ISHASHA 6.6 MW

SMALL HYDROPOWER PROJECT

Document Prepared By Mr. Ang Kong Nian

C-Quest Capital Malaysia Limited

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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

Purpose of the project activity and the measures taken for GHG emission reductions or net anthropogenic GHG removals by sinks

Ishasha Small Hydropower project is a 6.4 MW run-of-river hydropower plant located on Ishasha River, Kanungu district of Western Uganda (hereafter referred to as "the project"). The electricity generated will be transmitted to the Uganda Electricity Transmission Company Limited (UETCL), which operates the national grid system.

The project results in a reduction of anthropogenic emissions of greenhouse gas by displacing an equivalent volume of electricity that would otherwise be generated by the fuel-fired power plants tied to the national grid.

Brief description of the installed technology and equipment

The project involves installation of a run-of-river hydropower plant system and the installed capacity is 6.4 MW. 6.4 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) Leroy Somer synchronous generators, each rated at 4.0 MVA and operated at power factor of 0.8.

The project will harness water from the Ishasha River and deposit the water approximately 90 metres through a mild steel penstock of 1,140 metres 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.

Relevant dates for the project activity

Event	Date
Start date of plant operation	06-03-2011
Registration of project activity at UNFCCC website	08-06-2012
1st monitoring period	06-03-2011 to 30-06-2012

Total GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period

The project results in a total emission reduction of 24,462 tCO_2e over the monitoring period of 6 March 2011 to 30 June 2012.

1.2 Sectoral Scope and Project Type

The project is categorised under type/category as below:

a) Sectoral scope: 01 - Energy industries (renewable - / non-renewable sources)

b) Type: I - Renewable energy projects

The project is not a grouped project.

1.3 Project Proponent

Organization name	Eco Power Uganda Limited
Contact person	Bhatiya Ranatunga
Title	CEO
Address	30/1 Bagatalle Road, Colombo, 3, Sri Lanka
Telephone	+94-11-4513470/1/2
Email	bhatiya@ecopower.lk

Organization name	C-Quest Capital LLC
Contact person	Ken Newcombe
Title	CEO
Address	1211 Connecticut Ave, NW - Suite 800, Washington DC 20036
Telephone	+1 202 416 2400
Email	cqc-operations@cquestcapital.com

1.4 Other Entities Involved in the Project

Not applicable.

1.5 Project Start Date

06-03-2011 (which is the start date of plant operation)

1.6 Project Crediting Period

Start date of crediting period: 06-03-2011

End date of crediting period: 30-06-2012

1.7 Project Location

a) Host Party(ies): Republic of Uganda

b) Region/ State/ Province: Kanungu District of South-Western Uganda

c) City/ Town/ Community: Ruheza-Kyajura Village, Nyamigoue Parish in Kanyantoorogo sub-county

d) Physical/ Geographical location:

Location	Coordinates
Weir/Diversion Intake	-0.935556, 29.668611
Power House/Tailrace	-0.878611, 29.657500

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1.8 Title and Reference of Methodology

Methodology: AMS I.D version 17 - Grid connected renewable electricity generation
Tool: Tool to calculate the emission factor for an electricity system" (version 02.2.1)

1.9 Other Programs

Participation under Other GHG Programs:

The project was registered under the CDM on 8 June 2012 with CDM reference number 6381. Under the CDM, the project was granted a fixed crediting period of 10 years from 1 July 2012 to 30 June 2022. The emission reduction claimed under VCS is for period prior to 1 July 2012.

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

The implementation of the project consists 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 approximately 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. The detailed technical specification of turbine and generator are listed as below.

