Project design document form for small-scale CDM project activities

(Version 08.0)

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

PROJECT DESIGN DOCUMENT (PDD)	
Title of the project activity	Ishasha 6.6 MW Small Hydropower Project[1]
Version number of the PDD	10
Completion date of the PDD	26/09/2016
Project participant(s)	1. Eco Power Uganda Ltd 2. C-Quest Capital LLC
Host Party	Government of Uganda (host)
Applied methodology(ies) and, where applicable, applied standardized baseline(s)	**Methodology:** AMS-I.D, version 17, "Grid connected renewable electricity generation"
Sectoral scope(s) linked to the applied methodology(ies)	**Sectoral Scope 1:** Energy Industries (renewable/ non renewable sources)
Estimated amount of annual average GHG emission reductions	21,084 tCO_2

[1] In the registered PDD, the project was to be implemented for a capacity of 6.6 MW. However the actual capacity installed is 6.4 MW only. The title of the project activity (with description of 6.6 MW) has been used in CDM documentation since validation stage and to ease the identification of the project the original title has been retained without changes.

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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Eco Power Uganda Limited (EPUL) plans to initiate the Ishasha Small Hydropower project, a 6.4 MW[2] run-of-river project with an annual production of 31,596 MWh[3] (hereafter referred to as "the project"). The project is located 500 meters below the border of Bwindi Forest National Park in Karima sub county, Kanungu District of Western Uganda. The project will harness water from the Ishasha River and drop the water approximately 90 meters through a mild steel penstock of 1,140 meters to run two turbines located in a power house at the end of the penstock. The runoff water tailrace is channelled for a re-entry into the Ishasha River at a point less than 1.5 kilometres from the dam/weir location. The electricity generated will be transmitted to the Uganda Electricity Transmission Company Limited (UETCL), which operates the national grid system, via a 7 km long transmission line.

The Electricity Regulatory Authority of Uganda (ERA) manages the electricity generation project development process in Uganda by allowing private project developers to formally apply for licenses and permits to develop projects from a published list of potential project sites. EPUL had followed this process and had obtained permits to develop the project, and hence there was no concession by the Ministry of Energy.

Implementation of the project will consist of construction of the following main items:

- A dam/diversion weir which rises 15 meters above the water level in the Ishasha River to allow sufficient water storage to operate the plant at full capacity for 2 hours
- Intake Structure
- The penstock, 1,140 meters long, laid along the ground on concrete supports from the intake to power house
- The power house of floor area approx. 200m^2
- Power house with two horizontal 3.4 MW Francis turbines each coupled to a 4.0 MVA synchronous generator operated at a power factor of 0.8 to produce the plant design electrical capacity of 6.4 MW.
- Tailrace canal and related structures back to the Ishasha River
- Switch station and a 7 kilometre 33kV transmission line
- A redundant (i.e., double check) metering system, consisting of main and check meters installed at the electricity delivery points, to determine the volume of electricity supplied to UETCL
- Access Roads
- Staff quarters

Contribution to sustainable development

The primary objective of the project is to supply affordable electricity and contribute to environmental and economical sustainability for the population of Uganda. The electricity grid in Uganda supplies only a small fraction of the population and relies partly on fossil fuels. During the peak demand hours the fossil fuel use is very heavy. Increased production of electricity from renewable resources will lead to the reduction of the global emissions of greenhouse gases. The project will further help Uganda to stimulate and commercialize the use of grid connected

[2] The 6.4 MW is the plant design (electrical) capacity resulting from the coupling of two (2) Turboinstitut "Francis" turbines each with a nameplate capacity of 3.4 MW and two (2) Leroy Somer synchronous generators, each rated at 4.0 MVA and operated at power factor of 0.8 to produce the plant design electrical capacity of 6.4 MW.

[3] Actual net electricity output monitored from July 2012 to June 2013 (first year of crediting period).

renewable energy technologies. The project will demonstrate the viability of small scale grid connected hydropower directed primarily at peak hour service which can support improved energy security, improved air quality, improved local area livelihoods and sustainable renewable energy industry development.

It is estimated that the project will lead to an annual emission reduction of 21,084 tCO_{2e} annually.

The project will:

- Produce renewable energy and thus reduce global greenhouse gas emissions;
- Help to stimulate the small hydropower industry in Uganda;
- Create local employment during the construction and operation of the hydropower station;
- Reduce other pollutants such as particulates, SO_2, and NO_X resulting from fossil fuel power generation industry in Uganda;
- Reduce Uganda's increasing energy deficit; and
- Reduce import dependency.

The project contributes to sustainable development in Uganda in the following ways:

- Hydropower presents various environmental benefits compared to other primary energy sources: hydropower does not result in emissions of pollutants into the atmosphere nor does it emit residuals that can have a negative impact on soil, vegetation, drinking water etc. As a renewable energy source hydropower can be sustainably used by future generations. The proposed project will also contribute to a reduction in emissions other than GHG emissions related to conventional electricity generation, such as emissions of sulphur dioxide, nitrogen oxides, and particulates:
- The project will diversify Uganda's energy mix which comprises of biomass, petroleum and electricity. According to the energy balance 2006, final energy consumption is as much as 92.1% biomass, plus 7.0% petroleum products but only 0.9% electricity;[4]
- The project will result in additional employment opportunities, especially during the construction phase. Construction materials for the substantial quantum of concrete used for the project and access roads will be sourced locally;
- The project complies with national and local laws and regulations. The project has been granted a permit to develop the Ishasha small hydropower plant by the Electricity Regulatory Authority (ERA) and the Environmental and Social Impact Assessment (ESIA) has been approved by the National Environment Management Agency (NEMA);
- The project supports the main policy goal of the Ministry of Energy and Mineral Development; namely "To establish, promote the development, strategically manage and safeguard the rational and sustainable exploitation and utilization of energy and mineral resources for social and economic development".[5]

A.2. Location of project activity

A.2.1. Host Party

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The host party is the Republic of Uganda.

A.2.2. Region/State/Province etc.

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The project activity is located in the Kanungu District of south-western Uganda.

[4] Annual Report 2006, Ministry of Energy and Mineral Development, page 32
[5] Annual Report 2006, Ministry of Energy and Mineral Development, page iii

A.2.3. City/Town/Community etc.

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The project is located at the Ruheza-Kyajura Village, Nyamigoue Parish in Kanyantoorogo sub-county.

A.2.4. Physical/Geographical location

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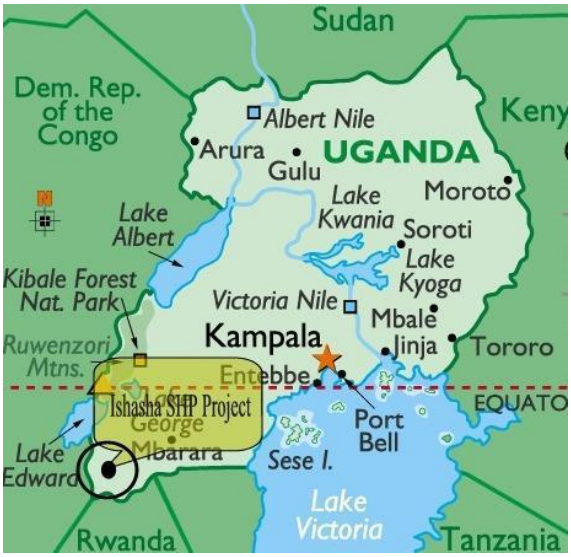
The Ishasha Small Hydropower plant is located on Ishasha River, Kanungu district in the Western region of Uganda with the dam/weir being constructed 500 meters downstream of the border of the Bwindi Impenetrable National Park (see Figure 1).

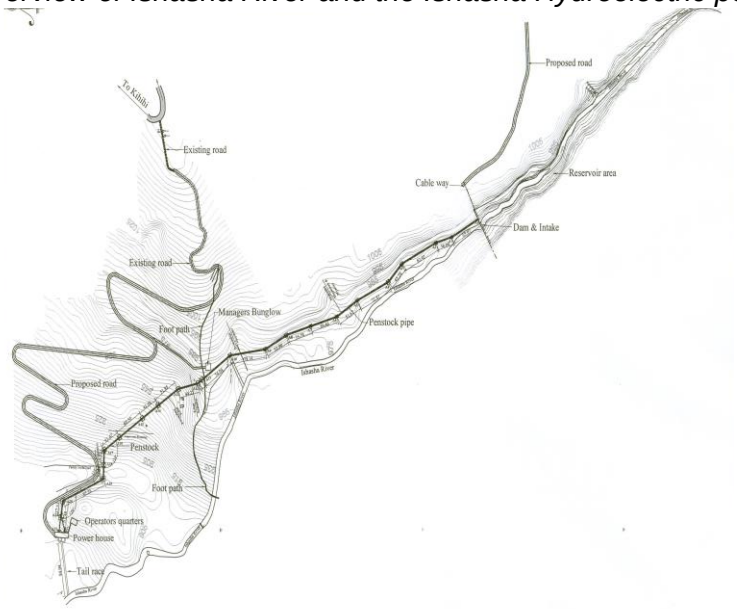
Figure 1: Map of Uganda showing project site



The coordinates of the Ishasha Hydro Power project site are:

	Longitude:	Latitude:
Weir/Diversion Intake:	-0.935556	29.668611
Power House/Tailrace	-0.878611	29.657500

Figure 2: Overview of Ishasha River and the Ishasha Hydroelectric power Project



A.3. Technologies and/or measures

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The proposed project activity generates electricity from run-of-river hydropower and supplies it to the national electricity grid, replacing electricity production derived from diesel generators. Hydropower being renewable energy type I category has been chosen and the electricity generated is supplied to the grid meeting the applicability conditions for AMS I.D (detailed in section B.2). The installed capacity of the project is 6.4 MW which is below the 15 MW small scale limit, so it clearly qualifies as a small scale project.

Project concept

The Ishasha Small Hydropower project is a unique 6.4 MW run-of-river project making optimum use of the available water resources to supply electricity to the main grid with excellent reliability potential during the peak demand hours.

Implementation of the project will consist of construction of the following main items:

- A dam/diversion weir which rises 15 meters above the water level in the Ishasha River to allow sufficient water storage of about 44,000 cubic meters to operate the plant at full capacity for 2 hours.
- Intake Structure
- A 1,140 meters in length penstock laid along the ground on concrete supports or buried in some areas from the intake to the power house
- A Power house with a floor area of approximately 200m^2
- A Power house with two horizontal 3.4 MW Francis turbines each coupled to a 4.0 MVA synchronous generator operated at a power factor of 0.8 to produce the plant design electrical capacity of 6.4 MW.
- A Tailrace canal and related structures back to the Ishasha River
- A Transformer station and a 7 km 33kV transmission line
- Access Roads
- Staff quarters

In the power house two horizontal axis turbines will be installed, each of 3.4 MW electrical capacity each coupled to a 4.0 MVA synchronous generator operated at a power factor of 0.8 to produce a plant design electrical capacity of 6.4 MW. The efficiency of the turbines peaks at 94% and the single unit normal flow is 4.1m^3/s. The two generators are horizontal axis, three-phase,

synchronous salient-pole, with sleeve bearings and brushless excitation systems. The generators each have a power rating of 4.0 MVA, voltage rating of 6600 V, and an operating frequency of 50Hz.

The power generated by the plant will be stepped up to 33 kV through two 4.0 MVA 6.3kV/33kV 3-phase outdoor transformers and transmitted approximately 7 kilometres on a single circuit Lynx pole line to where it will connect to the closest available point on the new 33 kV line from Kayonza to Rukungiri. The electricity delivered to the main grid interconnection point will be sold to UETCL.[6]

The key project data for the Ishasha Small Hydropower project is given below:

Catchment area	445 km^2
Design flow	8.2 m3/s
Penstock length	1,140 m
Penstock diameter	1.8/1.9/2.0 m
Net operating head ranges	86-91 m
Rated head	91 m
Turbine type/number	Francis/2
Turbine design speed	750 rpm
Turbine rating	2 x 3.40 (6.80) MW
Generator rating	2 x 4.0 (8) MVA
Design plant capacity	2 x 3.2 (6.4) MW[7]
Mean annual production	31,596 MWh

A.4. Parties and project participants

Party involved (host) indicates host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Government of Uganda (host)	Eco Power Uganda Ltd	No
Government of the Netherlands	C-Quest Capital LLC	No

The developer of the CDM project is Eco Power Uganda Limited (EPUL).

A.5. Public funding of project activity

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No public funding or official development assistance from Annex I parties is being used to support this project. All project costs are met by the project participants own sources and in part by debt finances from a consortium of banks.

