Verified Carbon Standard

MONITORING REPORT

BUGOYE 13.0 MW RUN-OF-RIVER HYDROPOWER PROJECT

Document Prepared by AERA Group
On behalf of Bugoye Hydro Limited

BUGOYE HYDRO

Project Title	Bugoye 13.0 MW Run-of-River Hydropower Project
Version	1.3
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Monitoring Period	01-January-2013 to 06-October-2019
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CONTENTS

1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

Bugoye Hydro Limited (formerly Tronder Power Ltd) has implemented the Bugoye hydropower project, a run-of-river plant. The project is located at the foot of the Rwenzori Mountains in the Kasese District, Western Uganda. The project diverts water from the rivers Mubuku and Isya which runs via a five kilometer-long canal into a 950 meter-long penstock with a head of 160 meters. After passing through two turbines, the water is discharged to the Mubuku River. The project uses the remaining head between two existing hydropower plants; Mubuku 1, upstream of the project site, and Mubuku 3, downstream of the project site.

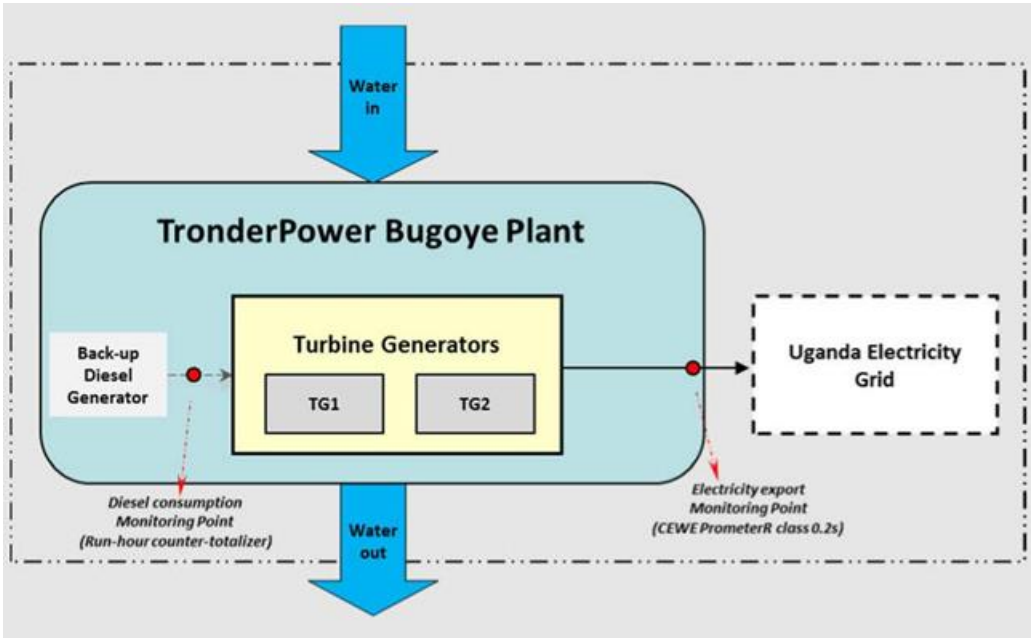
The hydro power plant is connected to the national grid[1] via a 6 km long transmission line routed to the Nkenda substation. The primary purpose of the project is to supply affordable renewable energy to the population of Uganda. The electricity sold to the grid is measured by a main meter and is verified by the purchaser, the Ugandan Electricity Transmission Company (UETCL); a check meter is also installed.

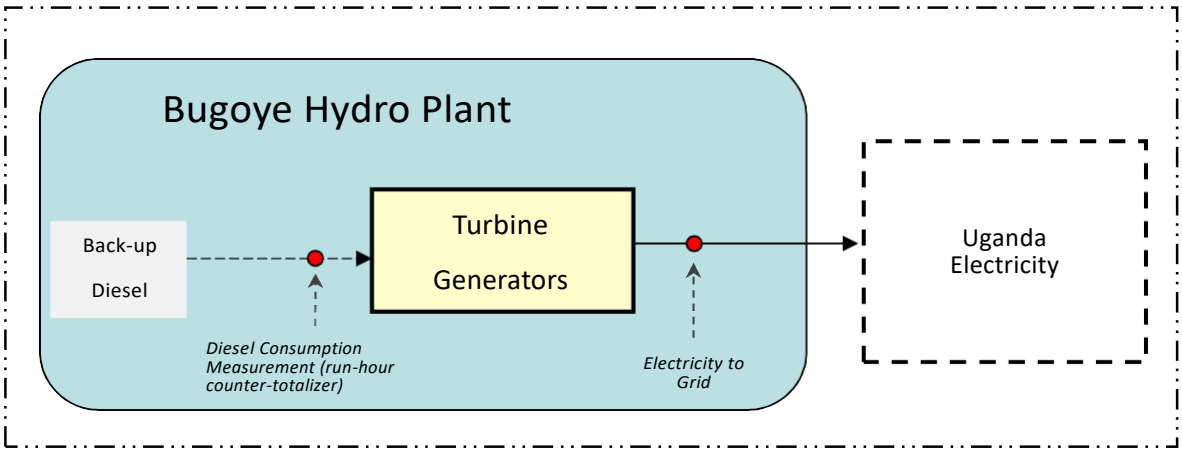
Before the implementation of the project and in its absence, the baseline situation was the continuation of the current situation i.e. electricity will continue to be generated by the existing generation mix operating in the grid. Implementation of the project consists of construction of the following main items:

- A main intake and sedimentation basin where water from the river Mubuku is diverted through a 1,0 km canal to the river Isya;
- A second intake and sedimentation basin at the river Isya, where tailrace water from the Mubuku 1 power station is added to the system;
- An open concrete headrace canal with total length of 4.0 km;
- A spillway of approximately 1 km, a forebay and 950 m penstock;
- Power house with two horizontal 7.228 MW Francis turbines and two 7.140 MW generators;
- Tailrace canal back to the Mubuku river;
- Switch station and a 33 kV transmission line of 6.5 km;
- An emergency diesel generator.

A technology diagram is provided below:

[1] National Ugandan Electricity Grid, operated by Ugandan Electricity Transmission Company (UETCL).





In the power house two horizontal axis turbines are installed, each with a capacity of 7.228 MW, giving a total capacity of 14.456 MW. The two 7.140 MW generators are horizontal axis, three-phase, synchronous salient-pole, with sleeve bearings and brushless excitation systems; hence possessing the generator capacity of 2 x 7.140 (14.28) MW. The generators have a power factor of 0.85, a frequency of 50 Hz and an output of 8.4 MVA. The power output for supply to the grid has to include losses in the generator (n~0.97) and transformer (n~0.985). The rated output to the grid for combined operation of the two turbines at discharge 10 m3/s, taking into account losses in the generator and transformer, is 13 MW. Electricity generation is 451,703MWh for the monitoring period under consideration (01/01/2013 –06/10/2019).

The project also includes installation of a small switch field at the power house. Two transformers amplify the production energy of 6.3 kV to a potential of 33 kV. The 33kV line is connected to the indoor switchgear in the existing spare 33kV panel at Nkenda Substation by an underground cable. The energy produced at the outlet of the switch field is sold to UETCL.

During maintenance periods, power is drawn from the grid. Normally however, it is possible to operate one turbine while the other is under maintenance, so there should be little need to import power from the grid. An 80 kVA emergency diesel generator is installed to cover non-operation of the turbines. This on-site diesel generator is only used in exceptional periods, for example when the grid is down and on-site loads cannot be self-supplied.

The key project data for the Bugoye Hydropower Project is given below:

- Catchment area 207 km2
- Mean annual run-off 10.2 m3/s
- Intake pond storage 1000 m3
- Canal length 4.0 km
- Penstock length 950 m
- Penstock diameter 1.8/2.0/2.2 m
- Rated head 160 m
- Turbine type Francis
- Turbine capacity 2 x 7.228 (14.456) MW Mavel Francis Turbines
- Generator type ELPROM ZEM Horizontal synchronous Generator
- Generator capacity 2 x 7.140 (14.28) MW
- Mean annual production 82,000 MWh
- Plant load factor 65.55%

Total electricity generation for this monitoring period spanning 01-January-2013 to 06-October-2019 was 452,608 MWh is sold to the Uganda Electricity Transmission Company Limited (UETCL) as per the power purchase agreement.

Below is a summary of key events related to the project activity and related infrastructure:

- January 2008 : Start of construction of the Bugoye 13.0 MW run-of-river Hydropower Plant
- 7 October 2009 : Commissioning of BHP
- 31 December 2012 : Cut-off of the previous CDM monitoring period

During this Monitoring Period No.4 (01-January-2013 to 06-October-2019), the net emission reductions achieved are **281,345 tCO2e** in accordance with the formulae presented in Section 5 below.

1.2 Sectoral Scope and Project Type

The sectoral scope is Scope 1 – Energy Industries (renewable sources) – AMS Type I – Category I.D.- Grid connected renewable electricity generation.

The project is a renewable energy type and is not a grouped project.

1.3 Project Proponent

Organization name	Bugoye Hydro Limited (formerly Tronder Power Ltd.)
Contact person	Nicholas Tatrallyay
Title	Director
Address	1st Floor, UEDCL Tower, Plot 37 Nakasero Kampala
Telephone	+256(41)4232163
Email	Nicholas.Tatrallyay@Berkeley-Energy.com

1.4 Other Entities Involved in the Project

Organization name	AERA Group

Role in the Project	Carbon consultant
Contact person	Alexandre Dunod
Title	Chief Operating Officer
Address	28 Cours Albert 1er, 75008 Paris, France
Telephone	+33 1 42 18 02 02
Email	a.dunod@aera-group.fr

1.5 Project Start Date

7 October 2009, as the date of commissioning, synchronization and start of GHG emission reductions.

1.6 Project Crediting Period

The project crediting period started on 07-October-2009and lasted10 years, until 06-October-2019.

1.7 Project Location

The project is located in the Bugoye Sub County which is situated around 15 km north of Kasese town, in Kasese District in the Western region of Uganda, 400 km drive from Kampala, in the Republic of Uganda.

