4 and CO_2 from non-condensable gases contained in geothermal steam.	CO_2	Yes	Main emission source. However, this emission source is not applicable to the project activity, since the proposed project is the installation of two run-of-river hydro power plants.
		CH_4	Yes	Main emission source. However, this emission source is not applicable to the project activity, since the proposed project is the installation of two run-of-river hydro power plants.
		N_2O	No	Minor emission source
	For binary geothermal power plants, fugitive emissions of CH_4 and CO_2 from non-condensable gases contained in geothermal steam.	CO_2	Yes	Main emission source. However, this emission source is not applicable to the project activity, since the proposed project is the installation of two run-of-river hydro power plants.
		CH_4	Yes	Main emission source. However, this emission source is not applicable to the project activity, since the proposed project is the installation of two run-of-river hydro power plants.
		N_2O	No	Minor emission source
	For binary geothermal power plants, fugitive emissions of hydrocarbons such as n-butane and isopentane (working fluid) contained in the heat exchangers.	Low GWP hydrocarbon/ refrigerant	Yes	Main emission source. However, this emission source is not applicable to the project activity, since the proposed project is the installation of two run-of-river hydro power plants.
	CO_2 emissions from combustion of fossil fuels for electricity generation in solar thermal power plants and geothermal power plants.	CO_2	Yes	Main emission source. However, this emission source is not applicable to the project activity, since the proposed project is the installation of two run-of-river hydro power plants.
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
	For hydro power plants, emissions of CH_4 from the reservoir.	CO_2	No	Minor emission source
		CH_4	Yes	Main emission source. Considering that both plant's power density is greater than 10 W/m², there are no project emissions from the reservoir involved in the project activity.
		N_2O	No	Minor emission source

B.4. Establishment and description of baseline scenario

According to ACM0002, if the project activity is the installation of a Greenfield power plant, the baseline scenario is electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system".

The baseline scenario mentioned above is applicable since the project activity is the installation of two Greenfield power plants.

According to the CDM Project Standard (Version 01.0):

287. To demonstrate the validity of the original baseline or its update, the project participants are not required to re-assess the baseline scenario. Instead, the project participants shall assess the GHG emission reductions or net anthropogenic GHG removals that would have resulted from that scenario.

288. The project participants shall assess and incorporate the impact of national and/or sectoral policies and circumstances, existing at the time of requesting the renewal of the crediting period, on the current baseline GHG emissions, without reassessing the baseline scenario.

289. The requirements contained in paragraph 288 above are not applicable to a registered CDM project activity applying the valid version of an applicable approved standardized baseline that standardizes baseline scenario in accordance with paragraph 285 above.

290. If data and parameters used for determining the original baseline, that were determined ex-ante and not monitored during the crediting period, are no longer valid, the project participants shall update such data and parameters in accordance with the "Methodological tool: Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period".

The "Methodological tool: Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" shall be used to assess the continued validity of the baseline and to update the baseline at the renewal of a crediting period. Therefore, the following steps were taken:

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

The "Procedures for the renewal of the crediting period of a registered CDM project activity" approved by the CDM Executive Board require assessing the impact of new relevant national and/or sectoral policies and circumstances on the baseline.

The validity of the current baseline is assessed using the following Sub-steps:

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

There are no new relevant mandatory national and/or sectoral policies and/or circumstances in the electricity generation sector applicable to the project activity, which have come into effect after the submission of the project activity for validation and are applicable at the time of requesting renewal of the crediting period, which would affect the compliance of the current baseline scenario.

Step 1.2: Assess the impact of circumstances

There are no new relevant mandatory national and/or sectoral policies and/or circumstances in the electricity generation sector applicable to the project activity, which have come into effect after the submission of the project activity for validation and are applicable at the time of requesting renewal of the crediting period, which would affect the compliance of the current baseline scenario. This information could be confirmed by assessing CCEE website[12] .

The inclusion or not of new fuels or raw materials was taken inn account in the calculation of the emission factor.

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.