A.6. Debundling for project activity

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In Appendix C of the Simplified Modalities and Procedures for small-scale CDM project Activities, it is stated the following results in de-bundling of a large CDM project:

[6] Uganda Electricity Transmission Company Limited (UETCL) is the single buyer for main grid transactions.
[7] Based on generator capacity of 4.0 MVA operating at a power factor of 0.8.

"A proposed small-scale project activity shall be deemed to be a de-bundled 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."

For the proposed project activity, the project participant does not own any more hydropower projects registered within the previous 2 years whose boundary project is within 1 km of the project boundary of the proposed activity. Thus, the proposed small-scale project is a stand-alone project and is not a de-bundled component of a larger project.

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

B.1. Reference of methodology and standardized baseline

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The approved baseline and monitoring methodology of the project activity are described as:

AMS Type I – Renewable Energy Project
Category I.D.- Grid connected renewable electricity generation (version 17), EB 61, valid from 17th June 2011 onwards.
The "tool to calculate the emission factor for an electricity system" (version 02.2.1), has been used to calculate the emission factor.

The capacity of the project activity remains below 15 MW, thus the post registration changes requested do not have impact on the scale of the project activity.

B.2. Project activity eligibility

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The choice of methodology AMS I.D., version 17, is justified as the proposed project activity meets its required applicability criteria:

- The Ishasha Small 6.4 MW Run-of-River Hydro power project is a grid-connected renewable power generation project that adds electricity capacity from only hydro power sources with no use of fossil fuels, and which will supply electricity to and displaces electricity from an electricity distribution system that is supplied by at least one fossil fuel fired generating unit.
- The project activity results in a very small reservoir with a total area of approximately 9,608 m^2 and a resulting power density of 666.11 W/m^2, which is significantly greater than the 4 W/m^2 or less requirement for consideration of Project Emissions from the reservoir associated with the Ishasha hydropower project.
- The unit added has only renewable components of total maximum production capacity of 6.4 MW, which does not exceed the eligibility limit (15 MW). EPUL does not plan to upgrade the plant capacity during the crediting period and will also not be able to do so due to the limitations of water availability.
- The project involves construction of new units in a new plant, and does not involve the addition of renewable energy generation units at an existing renewable power generation

facility, nor does it seek to retrofit or modify an existing facility for renewable energy generation.

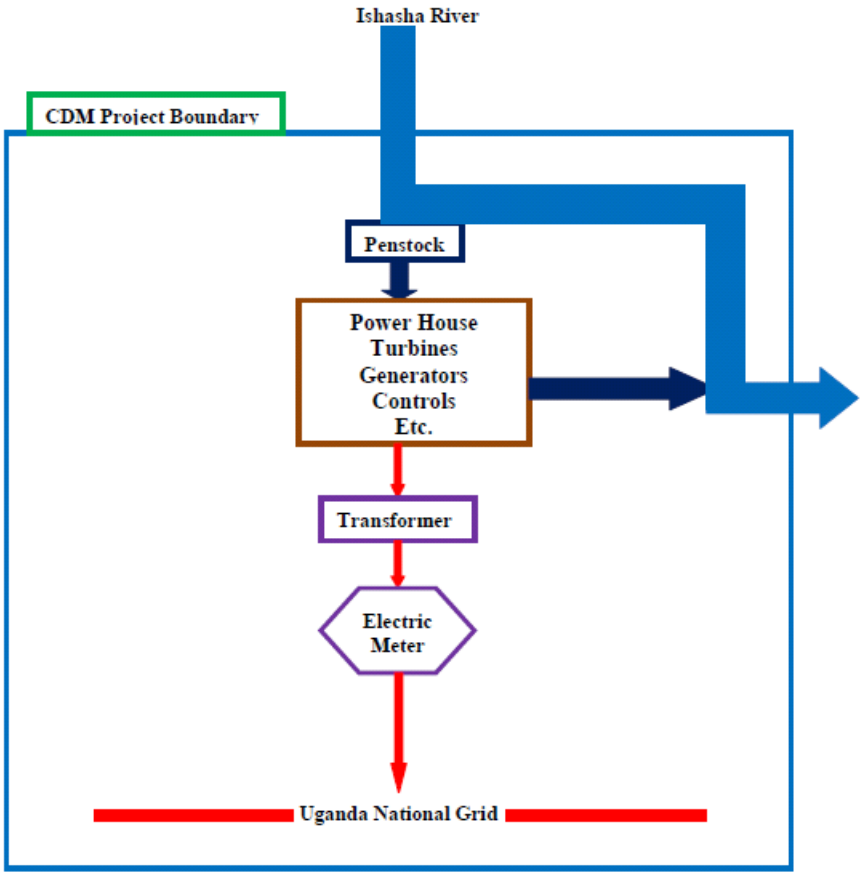
- The project owner does not own any more hydro power plants registered within the previous 2 years whose project boundary is within 1 km of the proposed project.

The post registration changes requested do not have impacts on the applicability and application of the applied methodology AMS-I.D. version 17.

B.3. Project boundary

According to AMS I.D./17, "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." Thus, the project boundary includes the equipment installed for the new hydro power plant – the main elements of which are the turbines, generators, transformers and connection to the grid. The meter to measure the output of the project is located after the transformer and before the connection to the grid and is within the project boundary.

Figure 3: Flow Diagram of Ishasha 6.4 MW Small Hydropower Project



In the "Tool to calculate the emission factor for an electricity system" (version 02.2.1), the physical project boundary is defined as the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity (e.g. the renewable power plant location or the consumers where electricity is being saved) and that can be dispatched without significant transmission constraints. The spatial extent of the project boundary therefore includes

the project power plant, all the other power plants connected physically to the project electricity system, the transmission line, and switch stations within the project electricity system. The geographical boundary for small-scale CDM project activities are defined as all structures related to the project system.

According to the above guidance, it is justifiable that the project boundary for this project activity is the Ugandan national grid. Although the Ugandan national grid is connected to that of Rwanda and Kenya[8] and there is both import and export of electricity to and from the Uganda grid, the physical boundary for this project activity is limited to the Ugandan national grid.

Complying with the guidance and rules for small-scale project activities, emissions related to production, transportation, and distribution of fuel used for the power plants in the baseline are not included in the project boundary, as they do not occur at the physical and geographical site of the project.

Table 2. Summary of the greenhouse gases included within the project boundary

Source		Gas	Included	Justification/Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that is displaced due to the project activity	CO_2	Yes	According to AMS.I.D. (Version 17)
		CH_4	No	
		N_2O	No	
Project Activity	For hydro power plants emissions of CH_4 from the reservoir. Project is run of river.	CO_2	No	According to AMS.I.D. (Version 17)
		CH_4	No	
		N_2O	No	

B.4. Establishment and description of baseline scenario

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The project activity is generating electricity from a new hydropower plant, which will be fed into the Uganda grid, displacing electricity generated from the Uganda source mix. In case the project activity was not implemented, the same amount of electricity would be generated from the power plants connected to the grid. Therefore, according to the methodology AMS I.D. Grid connected Renewable Electricity Generation (ver. 17), the baseline is the kWh produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO_2e/kWh) calculated in a transparent and conservative manner as:

a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the "Tool to calculate the emission factor for an electricity system" (Version 2.2.1); OR
b) The weighted average emissions (in kg CO_2e/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

As per the version 17 of methodology AMS – I.D:

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

$BE_y = EG_{BL,y} * EF_{CO2,grid,y}$

Where,

BE_y = Baseline emissions in year y (t CO_2)
$EG_{BL,y}$ = Quantity of Net Electricity supplied to the Grid in year y (MWh)
$EF_{CO2\ grid,y}$ = CO_2 Emission factor in year y (t CO_2 /MWh).

[8] Due to the power shortage, the government has suspended the electricity export to Kenya and instead negotiated for import up to 20 MW when available. Total import from Rwanda and Kenya has increased over the last years and represented 2% of total electricity supply in 2008.

For this project, option a) above is chosen as this will give a more accurate emission factor for the entire crediting period and the data of the year in which project generation occurs (i.e., requirement in option b) is not publicly available. All the procedures, including the characteristics of electricity generation and the accordant emissions in the baseline scenario, are based on the 7-step approach described in the "Tool to calculate the emission factor for an electricity system" (Version 2.2.1).

The baseline is defined as electricity delivered to the grid by the project activity that 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 combination margin (CM) calculations.

Step 1. Identify the relevant electricity system

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

The national grid of Uganda is the project system. The national grids of Kenya and Rwanda are connected to the Uganda grid but are not within the project boundaries. Electricity transfers from connected electricity systems to the project electricity system are defined as electricity imports and electricity transfers to connected electricity systems are defined as electricity exports.

For the purpose of calculating operating margin, the emission factor of 0 tCO_2/MWh is applied to net import from Rwanda. Electricity exports to Kenya are not subtracted from electricity generation data used for calculating and monitoring the electricity emission factors. For the purpose of determining the build margin emission factor, as per the guidance in the tool, the spatial extent is limited to the project electricity system.

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

Only grid power plants are included in the calculation.

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

The calculation of the operating margin emission factor ($EF_{grid, OM, y}$) should be 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.

The OM will be calculated according to (b), the Simple adjusted OM, and as under the Simple OM, there are three options to determine the emissions factor of each plant. Option A1 will be selected because specific fuel data for each plant is available, and thus, the project participants can use the net electricity generation of all the power plants considering the fuel types and volumes consumed in the project electricity system. Since the data available and more than 50% of the total electricity generated in Uganda comes from large hydroelectric power plants, the adjusted option is applicable. For the simple adjusted OM, the emissions factor can be calculated using either the two following data vintages:

- *Ex ante option*: A 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, without requirement to monitor and recalculate the emissions factor during the crediting period, or

- *Ex post option*: The year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring.

The *ex-ante* option is used to calculate the emissions factor for this project activity.

The emissions factor may be calculated based on three different data sources:
- Based on the net electricity generation and a CO2 emission factor of each power unit; or
- Based on data on net electricity generation, the average efficiency of each power unit and the fuel type (s) used in each power unit (Option B)

Option A1 is used because plant specific fuel consumption data is available from the national utility regulating agency. Under Option A1, for both low cost/must-run resources (k) and other units (m), the emissions factor of each power plant is calculated using the formula outlined in Step 4 below.

Power plants registered as CDM project activities should be included in the sample group used to calculate the operating margin if the criteria for including the power source apply. The only CDM project in Uganda is not connected to the national grid and is therefore not included in the sample.

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

(b) Simple adjusted OM

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

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

Where:

$EF_{grid.OM\text{-}adj.y}$	= Simple adjusted operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
λ_y	= Factor expressing the percentage of time when low-cost/must-run power units are on the margin in year *y*
$EG_{j,y}$	= Net quantity of electricity generated and delivered to the grid by power plant/unit j in year *y* (MWh)
$EG_{k,y}$	= Net quantity of electricity generated and delivered to the grid by power plant/unit k in year *y* (MWh)
$EF_{EL,m,y}$	= CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$EF_{EL,k,y}$	= CO_2 emission factor of power unit *k* in year *y* (tCO_2/MWh)
M	= All grid power units serving the grid in year *y* except low-cost/must-run power units
K	= All low-cost/must-run power units serving the grid in year *y*
y	= The relevant year as per the data vintage chosen in Step 3 (i.e., three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option)).

According to the "tool for calculating the emission factor of an electricity system," typical low operating cost and must run resources include hydro, geothermal, wind, low-cost biomass, nuclear, and solar generation. For the Ugandan national grid, (m) consists of hydro power plants, a biomass plant and imports, whereas (k) consists of diesel generators.

The parameter lambda (λ_y) is defined as follows:

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

Lambda (λ_y) is calculated in Section B.6.3.,

Step 5. Calculate the build margin emission factor

Project participants have two options to determine the Build Margin. For this project, Option 1 will be used. For the first crediting period, the BM will be calculated based on *ex-ante* data for the most recent information available on the sample group *m*. The second crediting period the build margin emission factor will be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option will not require monitoring the emission factor during the crediting period.

The sample group of power units *m* used to calculate the build margin should be determined as per the following procedure, consistent with the data vintage selected above:

(a) Identify the set of five power units, excluding power units registered as CDM project activities, started to supply electricity to the grid most recently ($SET_{5\text{-units}}$) and determine their annual electricity generation ($AEG_{SET\text{-}5\text{-}units}$, in MWh);

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

(c) From $SET_{5\text{-units}}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample});

Identify the date when the power units in SETsample started to supply electricity to the grid.
If none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then use SET_{sample} to calculate the build margin. In this case ignore steps (d), (e) and (f).