Coordinates for the main project infrastructure are given below:

Project coordinates		
Diversion intake:	0°20'02.30"N	30°04'27.76"E
Intake:	0°19'46.58"N	30°04'16.27"E
Forebay:	0°18'51.93"N	30°05'43.25"E
Power station:	0°18'25.80"N	30°05'57.57"E
Tailrace outlet:	0°18'27.94"N	30°06'07.20"E

1.8 Title and Reference of Methodology

The project comes under AMS Type I – Renewable Energy Project and Category I.D.- Grid connected renewable electricity generation (version 15).

1.9 Participation under other GHGPrograms

The project is registered under the Clean Development Mechanism[2] (Project #3017) on 01-Jan-2011, although its GHG emission reduction will either be claimed under the VCS programme or the CDM programme, never both.

1.10 Other Forms of Credit

The project does not reduce GHG emissions from activities that are included in an emissions trading program or any other mechanism that includes GHG allowance trading.

The project has neither sought nor received another form of GHG-related environmental credits.

[2]https://cdm.unfccc.int/Projects/DB/BVQI1254738519.15/view

1.11 Sustainable Development

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

- Hydro power presents various environmental benefits compared to other primary energy sources: hydro power 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 hydro power can be used without putting the supply of primary energy sources into danger for future generations. The proposed project will also contribute to a reduction in other emissions than GHG emissions related to conventional electricity generation, like emissions of sulphur dioxide, nitrogen oxides and particulates;

- The project will result in additional employment opportunities, especially during the construction phase. Construction materials for the foundations, cables and access roads will be sourced locally;

- Project developer will build a fence along the vulnerable parts of the canals and 12 footbridges as well as one motor vehicle bridge. Adjacent to the footbridges, there will be water collection points. The project developer will further leave the road from Ibanda to Nkenda will be in the same or better standards as before constructions and Support to establishment of gravity fed water supply system for affected villages both sides.

- 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"[3].

- The project is expected to involve some transfer of technology. First, the project developer will use modern technology which will be of a higher standard than other power plants currently existing in Uganda. Further, project developer will train both skilled and unskilled local workers.

2 SAFEGUARDS

2.1 No Net Harm

An Environmental & Social Audit of the Operation activities for Bugoye Hydropower Project was conducted in compliance with the National Environment (Conduct and Certification of Environmental Practitioners) Regulations, 2003, National Environment (Audit) Regulations, 2006, other relevant laws and permits that have been issued for the operation of Bugoye Hydropower Project.

Overall performance by the Auditee in managing environmental issues relating to resource protection, user protection and environment conservation was satisfactory, with improvements needed in the following areas:
☐Abstraction volume should be regulated to allow continued flow along the entire river channels especially at the intake along R. Mubuku.
☐Mitigations to be put for such areas with high noise levels that include; administrative controls such as

- Provision of adequate Personnel Protective Ear muffs,
- Limiting the time that workers are exposed to noise through job rotation
- Task modifications and increased noise hazard awareness be availed to workers who access noise polluted areas
- Relocating the control room

☐The Riverbank permit expired in March, 2020 ; it should be renewed as soon as possible

3 annual report 2006, Ministry of Energy and Mineral Development (MEMD), page iii

2.2 Local Stakeholder Consultation

BHL has a grievance mechanism for its employees that enables employees to seek redress in the shortest time possible. The employees are aware of the reporting procedure. The community channels grievances through the BHCC member who meets them to discuss the different grievances raised by the community. However, the auditors noted that there was need to re-elect a new committee with better inclusion and interface with all the community. Members from Ibanda area claimed they did not even know the people that were part of BHCC.

The composition of the BHCC before constituted an elder from the community, a representative from the project affected persons elected by the PAPs, two community representatives representing the 3 parishes of Ibanda, Bugoye and Kibirizi. Recently all the LCs leaders are included to represent each village in the 3 Parishes. The villages include; Bugoye, Kanyaminigo, Kikokera, Rwakingi A&B, Kibirizi, Kibirizi upper, Kasangi, Ihani, Bulindiguru, Ibanda 1&2, Nyakabuga, Katindo.

BHL public complaints log has been provided to the DOE, evidencing 8 resolved/closed cases out of 8 complaints;together with December 9th 2019 E&S consultations minutes.

2.3 AFOLU-Specific Safeguards

Not applicable.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

The project has operated satisfactorily during this monitoring period spanning 01-January-2013 to 06-October-2019, and accrued 452,608 MWh of electricity generation sold to the Uganda Electricity Transmission Company Limited (UETCL).

The table below summarizes the number of downtime events and category of downtime events for the monitoring period:

TG1 and TG2 Downtime Events and Category		
CATEGORY OF EVENT	No. of Events	
	TG1	TG2
Forced Outage of Plant (FP)	343	311
Scheduled Outage of Plant (SP)	114	99
Forced Outage of Grid (FG)	1,175	1,193
Scheduled Outage of Grid (SG)	85	79
Low Hydrology (LH)	818	821
Total Number of Downtime Events	**2,536**	**2,503**
	No. of Hours	
Total Downtime Hours	18,744	19,383

Main production interruption occurred between February 14th 2017 and September 27th 2017 following penstock failure. The shutdown events did not result in any permanent changes in the project.

During this Monitoring Period No.4 (01-January-2013 to 06-October-2019), the net emission reductions achieved are **281,345tCO2e**.