[12] http://www.ccee.org.br/portal/wcm/idc/groups/bibpublic_juridicoregulatorio/documents/conteudoccee/ccee_031561.pdf

The baseline identified at the validation of the project activity was the continuation of the current practice. In the absence of the project activity, the electricity would be generated by grid connected power plants. The National Interconnected System (**SIN, from the Portuguese "Sistema Interligado Nacional"**) is composed by 4667 plants[13] and each one has specific characteristics and equipment. Thus, this step does not apply, since the whole system would continue to supply energy independently of the lifetime of individual equipment.

Regarding the project lifetime, the project has 30 years lifetime without any new investment required as validated in the registered PDD. Since the project startup occurred in 2009 and 2010 years, the project is expected to be operational up to 2039-2040 year. Then, the remaining technical lifetime exceeds the end of the last crediting period of the project (2031 year).

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

According to the "Assessment of validity of the original/current baseline and update of the baseline at the renewal of the crediting period" updates should be undertaken in the following cases:

- Where IPCC default values are used, the values should be updated if any new default values have been adopted and published by the IPCC, for example, in guidelines for national GHG inventories, IPCC assessment report or special reports by the IPCC;
- Where emission factors, values or emission benchmarks are used and determined only once for the crediting period, they should be updated, except if the emission factors, values or emission benchmarks are based on the historical situation at the site of the project activity prior to the implementation of the project and cannot be updated because the historical situation does not exist anymore as a result of the CDM project activity.

As mentioned above, the baseline identified at the validation of the project activity was the continuation of the current practice. In the absence of the project activity, the electricity would be generated by grid connected power plants, which have been enlarged to attend the increasing demand for electrical energy supply.

The dispatch of new energy plants altered the energy matrix profile. According to ANEEL latest data: 61.21 % of Brazil's installed capacity is composed by large hydropower plants and 26.97 % by thermal power stations (Table 3), during the time of the first registration, the profile was: 73.4% large hydropower plants, and 21.91% by thermal power station. As can be notice, the profile of the energy plants that dispatches energy to the SIN have altered, increasing the amount of fossil fuel participation in it. These facts reflect on the emission factor value, which must be recalculated. See sections B.6.1 and B.6.3 of this PDD for a detailed description of data and parameters applied for the calculation of emission reductions.

Table 3 – Operation types of project (% installed capacity)[14]

Type		% installed capacity
CGH	Hydroelectric generator center	0.36
EOL	Wind generator center	6.88
PCH	**Small hydroelectric power plant**	**3.27**
UFV	Solar generation center photovoltaic	0.02
UHE	Hydroelectric power plant	61.21
UTE	Thermoelectric power plant	26.97
UTN	Thermonuclear power plant	1.31

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

Step 2.1: Update the current baseline

As already mentioned, the current scenario still valid, thus there is no need to be updated. See sections B.6.1 and B.6.3 of this PDD for a detailed description of data and parameters applied for the calculation of emission reductions.

[13] http://www2.aneel.gov.br/aplicacoes/capacidadebrasil/capacidadebrasil.asp.

[14] http://www2.aneel.gov.br/aplicacoes/capacidadebrasil/capacidadebrasil.asp.

Step 2.2: Update the data and parameters

Considering changes in the Brazilian grid delineation, the CO_2 emission factor of the grid has to be updated to reflect the current delineation and matrix, following the latest version of the "Tool to calculate the emission factor for an electricity system". See sections B.6.1 and B.6.3 of this PDD for a detailed description of data and parameters applied for the calculation of emission reductions.

B.5. Demonstration of additionality

Not applicable in the second crediting period.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

Project Emissions

According to ACM0002, for most renewable energy power generation project activities, PE_y = 0. However, some project activities may involve project emissions that can be significant. These emissions shall be accounted for as project emissions by using the following equation:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y}$$

Where:
PE_y – Project emissions in year (tCO_2e/y);
$PE_{FF,y}$ - Project emissions from fossil fuel consumption in year (tCO_2e/y);
$PE_{GP,y}$ - Project emissions from the operation of dry, flash steam or binary geothermal power plants in year (tCO_2e/y);
$PE_{HP,y}$ - Project emissions from water reservoirs of hydro power plants in year (tCO_2e/y).

For all renewable energy power generation project activities, emissions due to the use of fossil fuels for the backup generator can be neglected.

The power density (PD) of the project activity is calculated as follows:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}}$$

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 in 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 in 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.