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 power generation data is available, calculated as follows:

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

Where:

$EF_{grid,BM,y}$	= Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EG_{m,y}$	= Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$EF_{EL,m,y}$	= CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
m	= Power units included in the build margin
y	= Most recent historical year for which power generation data is available (for this project activity, it is 2008)

Step 6. Calculate the combined margin emissions factor

The combined margin emissions factor is calculated as follows:

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

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

Considering that the project activity is a hydroelectric power facility in an electricity system dominated by hydroelectricity, 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.

B.5. Demonstration of additionality

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The table below is only applicable if the proposed project activity is a type of project activity which is deemed automatically additional, as defined by the applied approved methodology, tool, standardized baseline or specific renewable technologies/measures conferring automatic additional microscale CDM project activities proposed by a DNA and approved by the Board.

Specify the methodology, tool, standardized baseline or specific renewable technologies/measures conferring automatic additional microscale CDM project activities proposed by DNAs and approved by the Board, that establish automatic additionality for the proposed project activity (including the version number and the specific paragraph, if applicable).	Not applicable.
Describe how the proposed project activity meets the criteria for automatic additionality in the relevant methodology, tool, standardized baselines or specific renewable technologies/measures conferring automatic additional microscale CDM project activities proposed by a DNA and approved by the Board.	Not applicable.

According to the general guidance for SSC project activities, project participants shall demonstrate to a designated operational entity that the project activity would otherwise not be implemented due to the existence of one or more barrier(s) listed in attachment A of Appendix B (Version 08) in Annex 24 of EB 63. Reference is also made to “Guidelines for objective demonstration and assessment of barriers” (annex 13 of EB50), and specifically guideline 7 regarding Least Developed Countries (LDCs). In this respect, Uganda is on the UN list of LDCs. In addition, Uganda is also on the UN list of Landlocked Developing countries (LLDCs) where “lack of territorial access to the sea, remoteness and isolation from world markets and high transit costs continue to impose serious constraints on the overall socio-economic development”.

With respect to the updated Attachment A of Appendix B (Version 08) in Annex 24 of EB 63 of the simplified modalities and procedures for small-scale CDM project activities, in states that “project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

a) **Investment barrier**: a financially more viable alternative to the project activity would have led to higher emissions;

b) **Technological barrier**: a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or lower market share of the new technology adopted for the project activity and so would have led to higher emissions;
c) **Barrier due to prevailing practice**: prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions;
d) **Other barriers**: without the project activity, for another specific reason identified by the project participant, such as institutional barriers or limited information, managerial resources, organizational capacity, financial resources, or capacity to absorb new technologies, emissions would have been higher.

The Ishasha Small Hydropower project has identified "(d) Other barriers" and more specifically access to "financial resources" as the principal relevant barrier to implementation of the project. A more detailed explanation the difficulty to access financial resources is presented below.

(d) Other barriers - access to financial resources:

Uganda is one of few countries in Sub-Saharan Africa that has recorded good economic growth and limited but effective poverty reduction. However, Uganda is still one of the poorest countries in the world and remains an LDC. The percentage of the population with access to electricity is on average 10% throughout the country and less than 5% in the rural areas as of 2007.[9]

For the private sector in Uganda, availability and access to financial services is one of the major constraints to investment. Non-availability of financial services is manifested in the form of a lack of sufficient financial services infrastructure required to deliver appropriate or effective financial services across the country. In Uganda, borrowing takes place in informal networks with limited ties to formal credit or finance risk. Uganda's global ranking on the ease of doing business in the World Bank's "Doing Business" indicators 112th (out of 183 countries) in 2010.[10] Uganda ranked as number 113 out of 183 countries on "getting credit" in 2010. The lack of financial markets and availability of financial resources is a strong barrier to private participation in long-term investments such as hydropower plants, and Uganda still relies largely on foreign aid rather than private sector investors. According to the recent report from allafrica.com,[11] commercial banks average leading rate remained very high in 2009, at a range of between 15% at Stanbic Bank to a high of 24% with most banks in between. A recent IMF report states that "the nominal lending interest rates of banks range from 17% to 23% and in the formal micro-finance sector, nominal lending interest rates are even higher, ranging from 24% to 36%.[12] The high spread indicated a lack of competition in the banking sector and high operational inefficiency. "One of the key constraints for many firms in Uganda is access to credit, but even where there is access, lending interest rates have been prohibitively high (25-30 percent). Much of the lending is limited to short-term capital as the presence of UDB (Uganda Development Bank) has not been largely felt by industry."[13] The capital market for long-term funds in Uganda is still under developed and basically non-existent.

A private investor, such as EPUL, therefore needs to raise capital from outside Uganda, and has to assure its creditors that all investment risks have been minimized. Uganda by history and nature is a high risk environment. The potential revenue from the sale of CERs has been integral to EPUL's assessment of this project from its beginning as a risk mitigation initiative and has been crucial in its ability to secure its equity and debt financing for the project. EPUL sought, from the outset of its efforts to finance the project, to establish the explicit commercial value of emission reductions

[9] Slide 4 of a presentation titled "Investment Opportunities in the Power Sector in Uganda" given by Godfrey R. Turyahikayo, the Executive Director of the Rural Electrification Agency of Uganda on October 2, 2008. http://www.tpnetworks.co.za/export/sites/tpnetworks/content/downloads/Investment_Opportunities_in_UGANDA.pdf

[10] World Bank's "Doing Business ranking" indicators have been selected from its website: http://www.doingbusiness.org/economyrankings/.

[11] Report on web-site, http://allafrica.com/stories/200905250061.html.

[12] "Uganda: Poverty Reduction Strategy Paper", p.31; IMF Country Report No. 10/141, May 2010.

[13] Ibid: p. 133.

associated with the project to convince its investors of the feasibility of project to service debt and to provide an acceptable return on equity. Initially, EPUL approached the International Finance Cooperation (IFC) and the Netherlands Development Finance Company (FMO) for debt financing totalling US$8 million. Upon subsequent review of the project's financial risks, the IFC and FMO declined financing for the project. After being refused by a number of other potential sources for debt financing, EPUL subsequently approached a consortium of commercial banks in Sri Lanka, which its parent company, Eco Power (Pvt.) Ltd., has had business relations with for the development of small-hydropower in Sri Lanka. This consortium of Sri Lankan commercial banks was provided the project feasibility studies, which clearly indicated the need for CDM revenues to support the financial viability of the project. The consortium of Sri Lankan banks ultimately agreed, on the basis of the financial analysis in the feasibility report, to provide debt to the project at an interest rate of LIBOR plus 4% with a floor interest rate of 8%. Capital repayment of the loan is required in 5 years with a grace period ending on 31 March 2011. Equity funding was used for the project construction until loan funds were available for draw down.

In summary, EPUL was only able to secure its debt financing by demonstrating that the expected project revenues including revenues from CERs were sufficient to cover all operational expenses and service debt while providing an adequate risk adjusted return on investment. Without this assurance, financing for the project would not have been secured.

The Uganda Government and its Ministry of Energy and Mineral Development want to promote private investments in energy projects.[14] Over the last years, 50 sites has been identified as being potentially viable for private investors and about ten hydro projects with a total capacity of 210 MW have been studied for exclusive permits.[15] However, so far only one small-hydropower project has received financing, the Bugoye 13.0 MW Run-of-River Hydropower Project. This project was only able to get financing because it received a grant from the Norway Ministry of Finance of 60 million NOK (approximately US$10,322,000) and also relied on CER revenues.[16] This project was registered by the CDM on 1 January 2011. The Ishasha project site has been the subject of studies since the late 1950's, but investors have not been able to overcome the barriers to implement the project. This is a clear indication of the difficulties facing private investors.[17] The Ishasha 6.4 MW Small Hydropower project began development at approximately the same time as the Bugoye project. Thus, at this time there were no privately financed projects in Uganda, neither large nor small scale (see Table 3).

All of the grid connected power plants in Uganda are listed below in Table 3. Essentially the base-load for the system is provided by the 2 large scale hydroelectric plants associated with Owens Falls. These are the low cost supply heart of the system. These are must run plants that are limited by the water release rate from Lake Victoria that is governed by international treaties (and by the weather). The piston engine diesel and heavy oil plants that have been installed in 50 MW increments in recent years are almost full-time daily operators with the current supply/demand balance of the country, and there is only a very small time overlap wherein the system demand drops below the average capacity potential of the 2 large hydroelectric plants. These diesel plants take over as the capacity limit of the 2 hydroelectric power plants is reached producing some base-load plus the intermediate and peak demand power. The 2 additional small hydroelectric plants (essentially captive mine supply plants) plus the 2 sugar mill associated seasonal co-generation plants produce only a very small contribution to the overall system supply.

Table 3: Main Grid Connected Power Plants in Uganda

Grid Connected Power Plant	Capacity MW	Installed in	Ownership	Fuel

[14] Uganda Government, Ministry of Energy and Mineral Development, Annual Report, 2005.
[15] http://www.era.or.ug/Investment.php
[16] http://cdm.unfccc.int/Projects/DB/BVQI1254738519.15/view
[17] Two excellent resources supporting this are: (1) "The Renewable Energy Policy for Uganda" published by Government of Uganda in November 2007; and (2) "Uganda – Energy for Rural Transformation Project: Project Appraisal Document" published by the World Bank's Africa Regional Office in March 2001.

Mubuku1 Kilembe Mines	5	1954	Government	Hydro
Mubuku 3 KCCL	10	1993	Private (Kasese Cobalt Company Ltd)	Hydro
Owens Falls - Nalubaale*	180 (10 x 18MW)	1954	Government	Hydro
Owens Falls -Kiira*	200 (5 x 40MW)	2003	Government	Hydro
Kakira Sugar Mill	12**	2007	Private (Madhvani Group)	Bagasse
Kinyara Sugar Mill	5	2009	Gov't/Private	Bagasse
Aggreko Mutundwe	50 (60 x 0.85MW)	2008	Private	Diesel/Distillate Oil No. 2
Namanve Jacobsen	50 (60 x 0.85MW)	2008	Private	Residual Fuel Oil
Aggreko Kiira	50 (60 x 0.85MW)	2006	Private	Diesel/Distillate Oil No. 2
Aggreko Lugogo	50 (60 x 0.85)	2005	Private	Diesel/Distillate Oil No. 2

*Recurrent Lake Victoria low water levels have severely de-rated these capacities in recent years.
**Kakira dedicates 12 MW of its 19 MW installed for main grid supply with the balance for the sugar mill only.

The percentage of power generated in Uganda by privately owned renewable energy power plants is very small almost to the point of being negligible. The Kakira sugar mill co-generation plant fires bagasse residue fuel from the sugar making process and the incremental revenue earnings from surplus electricity sales to the grid drives the incremental investment requirement. The Mubuku 3 hydroelectric project is associated with a mining operation and also sells surplus (incremental) electricity to the grid. The Ishasha hydroelectric project relies solely on electricity sales to the grid not having the cushion of a captive use to justify the investment or for an increment of the investment.

While the electricity sector in Uganda has been partly privatized and there has been some attempt to increase the private sector generation contribution, there have been little tangible results thus far because of the risk facing any investor, especially for the smaller projects. Since the recent grid generation additions continue to be larger scale diesel based units, this is the prevailing practice along with widespread small scale self-generation diesel applications.

The additionality of the project activity has been demonstrated through **(d) Other barriers -** access to financial resources. The change in the design pertains to minor variation in installed capacity and the details indicated on the barrier are applicable at the time of decision making and thus the post registration changes requested does not adversely impact the additionality of the project activity.

Serious CDM Consideration

The initial plans to develop the Ishasha project were conceived in 2005. As a result, EPUL was formed and issued a Certificate of Incorporation on 15 December 2005. On 28 December 2008, EPUL executed an initial contract with TurboInstitut of Slovenia for supply, transport, installation and commissioning of the equipment for the Ishasha hydropower project. Additionally, all requisite preliminary approvals and licenses were applied for and obtained prior to the project start date of 28 December 2008. A full feasibility study was completed in February 2008 in which it was demonstrated that CDM revenues were necessary to offset financial risks and meet financial expectations of the project. In March 2008, EPUL requested and secured the assistance of International Resources Group Ltd, (IRG) for CDM validation and registration of the project. Subsequently EPUL negotiated and signed an Emissions Reduction Purchase Agreement (ERPA) with C-Quest Capital LLC on 30 April 2009. As can be seen from the chronology below, EPUL has

consistently undertaken the activities to support CDM consideration throughout the development of this project.