Bugoye Hydro Limited has also become the new Project Proponent (transitioned from formerly Tronder Power Ltd.)

3.2 Deviations

3.2.1 Methodology Deviations

No methodology deviations were applied.

3.2.2 Project Description Deviations

With respect to the registered monitoring plan, the following should be highlighted:

- Calibration of the main and check meters was stated in the CDM-PDD as having to be undertaken annually. Since the project has been implemented it has become apparent that there is no relevant expertise in Uganda needed to undertake the calibration of the said meters. The meter manufacturers (CEWE instruments) have confirmed that the installed meters, following initial test and calibration, do not require any further or regular calibration. For this reason, annual calibration, which is not considered to be required and which cannot be undertaken locally, has not been implemented. It should be mentioned that there has been a continuous check of the readings of the Main Meter vis-à-vis the Check Meter in order to ensure the accuracy of the Main Meter. The meter readings have been performed in the presence of the UETCL representatives (as purchaser of the generated electricity) and all of the invoices have been approved by UETCL and paid.PP has taken 0.2% error factor on conservative side for entire monitoring period based on latest calibration of main meter and check meter on 11th March 2021.

- The overall responsibility for monitoring and reporting issues now lies with Bugoye Hydro Limited (formerly Tronderpower Limited) and Nicholas Tatrallyay, its Managing Director of the company.

3.3 Grouped Projects

Not applicable.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Parameters for the "Tool to calculate the emissions factor for an electrical system"

<table>
<tr><td>Data / Parameter:</td><td colspan="3">$FC_{i,m,y}$</td></tr>
<tr><td>Data unit:</td><td colspan="3">Mass or volume unit</td></tr>
<tr><td>Description:</td><td colspan="3">Amount of fossil fuel type i consumed by power plant m in year y (for calculation of $EF_{EL,m,y}$)</td></tr>
<tr><td>Source of data:</td><td colspan="3">Utility official publications, collected from UETCL, See Annex 3</td></tr>
<tr><td>Value applied:</td><td colspan="3">For operating margin:
<table>
<tr><td></td><td></td><td>$FC_{i,m,y}$, 1000 litres</td></tr>
<tr><td>2005</td><td>LGGO Aggreko 1</td><td>37,724</td></tr>
<tr><td></td><td>KiiraAgrekko 2</td><td>-</td></tr>
<tr><td>2006</td><td>LGGO Aggreko 1</td><td>83,970</td></tr>
<tr><td></td><td>KiiraAgrekko 2</td><td>13,203</td></tr>
<tr><td>2007</td><td>LGGO Aggreko 1</td><td>73,989</td></tr>
<tr><td></td><td>KiiraAgrekko 2</td><td>70,445</td></tr>
</table></td></tr>
</table>

<table>
<tr><td></td><td>For build margin:
<table>
<tr><td colspan="2"></td><td rowspan="2">$FC_{i,m,y}$, 1000 litres</td></tr>
<tr><td>Power plants</td><td>Start ofoperation</td></tr>
<tr><td>Kakira Sugar Works KSW)</td><td>2007</td><td>-</td></tr>
<tr><td>50*KIIRA Aggreko</td><td>2006</td><td>70,445</td></tr>
<tr><td>20*LGGO Aggreko</td><td>2005</td><td>29,596</td></tr>
<tr><td>Total</td><td></td><td>100,051</td></tr>
</table></td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures applied:</td><td>• OM: Most recent three historical years for which data is available at the time of submission of the CDM-PDD tothe DOE for validation(2005-2007)
• BM: For the first crediting period, once ex-ante,following the guidance included in step 6. Sample group of power units according to option (b) representing 20.44%ofsystem generation</td></tr>
<tr><td>Purpose of data:</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Comments:</td><td>Calculation of the simple adjusted OM in cases where fuel consumption data is available for all power plants / units</td></tr>
</table>

<table>
<tr><td>Data / Parameter:</td><td>$EF_{CO2,i,y}$</td></tr>
<tr><td>Data unit:</td><td>tCO_2/TJ</td></tr>
<tr><td>Description:</td><td>CO_2 emission factor of fossil fuel type i in year y</td></tr>
<tr><td>Source of data used:</td><td>The following data sources may be used if the relevant conditions apply:
<table>
<tr><th>Data source</th><th>Conditions for using the data source</th></tr>
<tr><td>Values provided by the fuel supplier of the power plants in invoices</td><td>If data is collected from power plant operators (e.g. utilities)</td></tr>
<tr><td>Regional or national average default values</td><td>If values are reliable and documented in regional or national energy statistics / energy balances</td></tr>
<tr><td>IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td></td></tr>
</table>
Neither values from fuel supplier nor regional / national values are available, so the IPCC default values are used.</td></tr>
<tr><td>Value applied:</td><td>72.6 tCO_2/TJ</td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures applied:</td><td>IPCC standard for diesel (lower limit of uncertainty at 95%) used as values are not available by fuel supplier and no reliable national default values are available</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Comments:</td><td>--</td></tr>
</table>

Data / Parameter:	$EG_{m,y}$, $EG_{k,y}$
Data unit:	MWh
Description:	Net electricity generated and delivered to the grid by powerplant / unit *m or k* in year *y*
Source of data used:	Most recent 3 years data (2005-2007) collected from Electricity Regulatory Authority (ERA) and Uganda Electricity Transmission Company Limited (UETCL), see Annex 3.