If the power density of the project activity is greater than 4 W/m^2 and less than or equal to 10 W/m^2:

$$PE_{HP,y} = \frac{EF_{Res} \times TEG_y}{1000}$$

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 (kg CO_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).

If the power density of the project activity is greater than 10 W/m², $PE_{HP,y} = 0$.

Baseline Emissions

Baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity, calculated as follows:

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

Where:

BE_y - Baseline emissions in year y (tCO_2/yr).

$EG_{PJ,y}$ – Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr).

$EF_{grid,CM,y}$ - Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (tCO_2/MWh).

Calculation of the combined margin CO_2 emission factor for grid connected power generation ($EF_{grid,CM,y}$)

According to the "Tool to calculate the emission factor for an electricity system" the following six steps shall be applied in order to calculate the baseline emission factor as further detailed below.

STEP 1 - Identify the relevant electricity systems

According to the tool, "if the DNA of the host country has published a delineation of the project electricity system and connected electricity systems, these delineations should be used. If this information is not available, project participants should define the project electricity system and any connected electricity system, and justify and document their assumptions in the CDM-PDD".

Brazilian DNA has published the Resolution nº 8[15] issued on 26th May, 2008 that defines the Brazilian Interconnected Grid as a single system that covers all the five macro-geographical regions of the country (North, Northeast, South, Southeast and Midwest). Hence, this figure will be used to calculate the baseline emission factor of the grid.

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

The tool provides the following two options to calculate the operating margin and build margin emission factor:

Option I: only grid power plants are included in the calculation;

Option II: both grid power plants and off-grid power plants are included in the calculation.

Project participants choose to follow Option I.

STEP 3 - Select a method to determine the operating margin (OM)

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

(a) Simple OM, or

(b) Simple adjusted OM, or

(c) Dispatch data analysis OM, or

(d) Average OM.

STEP 4 - Calculate the operating margin emission factor according to the selected method

15 http://www.mctic.gov.br/mctic/export/sites/institucional/ciencia/SEPED/clima/arquivos/legislacao_cimgc/Resolucao-n-8-de-26-de-maio-de-2008.pdf.

The Brazilian DNA made available the operating margin emission factor calculated using option c – Dispatch data analysis OM. Detailed information on the methods and data applied can be obtained in the DNA's website[16].

The dispatch data analysis OM emission factor ($EF_{grid,OM-DD,y}$) is determined based on the grid power units that are actually dispatched at the margin during each hour *h* where the project is displacing electricity. This approach is not applicable to historical data and, thus, requires annual monitoring of $EF_{grid,OM-DD,y}$. As consequence, it will be calculated *ex-post*. Only for purpose of estimative, the numbers of the most recent years will be used.

The emission factor is calculated as follows:

$$EF_{grid,OM-DD,y} = \frac{\sum_h EG_{PJ,h} \times EF_{EL,DD,h}}{EG_{PJ,y}}$$

Where:

$EF_{grid,OM-DD,y}$ = Dispatch analysis operating margin CO_2 emission factor in year *y* (tCO_2/MWh);
$EG_{PJ,h}$ = Electricity displaced by the project activity in hour h *of* year *y* (MWh);
$EG_{PJ,y}$ = Total electricity displaced by the project activity in year *y* (MWh);
$EF_{EL,DD,h}$ = CO_2 emission factor for grid power units in the top of the dispatch order in hour h in year *y* (tCO_2/MWh);
h = Hours in year *y in which the project activity is displacing grid electricity;*
y = Year in which the project activity is displacing grid electricity.

As mentioned above, the host country's DNA will provide $EF_{EL,DD,h}$ in order to Project Participants to calculate the operating margin emission factor. Hence, this data will be updated annually applying the number published by the Brazilian DNA. For estimative purposes, the dispatch data analysis OM emission factor of the most recent year available in the DNA website will be used.

STEP 5 - Calculate the build margin (BM) emission factor

For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE (Option 1).

The build margin is also calculated by the DNA. The number is published in the website and for estimative purposes the data for the most recent year will be used.

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

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

Where:

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

STEP 6 – Calculate the combined margin (CM) emission factor

The calculation of the combined margin (CM) emission factor ($EF_{grid,CM,y}$) is as follows:

[16] Site accessed on June 2017:

http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html.