Date	Project Milestone	Evidence
15/12/2005	EPUL Certificate of Incorporation	Copy of Certificate of Incorporation from Registrar of Companies
13/12/2006	EPUL Certificate of Approval of Environmental Impact Assessment	Copy of Certificate from National Environmental Management Authority
15/02/2007	EPUL Investment License from Uganda Investment Authority	Copy of Investment License from UIA
16/07/2007	EPUL License for Generation and Sale of Electricity	Copy of License from Electricity Regulatory Authority
17/08/2007	EPUL Power Purchase Agreement with Uganda Electricity Transmission Company Limited.	Copy of signature page from PPA
1/02/2008	Feasibility Report for Ishasha Small Hydropower Project	Copy of Feasibility Report
26/02/2008	EPUL Board Resolution recognizing need for CDM to meet threshold returns and requesting appointment of International Resources Group (IRG) to assist in the validation and registration of the project	Copy of Eco Power (Pvt) Ltd. Board document.
13/03/2008	EPUL letter to International Resources Group (IRG) requesting assistance for CDM Validation	Copy of EPUL letter to IRG
21/11/2008	EPUL Term Sheet for ERPA signed by CQC	Copy of Term Sheet (Confidential Information)
28/12/2008	Initial EPUL contract executed with TurboInstitut d.d. of Slovenia for supply, transport, installation and commissioning of the equipment for the Ishasha hydropower project.	Copy of Contract Agreement between EPUL and TurboInstitut No. 196/08 (Confidential Information).
28/12/2008	Project Start Date	Designated
30/04/2009	EPUL ERPA executed with CQC	Copy of ERPA (Confidential Information)
16/05/2009	Revised EPUL contract executed with TurboInstitut d.d. of Slovenia for supply, transport, installation and commissioning of the equipment for the Ishasha hydropower project.	Copy of Contract Agreement between EPUL and TurboInstitut No. 124/09 (Confidential Information).
22/05/2009	EPUL Letter of Notification to DNA	Copy of Letter of Notification
6/07/2009	CQC signed contract signed AENOR for validation of Ishasha Small Hydropower Project.	Copy of signed agreement.
24/07/2009	Initial LOA from Uganda DNA	Copy of executed LOA
12/08/2009	CQC Request to Netherlands for LOA for Ishasha Small Hydropower Project	Copy of letter of request for LOA to SenterNovem, Netherlands.
26/10/2009	Initial LOA from Netherlands SenterNovem	Copy of LOA from SenterNovem

B.6. Emission reductions

B.6.1. Explanation of methodological choices

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The AMS I.D. methodology (Grid connected renewable electricity generation, version 17) is to be used. The methodology is applicable to renewable energy generation units, including hydro, which displaces electricity from an electricity distribution system supplied by at least one fossil fuel fired generating unit.

The "tool to calculate the emission factor from electricity system" version 02.2.1 is used to calculate the baseline emission factor. The baseline emission factor (tCO_2/MWh) is calculated as combined margin (CM), consisting of the combination of operating margin (OM) build margin (BM) according to the procedures prescribed in the tool.

Simple Adjusted OM is used to calculate the OM, as follows:

- The Ex ante option is chosen from this project. The Ex ante option is a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, without requirement to monitor and recalculate the emission factor during the credit period. The period 2006-2008 is used to calculate the OM and year 2008 is used for the BM.
- Option A is used to calculate the emission factors. Option A is based on data on fuel consumption and net electricity generation for the entire electricity system and of each power plant/ unit. Option A is used because plant specific fuel consumption data is available from the national utility regulating agency.
- Power registered as CDM project activities should be included in the sample group that is used to calculate the operating margin if the criteria for including the power source in the sample group apply. There is only one CDM project in Uganda and this plant is not connected to the national grid and is therefore not included in the sample.

The BM is calculated based on the generation-weighted average emission factor (tCO_2/MWh) of all power units *m* during the most recent year *y* for which power generation data is available, namely 2008. According to the "Tool to calculate the emission factor for an electricity system" (Version 02.2.1) individual power units one site comprise one power plant, where by a power unit characterizes that it can be operated independently of the other power units at the same site. The Aggreko power plants are 50MW installations that are made up of numerous power units, each with a nominal rating of 1250 kVA, giving 1000 kW peak capacity and 850 kW in base load. A 50MW plant is normally made up of nominally 60 units, to provide steady generation during maintenance etc. The power units can be installed, operated and dispatched independently. Each control unit covers 6-10 power units and each of the power units can be operated independently.

The following plants/units were commissioned progressively:

- Aggreko Lugogo: 50 MW (05/05)
- Aggreko Kiira: 35 MW (10/06)
- Aggreko Kiira: 15 MW (12/06)
- Aggreko Mutundwe: 50 MW (07/08)
- Namanve Jacobsen: 50 MW (08/08)

Current MEMD supply/demand tables show these plants as rated at a firm capacity of 50 MW. The diesel fuel burning Lugogo capacity was retired in August 2008. This suggests that the production balance has stayed essentially the same with more diesel capacity but somewhat better water availability in the large hydro facilities.

B.6.2. Data and parameters fixed ex ante

Data / Parameter	**$FC_{i,m,y}$, $FC_{i,j,y}$, $FC_{i,k,y}$**
Unit	Mass or volume unit
Description	Amount of fossil fuel type i consumed by power plant / unit m, j, of k in year y
Source of data	Utility official publications, collected from UETCL
Value(s) applied	See Appendix 4
Choice of data or Measurement methods and procedures	• OM: Most recent 3 historical years of data that were available at the time of validation are 2006 – 2008. • BM: For the first crediting period one time calculations following the appropriate guidance
Purpose of data	Baseline emission calculations
Additional comment	Calculation of simple adjusted OM in cases where fuel consumption data is available for all power plants/units

Data / Parameter	**$NCV_{i,y}$**
Unit	GJ / mass or volume unit
Description	Net calorific value (energy content) of fossil fuel type i in year y
Source of data	IPCC default values at the lower limit of uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value(s) applied	IPCC Standard for diesel/distillate is 41.4 TJ/10^3tonnes IPCC Standard for Residual Fuel Oil is 39.8 TJ/10^3tonnes
Choice of data or Measurement methods and procedures	Neither values from fuel supplier nor regional / national values are available and the IPCC default values are used.
Purpose of data	Baseline emission calculations
Additional comment	Applicable in calculation of the simple OM, the simple adjusted OM and the average OM in cases where fuel consumption data is available for all power plants / units, as per EF calculations in Section B.6.3.

Data / Parameter	**$EF_{co2,i,j}$ and $EF_{co2,m,i,y}$**
Unit	tCO_2/TJ
Description	CO_2 emission factor in year y
Source of data	IPCC default values at the lower limit of uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value(s) applied	IPCC Standard for diesel/distillate is 72.6 tCO_2/TJ IPCC Standard for Residual Fuel Oil is 75.5 tCO_2/TJ
Choice of data or Measurement methods and procedures	Neither values from fuel supplier nor regional / national values are available and the IPCC values are used.
Purpose of data	Baseline emission calculations
Additional comment	Applicable in calculation of the simple OM, the simple adjusted OM and the average OM in cases where fuel consumption data is available for all power plants / units, as per EF calculations in Section B.6.3.

Data / Parameter	**$EG_{m,y}$, $EG_{j,y}$, $EG_{k,y}$**
Unit	MWh

Description	Net electricity generated and delivered to the grid by power plant / unit m, j, k, or n (or in the project electricity system in case of EGy) in year y
Source of data	Most recent 3 years data (2006 – 2008) collected from Electricity Regulatory Authority (ERA) and Uganda Electricity Transmission Company Limited (UETCL)
Value(s) applied	See Appendix 4
Choice of data or Measurement methods and procedures	• OM: Most recent 3 historical years of data that were available at the time of validation are 2006 – 2008. • BM: For the first crediting period one time calculations following the appropriate guidance.
Purpose of data	Baseline emission calculations
Additional comment	-

Data / Parameter	**$EF_{CO2,grid,y}$**
Unit	t CO_2/MWh
Description	CO_2 emission factor of the grid
Source of data	As per PDD Section B.6.3
Value(s) applied	0.6673
Choice of data or Measurement methods and procedures	Ex-ante option as per the "tool to calculate the emission factor from electricity system" version 02.2.1.
Purpose of data	Baseline emission calculations
Additional comment	-

Data / Parameter	**Cap_{BL}**
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	Project site
Value(s) applied	0
Choice of data or Measurement methods and procedures	Determine the installed capacity based on recognized standards
Purpose of data	Project emission calculations
Additional comment	-

Data / Parameter	**A_{BL}**
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 (m2). For new reservoirs, this value is zero.
Source of data	Project site
Value(s) applied	0
Choice of data or Measurement methods and procedures	Measured from topographical surveys, maps, satellite pictures, etc.
Purpose of data	Project emission calculations
Additional comment	-

B.6.3. Ex ante calculation of emission reductions

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Calculation of emission factor

"Tool to calculate the emission factor for an electricity system" (Version 02.2.1) has been used to calculate emission factor in the following steps:

Step 1. Identify the relevant electricity system

The power plants connected to the grid as well as imports are the relevant electric power system, which is the Ugandan national electricity grid for this project activity. This includes all the plants listed in Table 3 in Section B.5. Imports of electricity are included. Overall electricity generation from grid connected power plants in Uganda from 2006 to 2008 are provided in Table 4.

Table 4 Generation from grid connected power plants in Uganda 2006 – 2008 (GWh)

Year	Domestic				Export	Total Supply
	Thermal	Hydro[18]	Nuclear	Biomass		
2006	316	1,207	0	0	49	1,572
2007	540	1,311	0	2	60	1,913
2008	591	1,421	0	54	41	2,107

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

Option I: Only grid power plants are included in the calculation.