<table>
<tr><td>Value applied:</td><td>For operating margin:
<table>
<tr><th colspan="2"></th><th>Gen ($EG_{m,y}$),MWh</th></tr>
<tr><td>2005</td><td>LGGO Aggreko 1</td><td>140,911</td></tr>
<tr><td></td><td>KiiraAgrekko 2</td><td>-</td></tr>
<tr><td>2006</td><td>LGGO Aggreko 1</td><td>319,320</td></tr>
<tr><td></td><td>KiiraAgrekko 2</td><td>50,137</td></tr>
<tr><td>2007</td><td>LGGO Aggreko 1</td><td>272,995</td></tr>
<tr><td></td><td>KiiraAgrekko 2</td><td>266,437</td></tr>
</table>
For build margin:
<table>
<tr><th colspan="2"></th><th>Gen ($EG_{m,y}$), MWh</th></tr>
<tr><th>Power plants</th><th>Start ofoperation</th><td></td></tr>
<tr><td>Kakira Sugar Works KSW)</td><td>2007</td><td>1,828</td></tr>
<tr><td>50*KIIRA Aggreko</td><td>2006</td><td>266,437</td></tr>
<tr><td>20*LGGO Aggreko</td><td>2005</td><td>109,198</td></tr>
<tr><td>Total</td><td></td><td>377,463</td></tr>
</table></td></tr>
<tr><td>Justification of the choice of data or description of measurement methods and procedures applied:</td><td>• OM: Most recent three historical years for which data is available at the time of submission of the CDM-PDD tothe DOE for validation(2005-2007)
• BM: For the first crediting period, once ex-ante,following the guidance included in step 6. Sample group of power units according to option (b) representing 20.44%of system generation</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Comments:</td><td>--</td></tr>
</table>

<table>
<tr><td>Data / Parameter:</td><td>$NCV_{i,y}$</td></tr>
<tr><td>Unit:</td><td>GJ per tonne</td></tr>
<tr><td>Description:</td><td>Weighted average net calorific value of diesel fuel in year y</td></tr>
<tr><td>Source of data:</td><td>
<table>
<tr><th>Data source</th><th>Conditions for using the data source</th></tr>
<tr><td>a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source if the carbon fraction of the fuelis not provided (Option A)</td></tr>
<tr><td>b) Measurements by the project participants</td><td>If a) is not available</td></tr>
<tr><td>c) Regional or national default values</td><td>If a) is not available

These sources can only be used for liquid fuels and should be based on well documented, reliable</td></tr>
</table></td></tr>
</table>

		sources.
	d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.2 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	If a) is not available
	Neither values from fuel supplier nor regional / national values are available, so the IPCC default values are used.	
Value applied	41.4TJ/Gg	
Justification of the choice of data or description of measurement methods and procedures applied:	Measurement method not required as d) chosen	
Purpose of data	*Calculation of baseline emissions*	
Comments:	--	

Data / Parameter:	EF_{CO_2}
Unit:	t CO_2e/MWh
Description:	CO_2 Emission Factor for the electricity grid
Source of data:	As determined in the PDD for the "Bugoye 13.0 MW Run- of-River Hydropower Project", and according to the "Tool to calculate the emission factor for an electricity system"(version 02)
Value applied	0.62286 tCO_2/MWh
Justification of the choice of data or description of measurement methods and procedures applied:	Used for Baseline emission calculations. According to methodology AMS I.D., the baseline emissions are the product of electrical energy produced by the renewable generating unit multiplied by an emission factor: $BE_y = EG_{BL,y} * EF_{CO2}$
Purpose of data	*Calculation of baseline emissions*
Comments:	None

4.2 Data and Parameters Monitored

Data / Parameter	EG_y
Data unit	*MWh*
Description	*Net electricity supplied by the project to the grid*