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$

Where:
$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year y (tCO_2/MWh);
$EF_{grid,OM,y}$ = Operating margin CO_2 emission factor in year y (tCO_2/MWh);
w_{OM} = Weighting of operating margin emissions factor (per cent);
w_{BM} = Weighting of build margin emissions factor (per cent).

The following default values should be used for w_{OM} and w_{BM}:

(a) Wind and solar power generation project activities: w_{OM} = 0.75 and w_{BM} = 0.25 (owing to their intermittent and non-dispatchable nature) for the first crediting period and for subsequent crediting periods;

(b) All other projects: w_{OM} = 0.5 and w_{BM} = 0.5 for the first crediting period, and w_{OM} = 0.25 and w_{BM} = 0.75 for the second and third crediting period, unless otherwise specified in the approved methodology which refers to this tool.

Calculation of $EG_{PJ,y}$

According to ACM0002, the calculation of $EG_{PJ,y}$ is different for Greeenfield plants, capacity additions, retrofits, rehabilitations, and replacements. Since the proposed project activity consists of a Greenfield plant, then:

$$EG_{PJ,y} = EG_{facility,y}$$

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

Leakage

No other leakage emissions are considered. The emissions potentially arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, transport etc.) are neglected.

Emission reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$

Where:
ER_y = Emission reductions in year y (tCO_2e/yr).
BE_y = Baseline emissions in year y (tCO_2e/yr).
PE_y = Project emissions in year y (tCO_2e/yr).

B.6.2. Data and parameters fixed ex ante

Data / Parameter	Cap_{BL}
Data unit	W
Description	Installed capacity of the hydro power plant before the implementation of the project activity. For new hydro power plants, this value is zero.
Source of data	Engineering plants. There was no reservoir before project activity.

Value(s) applied	Lavrinhas: 0 Queluz: 0
Choice of data or measurement methods and procedures	No equipments were installed before the project activity.
Purpose of data	Paramenter used to determine emissions from reservoir.
Additional comment	-

Data / Parameter	A_{BL}
Data unit	m^2
Description	Area of the single or multiple reservoirs measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new hydro power plants, this value is zero.
Source of data	Project site.
Value(s) applied	Lavrinhas: 0 Queluz: 0
Choice of data or measurement methods and procedures	Engineering plants. There was no reservoir before project activity.
Purpose of data	Paramenter used to determine emissions from reservoir.
Additional comment	

B.6.3. Ex ante calculation of emission reductions

Project emissions

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y}$$

There is no fossil fuel consumption and the project activity is not a geothermal plant. Therefore, as per ACM0002, $PE_{FF,y}$ and $PE_{GP,y}$ are zero.

For determine emissions from water reservoirs of hydro power plants ($PE_{HP,y}$), the power density is determined as follows:

Parameter	Value	
	SHP Lavrinhas	SHP Queluz
Cap_{BL} (MW)	0	0
A_{BL} (m^2)	0	0
Cap_{PJ} (MW)	30	30
A_{PJ} (m^2)	$0.76 * 10^6$	$1.27 * 10^6$
PD (W/m^2)	39	24

Source: The registered PDD, Preliminary license #666 and #667 issued by the local environmental agency and ANEEL Resolutions nº 138 and nº 139.

Since the power densities for both plants are higher than 10 W/m^2, the project emissions from water reservoirs are not considered, $PE_{HP,y} = 0$.

Therefore, $PE_y = 0$.

Baseline emissions

Determined based on the combined margin CO_2 emission factor for grid connected power generation and the quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity.

Calculation of the combined margin CO_2 emission factor for grid connected power generation ($EF_{grid,CM,y}$)

For estimation purposes, data provided by the Brazilian DNA for the year 2016 were applied in the calculation of the emission factor[17]. When applying the published numbers in the formula presented in step 4 of section B.6.1., the $EF_{grid,OM-DD,y}$ obtained is:

$$EF_{grid,OM-DD,\ 2016} = 0.6228\ tCO_2e/MWh$$

The building margin for the year of 2016 published by the DNA is:

$$EF_{BM,2016} = 0.1581\ tCO_2e/MWh.$$

With these numbers, applying in the formula presented in step 7 of section B.6.1., we have:

$$EFy = 0.25 * 0.6228 + 0.75 * 0.1581$$

$$EFy = 0.2743\ tCO_2e/MWh$$

Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity ($EG_{PJ,y}$)

As mentioned in section B.6.1, $EG_{PJ,y} = EG_{facility,y}$. Estimated quantity of net electricity generation supplied by the project plant/unit to the grid is calculated based on the assured energy authorized by ANEEL.