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

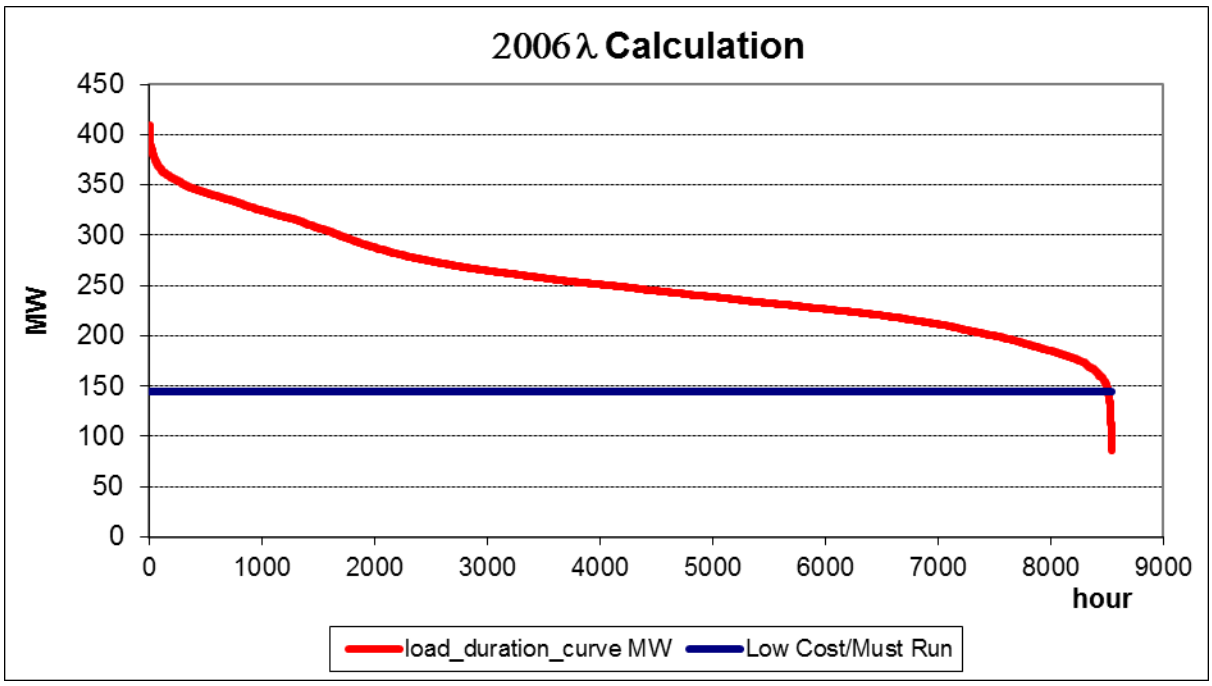
b) Simple adjusted OM with ex-ante data

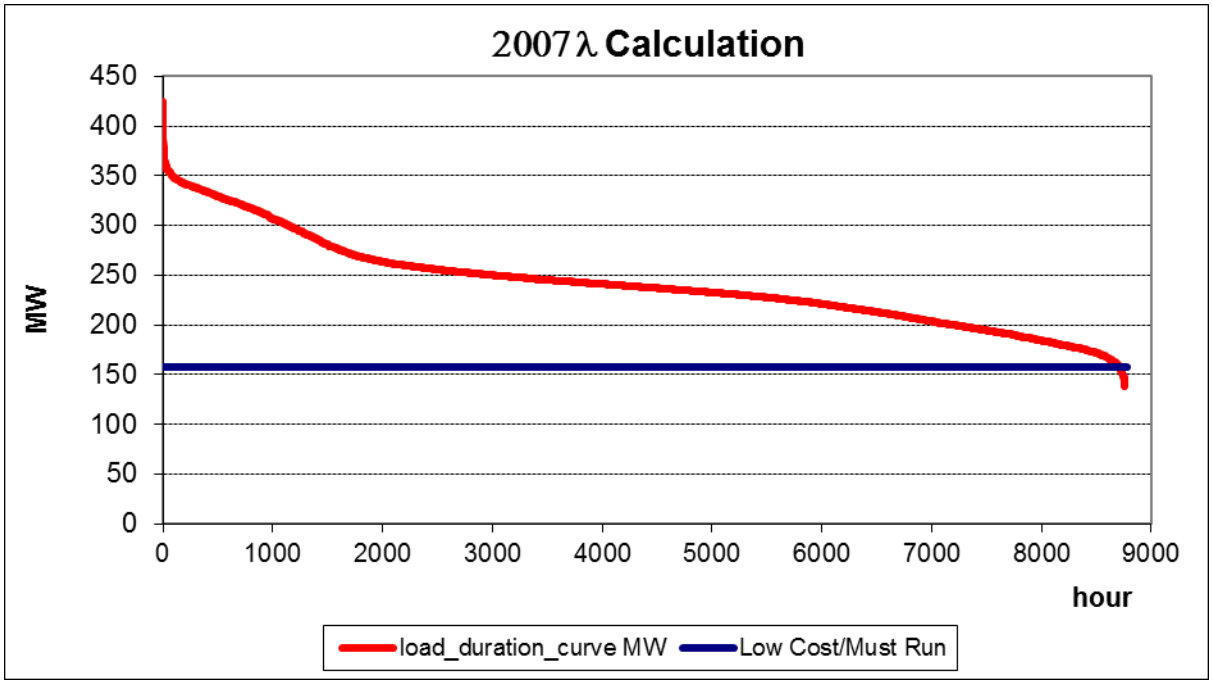
The operating margin is calculated according to the "simple adjusted OM" with the *ex ante* option and based on the net electricity generation of each power plant and an emission factor for each power plant.

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

In accordance with the use of "simple adjusted OM" method and the formulae described in Section B.4, emission factors of individual power units were calculated and the load duration curves for years 2006-2008 were plotted as presented below:

[18] Hydroelectric GWh data in Table 4 is used to calculate horizontal intersect point on load duration curves.


2006λ Calculation
MW
450
400
350
300
250
200
150
100
50
0
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
hour
load_duration_curve MW
Low Cost/Must Run


2007λ Calculation
MW
450
400
350
300
250
200
150
100
50
0
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
hour
load_duration_curve MW
Low Cost/Must Run

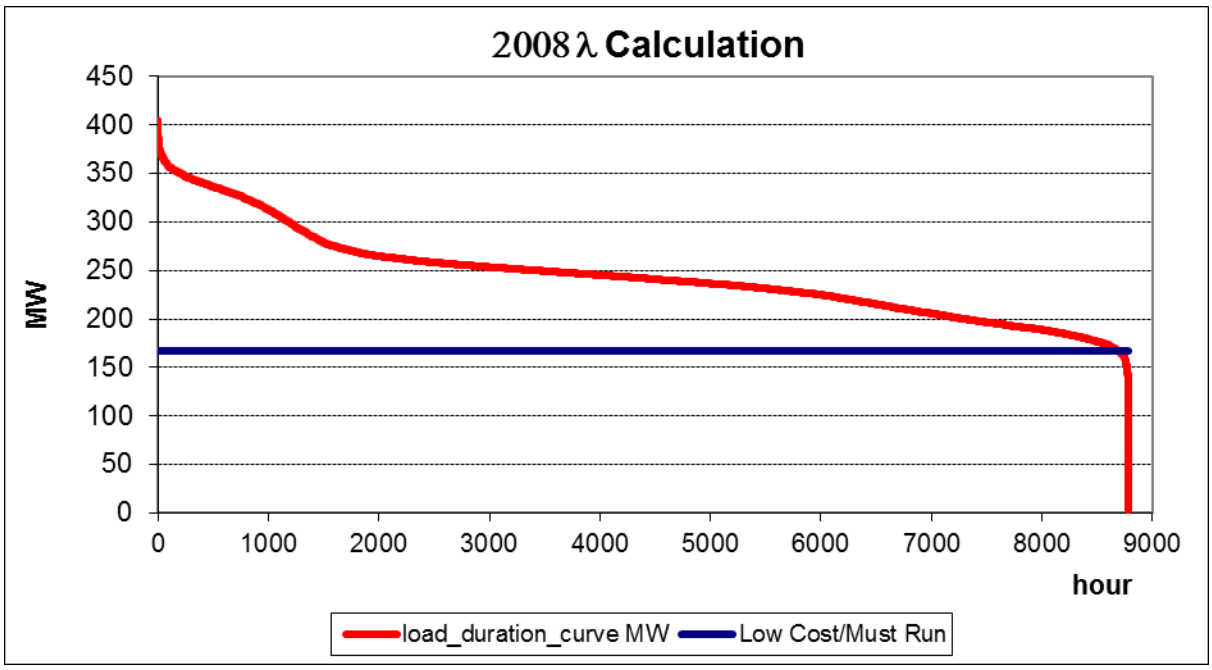


Table 5 below presents the calculation results of emission factors based on the information in the above steps.

Table 5. Ugandan Electricity Sector Power Plant Fuel Use, Electricity Production, and Emission Factor per Power Plant[19]

		FCi,j,y	Density	Fuel	NCVi,y	Conversion Factor			
		1000 Litres	Kg/m^3	1000 Kg	GJ/m^3	tCO_2/TJ	GWh	tCO_2	tCO_2/GWh
2006	LGGO Aggreko1	85187.2	0.85	72409.1	41.4	72.6	319.3	217635.7	681.6
2006	Kiira Aggreko 2	12857.9	0.85	10929.2	41.4	72.6	50.1	32849.3	655.7
2007	LGGO Aggreko1	73761.2	0.85	62697.0	41.4	72.6	273	188444.7	690.3
2007	Kiira Aggreko 2	70447.5	0.85	59880.4	41.4	72.6	266.4	179978.9	675.6
2008	LGGO Aggreko1	36286.19	0.85	30843.3	41.4	72.6	134	92703.7	691.8
2008	Kiira Aggreko 2	63083.08	0.85	53620.6	41.4	72.6	240.7	161164.3	669.6
2008	Mutundwe Aggreko	26239.86	0.85	22303.9	41.4	72.6	99.6	67037.4	673.1
2008	Namanve Jacobsen	26696.28	0.92	24560.6	39.8	75.5	116.5	73802.1	633.5

[19] Data received from Ministry of Energy and Mineral Development April 2009.

As the table shows the low-cost/must-run units were on the margin less than 1% of the time through the period of 2006 – 2008. The average operating margin emission factor over the most recent 3 years is 0.6735 tCO_2/MWh.

From the Load Duration Curve	2006	2007	2008
Total hours per year	8544	8760	8784
Intersection Point (%)	99	99	99
Hours low-cost on margin	33	45	40
λ (%) = hour low-cost on margin/8760	0.392%	0.519%	0.461%

EF Operation margin	2006	2007	2008
EF j	0.6781	0.6830	0.6681
EF k			
EF OM ((1-λ) j + λ k)	0.6754	0.6795	0.6650

EF OM	**0.6735**	tCO_2/MWh	

Step 5. Calculate the Build Margin

As shown in B.6.1 the thermal power plants each consist of 60 units totalling 50 MW of firm capacity with the ability to operate units independently. Electricity production and fuel consumption is therefore assumed to be $1/60^{th}$ for the respective units. Below is the Sample Group of power units to include in the build margin.

Table 6. Sample Group of Power Units to be Included in the Build Margin

5 Most Recently Built Plants (Excluding CDM Projects). ($SET_{5\text{-}units}$)

Grid Connected Power Plant	Capacity MW	Installed in	2008 AEGtotal (GWH)	Total Units
Namanve Jacobsen	50	2008	116.5	5

$AEG_{SET\text{-}5\text{-}units}$

TOTAL GWH: 116.5

Plants Comprising 20% of Total Generation ($SET_{\geq 20\%}$)

Grid Connected Power Plant	Capacity MW	Installed in	2008 AEGtotal (GWH)	Fuel
Aggreko Mutundwe	50	2008	99.6	Diesel
Namanve Jacobsen	50	2008	116.5	Residual Fuel Oil
Aggreko Kiira	50	2006	240.7	Diesel

Total GWH for System in 2008: 2,107 GWH

20% of system = 99.6 + 116.5 + 240.7 = ***456.8 GWH =*** $AEG_{SET\text{-}\geq 20}$

Note that the 134 GWH generated from Aggreko Lugogo is left out of this calculation because it would push total generation above the 20% threshold.

From $SET_{5\text{-units}}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample}). This is $SET_{5\text{-units}}$

Identify the date when the power units in SETsample started to supply electricity to the grid.
Because none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago, then SET_{sample} is used to calculate the build margin, and thus Steps D-F can be ignored.

In terms of vintage data, PP chooses Option 1 to calculate the build margin emission factor *ex ante* based on the most recent information available on units already built for sample group *m* at the time of CDM-PDD submission to the DOE for validation for the first crediting period and to update the build margin emission factor 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 second crediting period.

The build margin is calculated based on the sample group for which the 2008 generation is the largest. Therefore the build margin is calculated based on b) the sample group consisting of the 20% most recently built power units as shown above in Table 5.

The build margin emission factor for 2008 is 0.6611, which is calculated from the actual fuel consumption, GWh production, and CO_2 emission data given above in Table 5, again a weighted average weighted by the MWh production of each plant (see attached spreadsheet).

Table 7. Build Margin Emission Factor

	tCO_2/MWh
EF Build Margin	0.6611

Step 7. Calculate the combined margin emissions factor
When utilizing the 50%/50% weighting of operating margin and build margin the combined margin is 0.6673 tCO_2/MWh.

Table 8. Combined Margin Emission Factor

EF OM	0.50	0.6735	tCO_2/MWh
EF BM	0.50	0. 6611	tCO_2/MWh
EF Combined	1.00	0.6673	tCO_2/MWh

The combined margin emission factor is simply the numerical average of the EF OM and the EF BM as calculated above on a 50:50 basis.

Calculation of project emissions

As per AMS I.D. ver 17, the project emissions from water reservoirs of hydro power plants have to be considered following the procedure described in the most recent version of ACM0002.

If the power density of the project activity (*PD*) is greater than 10 W/m^2, PE = 0

The power density of the project activity (*PD*) 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

$$PD = \frac{(6.4 - 0)\ MW}{(9608 - 0)\ m^2}$$

$$= 666.11\ W/m^2$$

The power density of the project activity (*PD*) is greater than 10 W/m^2, therefore the project emissions are zero for Ishasha hydropower project.

Thus, PE= 0

Leakage

As per AMS I.D. ver 17, if the energy generating equipment is transferred from another activity, leakage is to be considered.

The energy generation equipment for Ishasha hydropower plant is new and not transferred from another activity, therefore leakage is zero.

Emission reductions calculation

Table 9. Annual Electricity Generation and Emission Reductions Summary

Capacity (MW)	Capacity factor %	Average annual electricity generation (MWh)	Emission factor (tCO_2/MWh)	Annual emission reductions (tCO_2)
6.4	56.36%	31,596	0.6673	21,084

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

Year	Baseline emissions (tCO_2 e)	Project emissions (tCO_2 e)	Leakage (tCO_2 e)	Emission reductions (tCO_2 e)
2012	10,629[20]	0	0	10,629
2013	21,084	0	0	21,084
2014	21,084	0	0	21,084
2015	21,084	0	0	21,084
2016	21,084	0	0	21,084
2017	21,084	0	0	21,084
2018	21,084	0	0	21,084
2019	21,084	0	0	21,084
2020	21,084	0	0	21,084
2021	21,084	0	0	21,084
2022	10,455[21]	0	0	10,455
Total	210,840	0	0	210,840
Total number of crediting years	10			
Annual average over the crediting period	21,084	0	0	21,084

B.7. Monitoring plan

The post registration changes requested do not impact the compliance of the monitoring plan with the applied methodology.

B.7.1. Data and parameters to be monitored

Data / Parameter	**EG_y**
Unit	MWh
Description	Annual Electricity supplied by the project to the grid
Source of data	Measurement of energy output meter at exit of the switch field
Value(s) applied	31,596
Measurement methods and procedures	Continuous measurement. Data should be archived electronically and kept for at least 2 years after the end of the last crediting period. 100% of the data should be monitored.
Monitoring frequency	Monthly
QA/QC procedures	The accuracy of the meter which is fully backed up is high because the electricity generation data is the basis for the electricity sales invoicing and payment.
Purpose of data	Baseline emission calculations
Additional comment	The post registration changes do not impact the level of accuracy and completeness in the monitoring of the project activity.