<table>
<tr><td>Source of data</td><td>Measurement of energy output meter at the 33 kV side of the transformer that connects to the 33 kV line that evacuates the power to the main grid.</td></tr>
<tr><td>Description of measurement methods and procedures to be applied</td><td>Automatic metering of electricity supplied to UETCL grid through main and check meter, meters read each month.
Representatives from UETCL and UMEME, together with a representative from Bugoye Hydro Limited (BHL), retrieve historical data for the previous month from each meter by using an optical eye connected to a laptop and the meter.</td></tr>
<tr><td>Frequency of monitoring/recording</td><td>Hourly measurements and monthly recordings of net electricity supplied by the project activity to the grid will betaken.</td></tr>
<tr><td>Value monitored:</td><td>
<table>
<tr><td>2019</td><td>44,401</td></tr>
<tr><td>2018</td><td>77 744</td></tr>
<tr><td>2017</td><td>32 105</td></tr>
<tr><td>2016</td><td>65 835</td></tr>
<tr><td>2015</td><td>77 038</td></tr>
<tr><td>2014</td><td>86 903</td></tr>
<tr><td>2013</td><td>67 677</td></tr>
<tr><td>Total</td><td>451,703</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>Specified information for main meter given below:
<table>
<tr><td>Type</td><td>CewePrometerR, 57/99-
120/208V, 5A (5mA – 10A),
50Hz, 0.2s, Aux: 40-276
VAC/40-300 VDC (single), I/O:4 inputs and 6 outputs, Com: No communication</td></tr>
<tr><td>Accuracy class</td><td>0.2s</td></tr>
<tr><td>Serial number</td><td>1641802</td></tr>
<tr><td>Date of last calibration</td><td>10.07.2008</td></tr>
</table>
</td></tr>
<tr><td>QA/QC procedures to be applied</td><td>Measurement results shall be cross-checked with records for soldelectricity (to UETCL).</td></tr>
<tr><td>Purpose of the data</td><td>Calculation of baseline emissions</td></tr>
<tr><td>Calculation method</td><td>Since previous calibration dated from 10.07.2008, the un-calibrated measurement period has been adjusted by deducting the accuracy range of meters from export readings:
<table>
<tr><td>Delayed calibration period</td><td>Uncalibrated metered data (MWh)</td><td>Applicable accuracy deduction</td><td>Adjusted data for ER calculation (MWh)</td></tr>
<tr><td>January 1st 2013 to October 6th 2019</td><td>EG_y: 452,608</td><td>0,2%</td><td>EG_y: 451,703</td></tr>
<tr><td colspan="4">As per latest calibration certificates of 11.03.2021, the meter’s accuracy is below 0.2 in-deed thus the applied error valid for the uncalibrated period.</td></tr>
</table>
</td></tr>
<tr><td>Comments</td><td>Meters’ verification conducted on March 11th 2021 together with UETCL with successful results</td></tr>
</table>

Data / Parameter	$FC_{i,j,y}$
Data unit	tonne/year
Description	Quantity of diesel fuel used by site diesel generator during year y
Source of data	Onsite measurement
Description of measurement methods and procedures to be applied	Counter on the diesel generator control panel (run-hours meter) monitoring continuously the number of hours the diesel generator has been running multiplied by the consumption rate of the generator (according to manufacturer's specifications).
Frequency of monitoring/recording	Continuous
Value monitored	*10,24*
Monitoring equipment	Counter on control panel monitoring continuously
QA/QC procedures to be applied	The consistency of metered fuel consumption quantities will be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Verified against annual diesel fuel purchase invoices from the financial records.
Purpose of the data	*Calculation of project emissions*
Calculation method	*Fuel consumption rate of the diesel generator (Manufacturer's Manual) 18Litres/Hour* *Density of diesel 0.842Ton/m3*
Comments	Will only be estimated if emissions from the diesel generator equal or exceed 1% of baseline emissions.

Data / Parameter	$NCV_{i,y}$
Data unit	GJ per tonne
Description	Weighted average net calorific value of diesel fuel in year y
Source of data	See nested table below

Data source	Conditions for using the data source
a) Values provided by the fuel supplier in invoices	This is the preferred source if the carbon fraction of the fuel is not provided (Option A)
b) Measurements by the project participants	If a) is not available
c) Regional or national default values	If a) is not available These sources can only be used for liquid fuels and should be based on well documented, reliable sources.
d) IPCC default values at the upper limit of the uncertainty	If a) is not available

	at a 95% confidence interval as provided in table 1.2 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories | Neither values from fuel supplier nor regional / national values are available, so the IPCC default values are used.
Description of measurement methods and procedures to be applied	Measurement method not required as option d) above is chosen (IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.2 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories)
Frequency of monitoring/recording	Not applicable
Value monitored	43.3 Tj/Gg
Monitoring equipment	Not applicable
QA/QC procedures to be applied	Any future revision of the IPCC Guidelines will be taken into account
Purpose of the data	*Calculation of project emissions*
Calculation method	Not applicable
Comments	None

Data / Parameter	$EF_{CO2,l,y}$
Data unit	tCO2/GJ
Description	Weighted average CO2 emission factor of diesel fuel in year y
Source of data	Data source | Conditions for using the data source a) Values provided by the fuel supplier in invoices | This is the preferred source if the carbon fraction of the fuel is not provided (Option A) b) Measurements by the project participants | If a) is not available c) Regional or national default values | If a) is not available These sources can only be used for liquid fuels and should be based on well documented, reliable sources. d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories | If a) is not available

	Neither values from fuel supplier nor regional / national values are available, so the IPCC default values are used.
Description of measurement methods and procedures to be applied	Measurement method not required as option d) above is chosen (IPCC default values at the upper limit of the 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)
Frequency of monitoring/recording	Not applicable
Value monitored	74.8 tCO_2/GJ
Monitoring equipment	Not applicable
QA/QC procedures to be applied	*Not applicable*
Purpose of the data	*Calculation of project emissions*
Calculation method	Not applicable
Comments	None

4.3 Monitoring Plan

The monitoring consists of metering the electricity generated by the renewable technology in line with "I.D. Grid connected renewable electricity generation" and the "Tool to calculate the emission factor for an electricity system".

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

CDM Manager

The overall responsibility for quality assurance of monitoring and reporting issues lies with BHL CDM Manager. If errors or omissions in the primary data required as part of the CDM monitoring are detected during final QA/QC by CDM Manager ,he is responsible for initiating a dialogue with the CDM Director in Kampala to handle these issues, ensuring a conservative approach is selected and taking into account guidance in the relevant CDM methodology, the registered CDM-PDD and any other CDM EB guidance.