Turbine specifications:

Quantity	2
Manufacturer	Turboinstitut
Type	Francis turbine

Model	TF 196TI-0.79-750
Serial Number	TF 1362/1, TF 1362/2
Net Head	91 m
Discharge	4.1 m^3/s
Turbine Speed	750 rpm
Turbine Output	3400 kW

Generator specifications:

Quantity	2
Manufacturer	Leroy Somer
Type	Synchronous generator
Model	LSA 56 UL9-8P
Serial Number	602328-1, 602328-2
Power Rating	4000 kVA
Power Factor	0.8
Power Output	3200 kW

- 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

The project was implemented and operated in accordance with the registered PDD. The project consists of one site only and the implementation is not phased. The project started the operation on 6 March 2011. During the monitoring period, the project activity was in normal operation. There was no events or situations occurred which may impact the applicability of the methodology.

2.2 Deviations

2.2.1 Methodology Deviations

Not applicable.

2.2.2 Project Description Deviations

As per the registered PDD, the project was to be implemented for a design capacity of 6.6 MW. 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

The above mentioned change in the project design does not alter the scale of the project and compliance to the applicability conditions of the applied methodology. The reduction in total installed capacity of the project is only reduced by 0.2 MW or 3% from the capacity stated in the registered PDD. The change in the design pertains to small variation in capacity does not adversely impact the additionality and the appropriateness of the baseline scenario of the project.

2.3 Grouped Project

Not applicable.

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

Data / Parameter	$EF_{CO2,grid,y}$
Data unit	t CO_2/MWh
Description	CO_2 emission factor of the grid
Source of data	Registered PDD
Value applied:	0.6673
Justification of choice of data or description of measurement methods and procedures applied	Ex-ante option as per the "tool to calculate the emission factor from electricity system" version 02.2.1.
Purpose of the data	Calculation of baseline emissions
Comments	-

Data / Parameter	Cap_{BL}
Data unit	W
Description	Installed capacity of the hydro power plant before the implementation of the project activity. For new hydro power plants, this value is zero.
Source of data	Project site
Value applied:	0
Justification of choice of data or description of	Determine the installed capacity based on recognized standards.

measurement methods and procedures applied	
Purpose of the data	Calculation of project emissions
Comments	-

Data / Parameter	A_{BL}
Data unit	m^2
Description	Area of the single or multiple reservoirs measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero.
Source of data	Project site
Value applied:	0
Justification of choice of data or description of measurement methods and procedures applied	Measured from topographical surveys, maps, satellite pictures, etc.
Purpose of the data	Calculation of project emissions
Comments	-

3.2 Data and Parameters Monitored

Data / Parameter	EG_y
Data unit	MWh
Description	Quantity of net electricity supplied to the grid
Source of data	1) Monthly invoices issued by EPUL to UETCL for the electricity sales invoicing and payment.[1] 2) Monthly reports of manual meter reading by UETCL.[2]
Description of measurement methods and procedures to be applied	The data has been measured continuously using meter and recorded on a monthly basis from the monthly invoices.
Frequency of monitoring/recording	Monthly
Value monitored:	36,659.65
Monitoring equipment	Two-way hourly meter. Meters M_1 and M_2 as described in Section 3.3 are Main

[1] The value of meter reading indicated in the invoices is the **net electricity supplied** (export minus import) to the grid.
[2] The report provides the present readings of monthly electricity generation and consumption.

<table>
<tr><td></td><td>Meter and Check Meter respectively. The calibration frequency of the meter is every five years.
<table>
<tr><th>Meter</th><th>Type</th><th>Serial Number</th><th>Accuracy class</th><th>Calibration date</th></tr>
<tr><td>M_1</td><td>CEWE Prometer W</td><td>CW001303</td><td>0.2s</td><td>18/12/2010</td></tr>
<tr><td>M_2</td><td>CEWE Prometer W</td><td>CW001304</td><td>0.2s</td><td>18/12/2010</td></tr>
</table></td></tr>
<tr><td>QA/QC procedures to be applied</td><td>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.