Data / Parameter	**Cap_{PJ}**
Unit	MW

[20] Based on 1 July 2012 start date for crediting period equivalent to 184 days in 2012

[21] Based on end date of crediting period of 30 June 2022 equivalent to 181 days in 2022

Description	Installed capacity of the hydro power plant after the implementation of the project activity
Source of data	EPUL
Value(s) applied	6.4
Measurement methods and procedures	Determine the installed capacity based on recognized standards
Monitoring frequency	Yearly
QA/QC procedures	-
Purpose of data	Project emission calculations
Additional comment	-

Data / Parameter	A_{PJ}
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	EPUL
Value(s) applied	9,608
Measurement methods and procedures	Measured from topographical surveys, maps, satellite pictures, etc
Monitoring frequency	Yearly
QA/QC procedures	-
Purpose of data	Project emission calculations
Additional comment	-

B.7.2. Sampling plan

>>
There is no sampling plan required for the project activity.

B.7.3. Other elements of monitoring plan

>>
Monitoring shall consist of metering the electricity generated by the renewable technology in line with the procedures in "I.D. Grid Connected Renewable Electricity Generation" and the "Tool to Calculate the Emission Factor for an Electricity System".

The monitoring plan will ensure that the true, maintainable and measurable GHGs of the CDM project will be monitored, recorded and reported. This is the key procedure to determine the CERs. According to the monitoring plan, monitoring systems should be reliable, conservative and comprehensive; this system will have the function of data evaluation, measurement, and collection and monitoring.

Project Manager
The overall responsibility for monitoring and reporting relevant issues will lie with EPUL hereby referred to as the Project Manager. The Project Manager will assign an Operational Manager who will be responsible for the monthly electricity generation results recording, and also meeting with the electricity purchaser as necessary to correct any measurement discrepancies according to the requirements and direction of the PPA. The EPUL Project Manager will be designated at the time of plant commissioning.

Operational Manager
The Project Manager will appoint an Operational Manager who will monitor electricity generation both as dispatched from the EPUL generators and recorded at the redundant dual check meters of

the electricity purchaser, UETCL. A double check is built in to the system as an always in use function. Electricity generation is the main input variable for the calculation of emission reductions.

The Operational Manager will report to the Project Manager and coordinate with UETCL on a monthly basis, and the figures confirmed by both as accurate will be used for reporting emission reductions. At the end of each 12 month monitoring period, the data from the dual monthly metered reading records will be added up to yield the yearly net electricity generation and this figure will then be multiplied by the combined margin emission factor on a Microsoft Excel spreadsheet. These figures will be formally certified by the Project Manager in writing. Thus, the complete calculations process is always transparent and traceable. The Project Manager will approve the annual figures after the Operational Manager assures the quality of the calculations.

Metering

EPUL is responsible to meter in the dual meter system according to the requirements of UMEME and UETCL, described in Annex 4 and the "Tool to calculate the emission factor for an electricity system" (Version 02.2.1). All data collected as part of monitoring should be achieved electronically and be kept at least for 2 years after the end of the last crediting period. 100% of the data should be monitored if not indicated in Section B.7.1. All measurements should be conducted with calibrated measurement equipment according to relevant industry standards. Calibrations should be done periodically. The recommended calibration frequency of meter as per manufacturer specification is every 5 years.

There will only be one line and the dual meters will be two-way hourly meters, so each meter reading will be a net reading of power exported/ imported to the power station. There will always be a back- up meter in service in case of a main meter failure. The monthly net power supply to the grid will hence be the sum of all monthly meter readings. The Main Meter and the Check Meter system to be installed, owned, and maintained by UETCL, will be designed such that the overall measurement system error (including instrument transformers, wiring, and metering instruments) shall be no greater than 0.2% (special UETCL requirement). The difference in measurement between the Main and Check meters should not exceed 1.5%. If it is exceeding 1.5% difference, then the meters should be called for calibration immediately.

According to the UETCL agreement EPUL will meter;

- Net active and reactive kWh from the Generation Facility

- Net kW from the Generation Facility

All instruments shall be the flush mounting type and shall be fitted with non-reflecting glass according to the relevant international standards. The metering system shall be described clearly in appropriate drawings to be provided by EPUL to both UETCL and UMEME for approval.

All data required for verification and issuance will be kept for at least two years after the end of the crediting period or the last issuance of CERs of this project, whichever occurs later.

Data Adjustment

The power purchase agreement (PPA) controls the way the data is metered and then confirmed. The following paragraphs from Clause 7.0 of the PPA define how adjustments are done, if needed.

> *"The Main and Check Meters specified in the PPA shall be installed in a metering and control chamber to be provided by EPUL in a mutually agreed position as shall be agreed upon by the Parties as soon as it is practically possible and the said Meters shall be sealed by each Party using their own seals. Sealing and breaking of the seals shall be witnessed by a representative of each of the Parties."*
>
> *"UETCL, EPUL and the Distributor may inspect the Metering System and may request to have the same tested or periodically calibrated by an accredited testing facility in the presence of authorized representatives of EPUL, UETCL and the Distributor. EPUL shall arrange for the*

said testing and/or calibration. Any part of the Metering System found to be defective shall be corrected or replaced by EPUL at its own cost. The cost of testing any of the Metering System adjudged not defective shall be borne by the Party requesting the testing."

"EPUL or UETCL, as the case may be, shall be compensated for any energy over billed or under billed as a result of any defect in the Metering System as determined by the testing. For the purpose of determining the extent of over/under billing, the Check Meter readings shall be taken as the correct readings for the month in which a Party requests testing of the Main Metering equipment up until the time the Main Metering equipment is replaced or recalibrated."

"The volume of the Electrical Energy supplied to UETCL by EPUL under this Agreement shall be determined by the units (kWh) supplied as ascertained by means of the Metering System which shall be read as near as practicable to the last day of each calendar month, or otherwise as may be agreed between the Parties."

"If for any cause whatsoever EPUL or UETCL shall at anytime during the term of this Agreement be unable to ascertain from the Metering System the volume of electricity supplied to UETCL or to EPUL for any month of supply the value of such supply for that month shall be determined by adopting the average of the last three billing months prior to the inability to ascertain the value of the electricity supplied."

The above process that has both parties (seller and purchaser) having to agree on electricity generation totals on a monthly basis and with a contractual formula for addressing even the check meter performance provides sufficient mutual checks and protection for a project of this type and size.

Environmental and Social Impacts

The Ishasha hydroelectric project is being built in a remote sparsely populated part of Uganda. The majority of the project site is on steep sloped land with very little human use and no habitation. The small size of the project also minimizes the environmental and social aspects of the project impact. The project has been subjected to an Environmental Assessment process and the Environmental Clearance Certificate has been issued. The main environmental concern was requiring that EPUL always allow 250 litres per second of river water to pass through an open pipe at the bottom of the dam such that there will always be an adequate flow of water in the 2 kilometre section of the river between the diversion and the tailrace, especially during the dry season. This will assure that the local fish species in the river (i.e., tilapia and mud fish) are not adversely impacted by the power plant operations. The 250 litres per second flow is designed into the system to be always open and will be visibly apparent to the plant operations staff who will take remedial flushing action if the flow appears to be diminished. The overall environmental monitoring in Uganda has national and local points of responsibility but there is very little monitoring and enforcement funding available. It would be the responsibility of the Kanugu District Environmental Officer to coordinate with the EPUL Operations Manager to make sure that the plant is operating in an environmentally acceptable manner and for coordinating annual communications among EPUL, the Kanugu District Environmental Committee, NEMA, and the Directorate of Water Development.

Electricity has not been readily available in the district and its surroundings. The income level there is relatively low such that only a limited number of people could afford it even if it were available. A positive social aspect of the project is through employment of local people and increasing the income of the EPUL employees and local service providing entities. It will also provide an opportunity for those local people that can afford electricity service to now have it on a regular basis. At the size of 6.4 MW and the long transmission distance to the large wealthier urban areas the best use for the electricity produced is in the areas closest to the plant. Neither the power plant operations nor the transmission of the electricity to an existing grid station will cause negative environmental impacts. The Rural Electrification Agency of Uganda (REA) would have the monitoring responsibility for the social aspects of the Ishasha plant operations since the mandate of the REA is to increase the rural access to electricity. EPUL would respond to any REA

coordination initiatives in this regard. Such initiatives are in the developmental state at this time and are expected to become the norm in a progressive manner over the next 5 years.

The post registration changes requested do not impact the compliance of the monitoring plan with the applied methodology.

B.8. Date of completion of application of methodology and standardized baseline and contact information of responsible persons/ entities

>>
19/09/2014

Ang Kong Nian
C-Quest Capital Malaysia Limited
akongnian@cquestcapital.com

C-Quest Capital Malaysia Limited is not the project participant.

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>>
The starting date will be the date on which the project participant has committed to expenditures related to the implementation of the project activity. The start date for the project is 28 December 2008.[22]

C.1.2. Expected operational lifetime of project activity

>>
The fiscal lifetime of the project is 20 years as specified by the Power Purchase Agreement, but the plant equipment specified can have an extended service life and EPUL would plan therefore to operate for a nominal period of 30 years.

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>>
Fixed crediting period

C.2.2. Start date of crediting period

>>
The starting date will be 1 July 2012, or the date of registration, whichever is later.

[22] The project start date of 28 December 2008 is evidenced by the signing of a contract between EPUL and TurboInstitut of Slovenia for supply, transport, installation and commissioning of the equipment for the Ishasha hydropower project.

C.2.3. Length of crediting period

>>
The crediting period will be for 10 years.

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>
Full Environmental and Social Impact Assessment (ESIA) studies according to World Bank standards are required by the GOU and have been conducted for the project. The report prepared by Ema Consult Limited, Plot 244, Ring Road Muyenga, Kampala, was made available for the validation. The project has received the approval for the ESIA and the project from the National Environmental Management Authority, NEMA.

The ESIA Report deals with the potential environmental and social impacts of the Ishasha small hydropower project and fulfills the legal requirements for an Environmental Impact Assessment for the Ishasha Small-Hydropower Project. Consultations and fieldwork for the ESIA were carried out in the first half of calendar year 2006.

The positive social impacts as detailed in the ESIA Report include:

1) The project will supply power to the grid and provide power stability. Constant power supply disruptions and rising oil prices have caused worsening in power crisis and economic development in Uganda since 2006. From a population of about 31 million people only 10%[23] (less than 5% in rural areas) has access to grid supplied electricity. The supply deficit has had serious negative economic implications on the commercial and industrial sectors. The electricity generated from the project will feed to the national grid.

2) The project will generate electricity from renewable resources which would lead to lower emissions of greenhouse gasses compared to the existing generation mix. It is also likely that it will also reduce load-shedding that would lead to reduced usage of privately owned diesel generators.

3) The project creates opportunities for economic development in the Kanungu District, beside power generation. Kanungu Town for example only has access to electricity for 4 hours a day from expensive local small diesel generation. The opportunities include employment of the local population during the construction period, foreseen growth of the local economy in terms of improved market opportunities for local produce, increased trade, and an upgrading of the road infrastructure in the project area. In terms of employment opportunities it is estimated that the project during its construction period will require 100-200 workers, out of whom around 30% will be skilled workers. Training of important operating and maintenance skills is an integral part of the project. Specifically, training of local workers to operate supplied equipment will be given by the equipment vendors during installation and after commissioning. Plant operators will be trained and tested to ensure their capability of monitoring, managing and operating of the equipment. Training will include safety and emergency procedures. In addition, the Plant Manager is expected to be a trained and experienced person seconded from Eco Power Pvt. Ltd, an associate company based

[23] *2007/2008 Human Development Report.* UNDP. http://hdrstats.undp.org/indicators/210.html; Slide 4 of a presentation "Investment Opportunities in the Power Sector in Uganda" given by Godfrey R. Turyahikayo, the Executive Director of the Rural Electrification Agency of Uganda on October 2, 2008. http://www.tpnetworks.co.za/export/sites/tpnetworks/content/downloads/Investment_Opportunities_in_UGANDA.pdf

in Sri Lanka. The Plant Manager will provide on-the-job training for all key plant operators. He will also ensure that all civil works, which require minimal maintenance, are monitored and maintained.

4) The local electricity supply will enable access to electricity in schools and health clinics with a tremendous positive impact potential. It will also allow farmers and commercial people to consider post harvest processing and storage options to increase the value added and demand for their products. This local electricity supply can be used as an economic growth driver on the local level.