CDM Director

The CDM Director in Kampala is responsible for proper quality assurance of all primary data to be utilized for CDM monitoring purposes. Any issues identified regarding primary data used for CDM monitoring detected during initial quality assurance shall without delay be communicated to the CDM Coordinator on site until the issue is resolved.

On a periodical basis the CDM Director shall, subject to having undertaken proper quality control, submit an electronic copy of the consolidated CDM reporting template to the CDM Manager of BHL.

At the end of each monitoring period, the CDM Director is responsible for reviewing the final dataset to be used as basis for CDM calculations for the monitoring period in consideration. This includes undertaking any relevant consistency checks vis-à-vis operational values. Following finalization of the complete dataset as contained in the CDM Monitoring Model (in excel format), the relevant data for the monitoring period in consideration shall be extracted into a CDM verification reporting template. Calculations of CDM parameter values, Baseline Emissions, Project Emissions and Emission Reductions relevant for the monitoring period shall be undertaken in line with CDM requirements and presented transparently in the CDM verification reporting template.

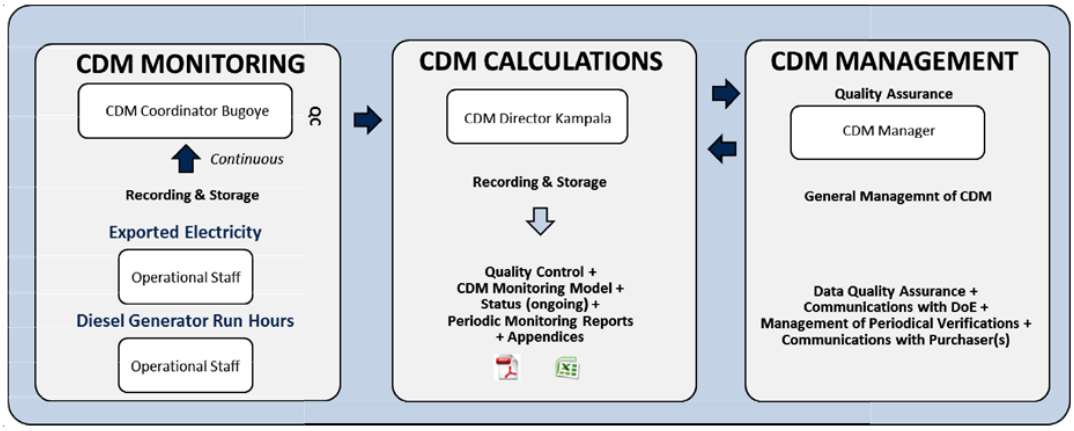
The CDM Director is responsible for organizing quarterly internal audits with a pre-notification of the CDM Coordinator. The internal audits include overall quality control of the Monitoring System and ensuring that all the internal specific CDM procedures are followed closely. On annual bases, the CDM Manager shall be involved in the internal audits as well.

CDM Coordinator

The CDM Coordinator on Bugoye is responsible for measurement and recording of all the primary data, including electricity exports to the grid, back-up diesel consumption, down-time events, and all of the supporting measurements and records.

Responsibility holders for the Monitoring Period under consideration in this report

Figure 2 summarizes, in a visual manner, the monitoring system and how the carbon responsibilities are distributed. Specific carbon procedures have been developed for all of the personnel involved in monitoring to describe the responsibilities and ensure the properness of implementation of the Monitoring Plan.



Meter

One main meter and one check meter system has been installed. The main and check meter, physically installed in the control room at the power house, measure the power flow at the 33 kV side of the transformer (i.e. the output of the transformer) that connects to the 33 kV line that evacuates the power to the main grid.

There is only one line and the meter will be a two-way hourly meter, so each meter reading will be a net reading of power exported/imported to the power station. The main meter and the check meter system installed, owned and maintained by TPL is designed such that the overall error of the installation, (including instrument transformers, wiring, and metering instruments) shall be no greater than 0.2% over the equivalent road range.

All instruments are of the flush mounting type and fitted with nonreflecting glass according to the relevant international standards.

As the main meter, TPL has installed a Cewe Prometer R supplied by Cewe Instrument AB. The Cewe Prometer R is a Precision meter in class 0.2S. The serial number for the main meter is 1641802.

As the check main meter, TPL has installed a Cewe Prometer R supplied by Cewe Instrument AB. The Cewe Prometer R is a Precision meter in class 0.2S. The serial number for the main meter is1641801.

Testing/calibration

- Calibration of the main and check meters was stated in the CDM-PDD as having to be undertaken annually. Since the project has been implemented it has become apparent that there is no relevant expertise in Uganda needed to undertake the calibration of the said meters. The meter manufacturers (CEWE instruments) have confirmed that the installed meters, following initial test and calibration, do not require any further or regular calibration. For this reason, annual calibration, which is not considered to be required and which cannot be undertaken locally, has not been implemented. Yet as a conservative follow-up initiative, meters have been verified on 11/03/2021 together with UETCL with successful results.