The electricity generated by the SHPPs Lavrinhas and Queluz can be estimated considering the assured energy authorized by ANEEL, which is 187,464 MWh for each one. Hence,

$$EG_{PJ,y} = 374{,}928\ MWh$$

The baseline emissions are calculated as follows:

$$BE_y = 374{,}928\ MWh * 0.2743\ tCO_2e/MWh = 102{,}843\ tCO_2e/year$$

Emission reductions

Emission reductions are calculated as follows:

$$ER_y = 102{,}843\ tCO_2e/year - 0 = 102{,}843\ tCO_2e/year$$

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)
2017*	2,818	0	0	2,818
2018	102,843	0	0	102,843
2019	102,843	0	0	102,843
2020	102,843	0	0	102,843
2021	102,843	0	0	102,843
2022	102,843	0	0	102,843
2023	102,843	0	0	102,843
2024**	100,025	0	0	100,025
Total	719,899	0	0	719,899

[17] The most recent complete data available.

Total number of crediting years	7			
Annual average over the crediting period	102,843	0	0	102,843
* From December 22nd ** Up to December 21st				

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter	$EG_{PJ,y}$ or $EG_{facility,y}$
Data unit	MWh/yr
Description	Quantity of electricity generated and supplied by the project power plant to the grid in year y Quantity of electricity generated and supplied by the project power plant to the consumers/electricity consuming facility i in year y
Source of data	Electricity meter(s)
Value(s) applied	374,928
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. If 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 grid.
Monitoring frequency	Continuous measurement and monthly recording.
QA/QC procedures	Electricity supplied by the project activity to the grid. Cross checked by receipt of sales.
Purpose of data	Calculation of baseline emissions.
Additional comment	Each small hydro will prepare its own monthly report. EG is the sum of both reports. $EG_{facility,y}$ used for ex-ante ER calculation is based on assured energy of projects as provided by ANEEL.

Data / Parameter	Cap_{PJ}
Data unit	W
Description	Installed capacity of the hydro power plant after implementation of the project activity.
Source of data	Project site.
Value(s) applied	Lavrinhas: 30 Queluz: 30
Measure ment methods and procedures	Installed capacity according to installed manual equipments.
Monitoring frequency	Once at the beginning of each crediting period.
QA/QC procedures	-
Purpose of data	Calculation of project emissions.
Additional comment	

Data / Parameter	A_{PJ}
Data unit	m^2
Description	Area of the single or multiple reservoirs measured in the surface of the water, after the implementation of the project activity, when the reservoir is full.

Source of data	Project site
Value(s) applied	Lavrinhas: 0.76 *10^6 Queluz: 1.27 *10^6
Measurement methods and procedures	Measured from topographical surveys, maps, satellite pictures, etc.
Monitoring frequency	Once at the beginning of each crediting period.
QA/QC procedures	-
Purpose of data	Calculation of project emissions.
Additional comment	-

Data / Parameter	$EF_{grid,CM,y}$
Data unit	tCO_2/MWh
Description	Combined margin emission factor for the grid in year y
Source of data	Calculate de combined emission factor, using the procedures in the latest approved version of the "Tool to calculate the emission factor for an electricity system".
Value(s) applied	0.2743
Measurement methods and procedures	As per the "Tool to calculate the emission factor for an electricity system".
Monitoring frequency	As per the "Tool to calculate the emission factor for an electricity system".
QA/QC procedures	As per the "Tool to calculate the emission factor for an electricity system".
Purpose of data	Calculation of baseline emissions.
Additional comment	As per the "Tool to calculate the emission factor for an electricity system".

B.7.2. Sampling plan

Not applicable.