5) The project company has committed itself to participate in an Environmental Management and Monitoring Plan. Elements of the plan are contained in the ESIA report as approved.

The identified potential negative social impacts reported in the ESIA for the project include:

1) The project does not require any resettlement. Only 2 households were possibly to be affected and a successful attempt was made to avoid their removal by careful location of the project access roads. The land to be used by the project is all essentially agriculturally productive or bare land, but given the number of farmers and the size of the plots cultivated, no individual landholder will lose more than 10% of the productive holdings to the project. The site construction work will temporarily disrupt additional farming but much of the land temporarily put out of service will be available for agricultural purposes after construction completion. This enabled an equitable cash-for-land arrangement to be proposed to and be accepted by the community. The resettlement payments for agricultural land or crop loss as mutually agreed to have been paid already under the terms of the agreed Resettlement Action Plan that will be available to the Validation Team.

2) Compensation is being paid to 36 claimants for loss of land and crops. Approximately 40 acres of land will be required for the project. Compensation at rates determined by local government authorities has been paid to all persons for loss of land and crops.

3) The project will also entail a reduced flow in a 2 km stretch of the Ishasha River. This will potentially affect water quality, riverbank vegetation, birds, fish populations and other aquatic life, but in a minimum way since there will always be a 250 liter a second flow release through the dam to mitigate the harm potential as directed by NEMA and the Directorate of Water Development.

4) The project will attract migrant labor during the construction period that historically brings with it increased potential for social issues connected to the spread of HIV/AIDS and other sexually transmitted diseases. These potential impacts can be minimized by implementing proper awareness programs at and around the site.

5) The construction period will entail increased traffic in an area not used to traffic concerns. The risk of pedestrian accidents is real in this case. Speed control, pedestrian awareness, and diver awareness programs will be needed.

6) The agricultural land to be taken over by the project is generally on rather steep slopes is barren of vegetation and this will lead to run-off and loss of valuable topsoil and deteriorating river water quality if not mitigated. EPUL will be responsible for planting native species in an appropriate way on such land to protect the land and the water resource of the river.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>>

The Environmental and Social Impact Assessment (ESIA) and a Resettlement Action Plan (RAP) are required in accordance with the National Environment Act and the Environmental Impact Assessment Regulations. As a part of the ESIA study a public consultation process was carried

out in April 2007 involving all of the relevant stakeholders and in particular the indirectly and directly involved population in the Kanungu District in southwest Uganda. Additional stakeholder meetings were held on 7 June 2008 and 23 August 2008. Government meetings were usually carried out on a one on one basis while community meetings were public affairs. In addition, the ERA while reviewing an electricity generation licence has specific procedures for public consultations and hearings that have environmental and social review aspects which were considered in planning the public consultation process.

The national level stakeholders in the proposed project who are actively involved include: the Ministry of Water, and Environment (MWLE); Lands and Urban Development, The Ministry of Energy and Mineral Development, the National Environment Management Authority (NEMA), The Ministry of Local Government, The Directorate of Water Development (DWD), The Office of the Prime Minister, Uganda Wildlife Authority (UWA), the Rural Electrification Agency (REA), and the Electricity Regulatory Authority (ERA). The main local stakeholders that will be affected and who have an interest in the project include:

- The Project Affected Population (PAP) in Kyajura village, in Kanyantorogo Parish, Kihihi county, Kanungu District (36 households - approximately 216 people, none of whom are to be resettled)
- Kanungu District Local Government
- Kanungu Town
- Kanyantorogo Sub County
- Bwindi Impenetrable National Park
- Kayonza Tea Factory
- Queen Elizabeth national Park

Community inputs are critically important for a smooth project planning and implementation. Knowledge of what the community percieves and desires goes a long way to helping compensation and resettlement planning and implementation. The community inputs were gathered using Focus Group Discussions (FGDs) which brought together men, women, the elderly, youth, orphans and the disabled persons of the area close to the project vicinity. The meetings were used to inform the public about the potential impacts of the project and the processes of compensation and resettlement, if necessary. The meetings were also a forum whereby the public could express opinions and concerns along with expectations to the project team. Multiple such consultative meetings were held by the development team. More recently in March 2009 a team representing the potential CER buyer visited the project site and also conducted public meetings seeking the essential local inputs.

The community was consulted very early in the development of this specific power project. During a scoping exercise conducted in 2004 by the developer, the same people were formally introduced to the potential power project and the potential developer. Meetings since then have been, therefore, follow-ups. The consultation meetings between the community and the project consultant provided several opportunities for the stakeholders to learn more about the developer, EPUL, and the project and to voice opinions and concerns. EPUL was given the concession for the project by the Ministry of Energy and Mineral Development. The community peoples have repeatedly proposed that when the project starts, they should be given the first priority to work in the non-technical jobs of the project. The issue of employment of local people to participate in project implementation was strongly raised and heard from early on. LC officials in the project area have also requested that the contractor should be advised to recruit all unskilled labourers from the communities in the project village. Table below presents an overview of the stakeholder consultations that took place over the project development period.

Consultation Event / Date	Location	Attendees/Stakeholders	Contents and Issues
Public Community Meetings / 3-7	Various local government offices and public	Various stakeholders including MEMD, REA, ERA, Kanungu District	Briefings were given on both the developer and the project including all proposed

April 2006 during EIA ; and 7 June 2008.	facilities were used for the public community meetings.	Local Government and LCs in the project area have been consulted along with the affected public.	activities and components while soliciting comments and concerns. As a requirement for this kind of project public consultation is on-going and will take place throughout the entire project cycle.
Household Visits / 17-18 Jan 2007 during RAP.	All people living within an area up to 100 meters from the project boundaries were visited.		Project information was disseminated along with information on compensation entitlements. Information was read to inhabitants not able to read.
Focus Group Discussions / 19-20 Jan 2007	Focus group discussions were held in Kyajura Village	On average 14 people attended each including women and youth. It is to be understood that the project site is a very sparsely populated area.	Briefings were provided about land acquisition process and other project related issues of interest in the community.
C-Quest Capital and Ministry of Energy and Mineral Development Site Visit / 4 April 2009.	The entire Construction site and the local populated areas were visited.	The stakeholders included Kenneth Tumuhamye, the Local Council III Chairman, Kanyantorogo and Ampumuza Mbabazi, the Senior Assistant Secretary/Sub County, Chief of Kanyantorogo. Along with the senior developer managers, many of the site workers, and the local inhabitants.	During this site visit some of the Local Leaders who have played a big role in getting the community understand the benefits of the project were met at the site. It was noted that there was a good working relationship between the local leaders and the project staff.
Socio-economic survey / 15-16 Jan 2007 during RAP		14 households were visited and surveys conducted. Each household contained between 1 an 11 people for a total of 64 people.	Detailed information was gathered directly from the local people on multiple pre-selected socio-economic indicators.

E.2. Summary of comments received

>>

The concerns raised in the various meetings are presented below. The project was rather well received by all stakeholders including the local land owners and dealt mainly with potential employment, direct benefit from the power plant output, and fair compensation for land to be used for the project.

Concern/Issue	Stakeholder Comments/Questions
Employment	Local people should get priority for jobs at the site.
Resettlement Land Loss	Will people have to be resettled? How much land will be needed? The people wanted to know the specific site boundaries as soon as possible.
Compensation	The people wanted reassurance that any land and crop losses would be fairly and promptly compensated for.
Valuation of assets	How will the assets be valued? The people expressed a desire to directly participate in the negotiations for their specific assets to be lost.
Water Supply	An improvement in village water supply was brought up as an area that the

	project might be able to provide help with.
Dam/Weir and Canal Safety	Breaks in dams and weirs that cause local floods were mentioned as a concern.
Infrastructure	The road conditions are very poor in the district and easy access to other parts of the sub county is limited for commercial, health, and personal purposes. Also there is agricultural and bare land that the project will be using. This land should be re-vegetated. While electricity service is now within the region the rural coverage is extremely poor. Electricity is needed for household, agricultural, and commercial purposes besides helping with schools and health clinics.

E.3. Report on consideration of comments received

>>

Table below gives the means of addressing the concerns as voiced by the most vulnerable stakeholders based on stakeholder comments.

Employment	The construction phase has provided employment opportunities to a number of local people who were unemployed before the project started. Currently about 80 people are employed at the site during the construction phase. 13 people have been trained and gained skills in steel bending and 10 are carpenters, the majority of whom have also been trained on-site in carpentry and in the use electric equipment. This has resulted in income generation coming from the employment, a number of employees have been able to invest in Agriculture, buy additional land and actively participate in a National Agricultural Advisory Services Programmes where they are advised in poultry farming, rearing Goats, Pigs and Cultivation of rice, coffee and bananas. The site road to the Power House was constructed using local man power instead of road construction equipment to provide employment to the Community.
Resettlement Land Loss	No one has to be resettled in this project since very careful deliberation was used in locating access roads for the project. Of the land lost to the project no single landholder lost more than 10% of the specific holdings. A mutually agreeable land for cash arrangement was concluded that met all applicable national and multilateral standards.
Compensation	The land lost and the crop losses were fairly compensated directly to the landholders at amounts agreed to by all of the applicable national and multilateral authorities. A letter issued by the local authorities relating to payment of compensation is dated 22 December 2008 stating that compensation has been paid in full.
Valuation of assets	Uganda has formal guidelines and centres of responsibility for establishing asset values. All applicable guidelines were followed and all affected people were allowed to participate and negotiate in the valuing of the specific assets. The Runkugiri District Government as the responsible entity determined the fair market value and recent transactions were also considered in the process.
Water Supply	The land included in the project site is steeply sloped, sparsely vegetated, and sparsely populated. To assure adequate water availability for domestic purposes and to maintain adequate water for aquatic life survival, a 250 litres per second unrestricted water release through the dam/weir has been designed into the project. The river run from the diversion site to tail race return is less than 2 kilometres.
Dam and Canal Safety	There is no open canal used anywhere in this project and water conveyance is by means of penstock pipes which are buried in some sections and above ground in others.. The dam will consist of a gravity concrete structure built across Ishasha river to divert stream flow directly into the penstock. The rock surface of the stream bed will be excavated to desired levels and cut-off walls will be introduced to prevent possible hydrostatic uplift and seepage under the

	dam. Dowels will anchor the dam to the bedrock along the axes of the dam. A flush out with a gate will be located at the bottom of the dam which will enable as-needed de-silting of the upstream silt collection. The dimensions of the dam are length: 66 meters; height at river section: 16 meters and spill length: 15 meters.
Infrastructure	Bare land and agricultural land bought by the project will be re-vegetated (in this case re-forested) by the developer. Electricity will be more available around the power plant site area and along the 7 kilometre transmission line for those that can afford to pay.

Compensation has now been paid to all land holders for land required for the project, as determined by the local Land Committee based on standard rates established for such compensation by the Ugandan government. Physical possession of the land has been granted to EPUL on completion of these payments. The final deeds of lease for the land in favour of EPUL are presently in the process of being executed. The draft compensation plan from the RAP was implemented after a detailed re-survey of the land was done on the ground along with the local authorities. The compensation to be paid was then finalized by the local authorities on the basis of the established government rates. In cases where the amounts differed from that in the RAP draft plan because of the surveying results and where EPUL did not have receipts for payment, EPUL paid any shortfalls to the land holders. On this basis the local Land Committee is preparing the final paperwork to be remitted for EPUL to soon receive the deeds of lease.

SECTION F. Approval and authorization

>>

The letters of approval from Uganda and Netherlands have been obtained and were submitted for registration.

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

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Eco Power Uganda Limited
Street/P.O. Box	30/1 Bagatalle Road
Building	Not applicable
City	Colombo
State/Region	Not applicable
Postcode	3
Country	Sri Lanka
Telephone	+94-11-4513470/1/2
Fax	+94-11-4513471
E-mail	bhatiya@ecopower.lk
Website	Not applicable
Contact person	Mr. Bhatiya Ranatunga
Title	Chief Executive Officer
Salutation	Mr.
Last name	Ranatunga
Middle name	
First name	Bhatiya
Department	+94-7722-44678
Mobile	Not applicable
Direct fax	Not applicable
Direct tel.	Not applicable
Personal e-mail	bhatiya@ecopower.lk

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	C-Quest Capital LLC
Street/P.O. Box	1211 Connecticut Ave, NW - Suite 800
Building	
City	Washington
State/Region	DC
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Appendix 2. Affirmation regarding public funding

No public funding or official development assistance from annex i parties is being used to support this project. All project costs are met by the project participants own sources and in part by debt finances from a consortium of banks.

Appendix 3. Applicability of methodology and standardized baseline

Described in Section B.2.