Meter calibration will only be necessary if the difference in reading between the main and check meters deviates by more than 1.5%.</td></tr>
<tr><td>Purpose of the data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Calculation method</td><td>-</td></tr>
<tr><td>Comments</td><td>-</td></tr>
</table>

Data / Parameter	Cap_{PJ}
Data unit	MW
Description	Installed capacity of the hydro power plant after the implementation of the project activity.
Source of data	EPUL
Description of measurement methods and procedures to be applied	Determine the installed capacity based on recognized standards
Frequency of monitoring/recording	Yearly
Value monitored:	6.4
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of the data	Calculation of project emissions
Calculation method	-.
Comments	-

Data / Parameter	A_{PJ}
Data unit	m^2
Description	Area of the single or multiple reservoirs measured in the surface of the water, after the implementation of the project activity, when the reservoir is full.
Source of data	EPUL
Description of measurement methods and procedures to be applied	Measured from dam reservoir layout.
Frequency of monitoring/recording	Yearly
Value monitored:	9,608
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of the data	Calculation of project emissions
Calculation method	-
Comments	-

Environmental and Social impacts

These parameters have no impact on emission reduction calculation and have been monitored in-line with the registered PDD.

The main environmental concern required EPUL always allow 250 litres (0.25 m^3) 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 section of the river between the diversion and the tailrace, especially during the dry season.

As observed in Environmental Audit Report, the environmental flow pipes of required dimensions had been installed into the dam infrastructure and it allows a release of 0.250 m^3 of water to the river all the time. To avoiding any situation where the flow will be reduced during dry spells, five pressures values have been installed just above the environmental flow pipe. This will enable the plant operator to maintain the required volume of free environmental flow by turning on the pressure values.

For the social impacts, a positive aspect of the project is through employment of local people. Below are the employment details as on December 2011 and June 2012.

	Dec-11	**Jun-12**
Employee category	**Number of Employees**	
Engineer	1	1
Liaison Officer	1	2

Power House Operator	2	2
Power House Assistant	9	6
Accounts	1	1
Helper	1	0
Technical Officer	1	2
Total	**16**	**14**

3.3 Monitoring Plan

Data collection procedures and metering

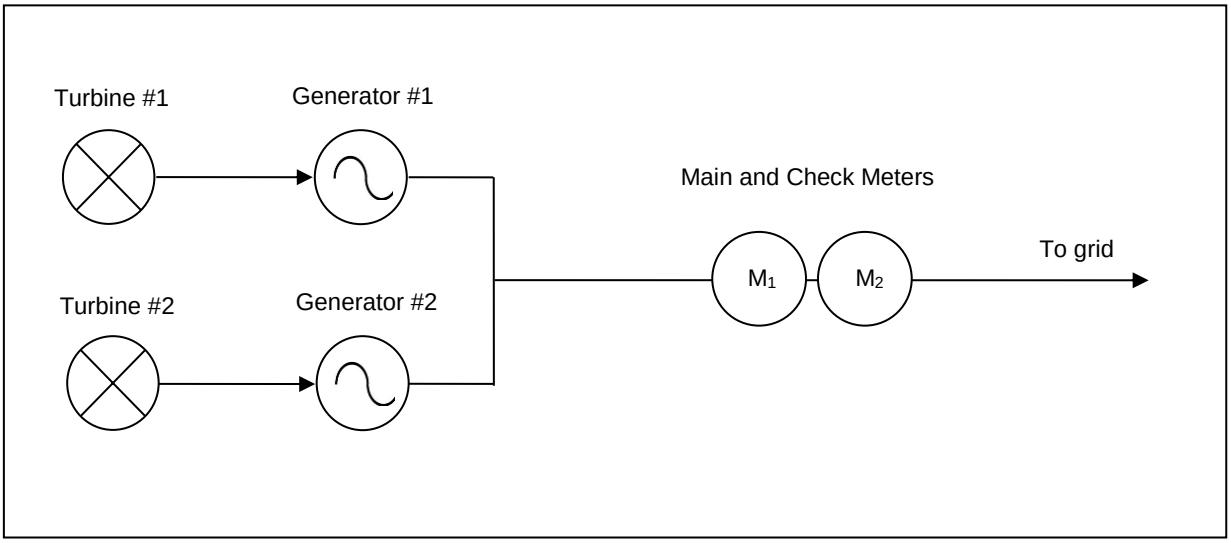
Electricity generation data is the main input variable for the calculation of emission reductions and it is monitored via metering approach. Eco Power Uganda Ltd (EPUL) is responsible to meter in the dual meter system. There is only one line and the dual meter is two-way hourly meter, so each meter reading is be a net reading of power exported from or 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 (Meter M_1) and the Check Meter (Meter M_2) system installed, owned and maintained by UETCL, is 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 metering system shall provide 3 separate meter readings based on the supply period defined below:

Supply Period	**Hours**
Off peak hours	0000 to 0600 hours
Shoulder hours	0600 to 1800 hours
Peak hours	1800 to 2400 hours

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.

The line diagram below shows the metering points for the project.



Organizational structure, roles and responsibilities

A Project Manager is appointed to be responsible for the overall monitoring system and reporting of all relevant issues which occurred in the monitoring activities. An Operational Manager is assigned to assist the Project Manager for the monitoring of monthly electricity generation and liaise with the electricity purchaser, UETCL, to correct any discrepancies of measurement according to the requirements and direction of the Power Purchase Agreement (PPA).

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.

Emergency procedures for the monitoring system

If there is any failure of the meters, the site technician will notify the grid company and CDM manager.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

The baseline emissions are calculated as per formula below.

$$BE_y = EG_y \times EF_{CO2,\ grid}$$

Where:

BE_y	Baseline Emissions in year *y* (t CO2)
EG_y	Quantity of net electricity supplied to the grid (MWh)
$EF_{CO2,\ grid}$	CO2 emission factor of the grid (t CO2/MWh)

Quantity of net electricity supplied to the grid

		Quantity of net electricity supplied to the grid according to the supply period (kWh)			Total net electricity supplied to the grid (kWh)
Inv #	**Month**	**Peak hours**	**Shoulder hours**	**Off Peak hours**	
Year 2011					
Mar/2011/001	Mar-11	292,010	394,250	206,090	892,350
Apr/2011/002	Apr-11	490,540	727,080	344,750	1,562,370
May/2011/003	May-11	785,680	1,169,500	490,850	2,446,030
June/2011/004	Jun-11	629,750	837,110	273,000	1,739,860
July/2011/005	Jul-11	560,800	763,410	267,650	1,591,860
Aug/2011/006	Aug-11	578,040	942,880	346,490	1,867,410
Sep/2011/007	Sep-11	973,300	1,723,100	761,220	3,457,620
Oct/2011/008	Oct-11	872,040	1,558,390	776,980	3,207,410
Nov/2011/009	Nov-11	823,150	1,378,070	674,660	2,875,880
Dec/2011/010	Dec-11	867,740	1,322,610	739,000	2,929,350
Year 2012					
Jan/2012/001	Jan-12	647,150	1,142,090	637,730	2,426,970
Feb/2012/002	Feb-12	508,090	799,530	431,290	1,738,910
Mar/2012/003	Mar-12	566,630	929,960	373,420	1,870,010
Apr/2012/004	Apr-12	678,290	1,048,490	568,960	2,295,740
May/2012/005	May-12	837,870	1,471,630	790,850	3,100,350
June/2012/006	Jun-12	752,200	1,186,870	718,460	2,657,530
Total		**10,863,280**	**17,394,970**	**8,401,400**	**36,659,650**

The ex-ante grid emission factor as per the registered PDD is 0.6673 t CO_2/MWh.

EG_y = 36,659,650/1000 = 36,659.65 MWh

BE_y = 36,659.65 x 0.6673

= **24,462 tCO_2e** (after rounded down)

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

= 666.11 W/m^2

The power density of the project activity (*PD*) is greater than 10 W/m^2, therefore the project emission can be ignored.

Thus, PE= 0

4.3 Leakage

There are no leakage emissions associated

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4.4 Net GHG Emission Reductions and Removals

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
Mar 11 to Dec 11	15,061	0	0	15,061
Jan 12 to Jun 12	9,401	0	0	9,401
Total	**24,462**			**24,462**