B.7.3. Other elements of monitoring plan

The energy generated will be monitored by a calibrated ION 8000 series or similar metering device. Reading will be registered continuously by the supervisory system. All information will be cross checked by the energy invoices, that uses the concessionaire monitoring equipments. The project developer will be responsible for the operation, for the monitoring plan, training the operators and data collection.
Data monitored are required for verification and issuance will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later.

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

01/12/2007 – Contract with Alstom, buying the turbo-generators, which was the first commitment.

C.2. Expected operational lifetime of project activity

More than 30 years.

C.3. Crediting period of project activity

C.3.1. Type of crediting period

Renewable crediting period.

C.3.2. Start date of crediting period

22/12/2017

C.3.3. Duration of crediting period

7 years.

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

Not applicable for the renewal of the crediting period.

D.2. Environmental impact assessment

Not applicable for the renewal of the crediting period.

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

Not applicable for the renewal of the crediting period.

E.2. Summary of comments received

Not applicable for the renewal of the crediting period.

E.3. Consideration of comments received

Not applicable for the renewal of the crediting period.

SECTION F. Approval and authorization

The Party involved in the project activity is the Host Country Brazil. The Letter of Approval is attached below and available at: https://cdm.unfccc.int/Projects/DB/RINA1264170593.12/view.

República Federativa do Brasil
Comissão Interministerial de Mudança Global do Clima

Carta de Aprovação

Para: USINA PAULISTA QUELUZ DE ENERGIA S.A. (Participante do Projeto)
USINA PAULISTA LAVRINHAS DE ENERGIA S.A. (Participante do Projeto)
AMBIO PARTICIPAÇÕES LTDA. (Participante do Projeto)
RINA S.P.A. (ENTIDADE OPERACIONAL DESIGNADA)

12 de janeiro de 2010.

1. Na qualidade de Presidente da Comissão Interministerial de Mudança Global do Clima, Autoridade Nacional Designada para o Mecanismo de Desenvolvimento Limpo no âmbito do Protocolo de Quioto, confirmo por meio desta que:

(i) A República Federativa do Brasil ratificou a Convenção-Quadro das Nações Unidas sobre Mudança do Clima em 28 de fevereiro de 1994 e o Protocolo de Quioto em 23 de agosto de 2002;

(ii) A República Federativa do Brasil participa voluntariamente do MDL;

(iii) O "Projeto" conforme definido pelo Documento de Concepção de Projeto **"Projeto de Energia Renovável Queluz e Lavrinhas",** datado de **28 de setembro de 2009** e identificado como **Versão 3**, e validado pela Entidade Operacional Designada **RINA S.P.A.**, por meio do Relatório de Validação datado de **22 de outubro de 2009** e identificado como **Revisão 2,** contribuirá para a República Federativa do Brasil alcançar o desenvolvimento sustentável.

2. Declaro que a Secretaria Executiva da Comissão Interministerial de Mudança Global do Clima fica desde já autorizada a submeter ao Conselho Executivo do MDL um pedido de revisão do "Projeto", no caso em que o Documento de Concepção do Projeto e o Relatório de Validação submetidos ao Conselho Executivo do MDL para registro não correspondam aos documentos mencionados no parágrafo 1 - (iii) acima.

Atenciosamente,

SERGIO MACHADO REZENDE
Ministro de Estado da Ciência e Tecnologia da República Federativa do Brasil
Presidente da Comissão Interministerial de Mudança Global do Clima

Appendix 1. Contact information of project participants

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Appendix 2. Affirmation regarding public funding

No public funding is involved in the present project and the project is not a diverted ODA from an Annex 1 country.

Appendix 3. Applicability of methodologies and standardized baselines

This section is left in blank intentionally. For details, please, refer to section B.2 above.

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

This section is left in blank intentionally. For details, please, refer to sections B.6.1 and B.6.3 above.

Appendix 5. Further background information on monitoring plan

This section is left in blank intentionally. For details, please, refer to section B.7 above.

Appendix 6. Summary report of comments received from local stakeholders

This section is left in blank intentionally. For details, please, refer to section E above.

Appendix 7. Summary of post-registration changes

This section is left blank intentionally.

Document information

Version	*Date*	*Description*
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.
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

Version	*Date*	*Description*
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

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