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

Main Grid Connected Power Plants in Uganda[24]

Grid Connected Power Plant	Capacity MW	Installed in	Ownership	Fuel
Mubuku1 Kilembe Mines	5	1954	Government	Hydro
Mubuku 3 KCCL	10	1993	Private (Kasese Cobalt Company Ltd)	Hydro
Nalubaale*	180	1954	Government	Hydro
Kiira*	200	2003	Government	Hydro
Kakira Sugar	12**	2007	Private (Madhvani Group)	Bagasse
Kinyara	5	2009	Gov't/Private	Bagasse
Aggreko Mutundwe	50	2008	Private	Diesel
Namanve Jacobsen	50	2008	Private	Residual Fuel Oil
Aggreko Kiira	50	2006	Private	Diesel
Aggreko Lugogo	50	2005	Private	Diesel

*****Recurrent Lake Victoria low water levels have severely de-rated these capacities in recent years.
**Kakira dedicates 12 MW of its 19 MW installed for main grid supply with the balance for the sugar mill only.

Generation from grid connected power plants in Uganda 2006 – 2008[25]

Year	Domestic				Import	Total Supply
	Thermal	Hydro	Nuclear	Biomass		
2006	316	1,207	0	0	49	1,572
2007	540	1,311	0	2	60	1,913
2008	591	1,421	0	54	41	2,107

Electricity Sector Power Plant Fuel Use and GWh Production Data[26]

Data	**Power Plant**	**Fuel Type**	**Fuel Consumed**			**NCV**	**EF for fuel type**	**Electricity Generated**	**EF**
-	-		m^3	tonne/m^3	tonne	GJ/t	tCO_2/TJ	GWh	tCO_2/MWh
2006	LGGO Aggreko1	Distillate Oil	85,187	0.85	72,409	41.4	72.6	319.3	695.7
2006	Kiira Aggreko 2	Distillate Oil	12,858	0.85	10,929	41.4	72.6	50.1	669.2
2007	LGGO Aggreko1	Distillate Oil	73,761	0.85	62,697	41.4	72.6	273.0	704.5
2007	Kiira Aggreko 2	Distillate Oil	70,448	0.85	59,880	41.4	72.6	266.4	689.6
2008	LGGO Aggreko1	Distillate Oil	36,286	0.85	30,843	41.4	72.6	134.0	706.1
2008	Kiira Aggreko 2	Distillate Oil	63,083	0.85	53,621	41.4	72.6	240.7	683.4
2008	Mutundwe Aggreko	Distillate Oil	26,240	0.85	22,304	41.4	72.6	99.6	687.0
2008	Namanve Jacobsen	Residual Oil	26,696	0.92	24,561	39.8	75.5	116.5	649.4

[24] Information Obtained from the Ministry of Energy and Mineral development April 2009.
[25] Ibid.
[26] Ibid.

Appendix 5. Further background information on monitoring plan

Project Manager

The overall responsibility for monitoring and reporting relevant issues will lie with EPUL hereby referred to as the Project Manager. The Project Manager will assign an Operational Manager who will be responsible for the monthly electricity generation results recording, and also meeting with the electricity purchaser as necessary to correct any measurement discrepancies according to the requirements and direction of the PPA. The EPUL Project Manager will be designated at the time of plant commissioning.

Operational Manager

The Project Manager will appoint an Operational Manager who will monitor electricity generation both as dispatched from the EPUL generators and recorded at the redundant dual check meters of the electricity purchaser, UETCL. A double check is built in to the system as an always in use function. Electricity generation is the main input variable for the calculation of emission reductions.

The Operational Manager will report to the Project Manager and coordinate with UETCL on a monthly basis, and the figures confirmed by both as accurate will be used for reporting emission reductions. At the end of each 12 month monitoring period, the data from the dual monthly metered reading records will be added up to yield the yearly net electricity generation and this figure will then be multiplied by the combined margin emission factor on a Microsoft Excel spreadsheet. These figures will be formally certified by the Project Manager in writing. Thus, the complete calculations process is always transparent and traceable. The Project Manager will approve the annual figures after the Operational Manager assures the quality of the calculations.

Metering

EPUL is responsible to meter in the dual meter system according to the requirements of the Distributor and UETCL, described in Annex 4 and the "Tool to calculate the emission factor for an electricity system" (Version 02.2.1). All data collected as part of monitoring should be achieved electronically and be kept at least for 2 years after the end of the last crediting period. 100% of the data should be monitored if not indicated in Section B.7.1. All measurements should be conducted with calibrated measurement equipment according to relevant industry standards. The calibration should take place periodically. The recommended calibration frequency of meter as per manufacturer specification is every 5 years.

There will only be one line and the dual meters will be two-way hourly meters, so each meter reading will be a net reading of power exported/ imported to the power station. There will always be a back- up meter in service in case of a main meter failure. The monthly net power supply to the grid will hence be the sum of all monthly meter readings. The Main Meter and the Check Meter system to be installed, owned, and maintained by UETCL, will be designed such that the overall measurement system error (including instrument transformers, wiring, and metering instruments) shall be no greater than 0.2% (special UETCL requirement). The difference in measurement between the Main and Check meters should not exceed 1.5%. If it is exceeding 1.5% difference, then the meters should be called for calibration immediately.

According to the UETCL agreement EPUL will meter;

- Net active and reactive kWh from the Generation Facility

- Net kW from the Generation Facility

All instruments shall be the flush mounting type and shall be fitted with non-reflecting glass according to the relevant international standards. The metering system shall be described clearly in appropriate drawings to be provided by EPUL to both UETCL and UMEME for approval.

All data required for verification and issuance will be kept for at least two years after the end of the crediting period or the last issuance of CERs of this project, whichever occurs later.

Data Adjustment

The power purchase agreement (PPA) controls the way the data is metered and then confirmed. The following paragraphs from Clause 7.0 of the PPA define how adjustments are done, if needed.

> *"The Main and Check Meters specified in the PPA shall be installed in a metering and control chamber to be provided by EPUL in a mutually agreed position as shall be agreed upon by the Parties as soon as it is practically possible and the said Meters shall be sealed by each Party using their own seals. Sealing and breaking of the seals shall be witnessed by a representative of each of the Parties."*
>
> *"UETCL, EPUL and the Distributor may inspect the Metering System and may request to have the same tested or calibrated by an accredited testing facility in the presence of authorized representatives of EPUL, UETCL and the Distributor. EPUL shall arrange for the said testing and/or calibration. Any part of the Metering System found to be defective shall be corrected or replaced by EPUL at its own cost. The cost of testing any of the Metering System adjudged not defective shall be borne by the Party requesting the testing."*
>
> *"EPUL or UETCL, as the case may be, shall be compensated for any energy over billed or under billed as a result of any defect in the Metering System as determined by the testing. For the purpose of determining the extent of over/under billing, the Check Meter readings shall be taken as the correct readings for the month in which a Party requests testing of the Main Metering equipment up until the time the Main Metering equipment is replaced or recalibrated."*
>
> *"The volume of the Electrical Energy supplied to UETCL by EPUL under this Agreement shall be determined by the units (kWh) supplied as ascertained by means of the Metering System which shall be read as near as practicable to the last day of each calendar month, or otherwise as may be agreed between the Parties."*
>
> *"If for any cause whatsoever EPUL or UETCL shall at anytime during the term of this Agreement be unable to ascertain from the Metering System the volume of electricity supplied to UETCL or to EPUL for any month of supply the value of such supply for that month shall be determined by adopting the average of the last three billing months prior to the inability to ascertain the value of the electricity supplied."*

The above process that has both parties (seller and purchaser) having to agree on electricity generation totals on a monthly basis and with a contractual formula for addressing even the check meter performance provides sufficient mutual checks and protection for a project of this type and size.

Environmental and Social Impacts

The Ishasha hydroelectric project is being built in a remote sparsely populated part of Uganda. The majority of the project site is on steep sloped land with very little human use and no habitation. The small size of the project also minimizes the environmental and social aspects of the project impact. The project has been subjected to an Environmental Assessment process and the Environmental Clearance Certificate has been issued. The main environmental concern was requiring that EPUL always allow 250 litres per second of river water to pass through an open pipe at the bottom of the dam such that there will always be an adequate flow of water in the 2 kilometre section of the river between the diversion and the tailrace, especially during the dry season. This will assure that the local fish species in the river (i.e., tilapia and mud fish) are not adversely impacted by the power plant operations. The 250 litres per second flow is designed into the

system to be always open and will be visibly apparent to the plant operations staff who will take remedial flushing action if the flow appears to be diminished. The overall environmental monitoring in Uganda has national and local points of responsibility but there is very little monitoring and enforcement funding available. It would be the responsibility of the Kanugu District Environmental Officer to coordinate with the EPUL Operations Manager to make sure that the plant is operating in an environmentally acceptable manner and for coordinating annual communications among EPUL, the Kanugu District Environmental Committee, NEMA, and the Directorate of Water Development.

Electricity has not been readily available in the district and its surroundings. The income level there is relatively low such that only a limited number of people could afford it even if it were available. A positive social aspect of the project is through employment of local people and increasing the income of the EPUL employees and local service providing entities. It will also provide an opportunity for those local people that can afford electricity service to now have it on a regular basis. At the size of 6.4 MW and the long transmission distance to the large wealthier urban areas the best use for the electricity produced is in the areas closest to the plant. Neither the power plant operations nor the transmission of the electricity to an existing grid station will cause negative environmental impacts. The Rural Electrification Agency of Uganda (REA) would have the monitoring responsibility for the social aspects of the Ishasha plant operations since the mandate of the REA is to increase the rural access to electricity. EPUL would respond to any REA coordination initiatives in this regard. Such initiatives are in the developmental state at this time and are expected to become the norm in a progressive manner over the next 5 years.

The post registration changes requested do not impact the compliance of the monitoring plan with the applied methodology.

Appendix 6. Summary of post registration changes

1. In the registered PDD, the project was to be implemented for a capacity of 6.6 MW. As per PDD, 6.6 MW is the plant design (electrical) capacity resulting from the coupling of two (2) "Francis" turbines each with a nameplate capacity of 3.4 MW and two (2) synchronous generators, each rated at 4.0 MVA and operated at power factor of 0.825.

   During the actual implementation, the capacity implemented was slightly different from what was registered. This is due to the operation of generators at lower power factor of 0.8. As a result, it produces the plant design capacity of 6.4 MW only.

Power Plant	Capacity indicated in the registered PDD (MW)	Actual installed capacity (MW)
Uganda	6.6	6.4

2. In the registered PDD, the annual net electricity supplied to the grid was estimated to be 29,404 MWh. Based on the actual net electricity output monitored from July 2012 to June 2013 (first year of crediting period), the annual estimate of net electricity output is revised to 31,596 MWh.

3. The Load Factor/ Capacity Factor of the plant has changed from the one described in the registered PDD. The change is described in the table below.

Power Plant	Plant Load Factor applied in the registered PDD	Plant Load Factor applied in the revised PDD
Uganda	50.86%	56.36%

4. In the registered monitoring plan, the main meter and check meter system were mentioned to be installed, owned and maintained by EPUL. In actual implementation, the responsibility on meter maintenance has been exchanged from EPUL to UETCL. The change was took place since the plant started to operate.

5. The information about calibration frequency of meter is not provided in the registered monitoring plan. As per manufacturer specification, the recommended calibration frequency is every 5 years. The difference in measurement between the Main and Check meters should not exceed 1.5%. If it is exceeding 1.5% difference, then the meters should be called for calibration immediately.

6. The following corrections have been done in the registered PDD.
   a) Under Section B.6.3, an explanation about how project emissions were calculated to be zero has been included.
   b) Under Section B.6.3, a justification on why leakage is zero according to the applied methodology has been included.
   c) Under Section B.6.2, the information for ex ante parameter of "CO_2 emission factor of the grid, $EF_{CO2,grid,y}$" was included in PDD.

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Document information

Version	*Date*	*Description*
08.0	22 July 2016	EB 90, Annex 2 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	Revisions 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; • Editorial improvement.
05.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the project design document form for small-scale CDM project activities (these instructions supersede the "Guidelines for completing the project design document form for small-scale CDM project activities" (Version 01.1)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from *F-CDM-SSC-PDD* to *CDM-SSC-PDD-FORM*; • Editorial improvement.
04.1	11 April 2012	Editorial revision to change history box by adding EB meeting and annex numbers in the Date column.
04.0	13 March 2012	EB 66, Annex 9 Revision required to ensure consistency with the “Guidelines for completing the project design document form for small-scale CDM project activities”
03.0	15 December 2006	EB 28, Annex 34 • The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.
02.0	08 July 2005	EB 20, Annex 14 • The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
01.0	21 January 2003	EB 07, Annex 05 Initial adoption.

Version	*Date*	*Description*

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