Recording

Main and Check meter is read at 12:00 on the 2nd day of each month. Representatives from UETCL and UMEME, together with a representative from Bugoye Hydro Limited (BHL) retrieve historical data for the previous month from each meter by using an optical eye connected to a laptop and the meter. The data is saved as an excel files. A copy of the data is copied on to a hard copy which is signed by the representatives from UETCL, TPL and UMEME.

Reporting

All readings are reported to UETCL and reading from main meter is used for preparing the invoice. 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. The invoice documentation can be used to quality assure report.

Emergency

If the meter is found to be inaccurate for more than two-tenths of a percent (±0,2%) or otherwise function improperly, BHL and UETCL shall jointly prepare an estimate for correct reading.

Training

Before the project was put into operation, the staffs received a training program on operation and metering, both on generally on operation of hydro power plant and specifically on carbon.

- The overall responsibility for monitoring and reporting issues lies with Bugoye Hydro Limited Managing Director.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

The monitoring period for which GHG emission reductions were achieved spans 01/01/2013 to 06/10/2019. Baseline emissions are calculated according to §4.1 methodological approach as the product of (i) the quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the project activity in year y and (ii) the combined margin CO_2 emission factor for grid connected power generation in year y:

$$BE_y = EG_{BL,y} \times EF_{CO2}$$

Where:

BE_y	Baseline emissions in year y (t CO_2/yr)
$EG_{BL,y}$	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the project activity in year y (MWh/yr)
EF_{CO2}	Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (t CO_2/MWh)

$EG_{BL,y}$ i.e. the quantity of net electricity generation supplied by the project plant to the grid, as monitored and displayed below on a yearly basis.

$EF_{CO2} = 0.62286 tCO_2/MWh$, as the Project Proponent have calculated, the DOE validated and the CDM-EB registered.

Year	$EG_{BL,y}$	EF_{CO2}	BE_y
	MWh	tCO_2/MWh	t CO_2
Year 2019 (until Oct 6th)	44,401	0,62286	27,655
Year 2018	77,744	0,62286	48,423
Year 2017	32,105	0,62286	19,996
Year 2016	65,835	0,62286	41,006
Year 2015	77,038	0,62286	47,984
Year 2014	86,903	0,62286	54,128
Year 2013	67,677	0,62286	42,153
TOTAL	**451,703**		**281,345**

5.2 Project Emissions

As described in the CDM-PDD, as the Bugoye run-of-river hydropower project does not lead to any emissions due to the operation of geothermal power plants, or from of water reservoirs), project emissions, PEy, should equal 0.

As noted in the CDM-PDD, however, a diesel generator has been installed in the plant to provide emergency power in the event of any grid blackouts. The generator was expected to be operating for less than 100 hours a year. Based on a conservative assumption that the generator operates for 100 hrs/yr, it was calculated that the emissions from this source will amount to 19.37 tCO_2/yr, which accounts for less than 0.05% of baseline emissions (see annex 6 of the CDM-PDD).

Nevertheless, fuel consumption of the diesel generator was to be monitored, and if running hours, and therefore fuel consumption, were to increase to a level where emissions from this source will be equal to or exceed 1% of baseline emissions, the electricity generation metered will be adjusted by deducting the electricity generation from fossil fuels using the specific fuel consumption and the quantity of fossil fuel used, as prescribed in AMS I.D. v 15.

The estimation of emissions from the diesel generator presented in Annex 6 of the CDM-PDD is based on a conservative assumption that typical fuel consumption for the said diesel generatoris68.12 l/hr, or 18 USg/hr, as opposed to 18 l/hr, or 4.8 USg/hr, i.e. assumption is made that fuel consumption by diesel generator is over 3.5 times that proposed by manufacturer. **Running hours for the diesel generator amounted to 675.5 hours during**

the totality of the monitoring period (i.e. 01/01/2013 to 06/10/2019). TheestimatemadeintheCDM-PDDshowedthatifthegeneratorranfor100hrs/yr,totalCO_2emissions from diesel use would amount to 19.37 tCO_2. Based on the estimation of emissions from the diesel generator presented in Annex 6 of the CDM-PDD, emissions from the diesel generator would therefore amount to 130.8 tCO_2 (675.5/100 * 19.37). As a percentage of baseline emissions, 130.8 tCO_2 represents 0.05% of baseline emissions.

As stated in the CDM-PDD "if running hours, and therefore fuel consumption, will increase to a level where emissions from this source will be equal to or exceed 1% of baseline emissions, the electricity generation metered will be adjusted by deducting the electricity generation from fossil fuels using the specific fuel consumption and the quantity of fossil fuel used, as prescribed in AMS I.D. v 15.". As emissions from this source have been shown not to equal or exceed 1% of baseline emissions, electricity generation metered is therefore not adjusted.

The below table summarizes calculations of the Project Emissions.

PROJECT EMISSION CALCULATIONS

According to the CDM-PDD:	*if the generator ran for 100 hrs/yr, total CO_2 emissions from diesel use would amount to 19.37 tCO_2*	
Running hours of the Generator during the entire Monitoring Period	675.5	Hours
Emissions from diesel use	130.8	tonneCO_2
Percentage of Baseline Emissions	0.05%	*This value is far below 1% of the Baseline Emissions so could be set to zero*

5.3 Leakage

As all generating equipment installed for the project activity is new and not transferred from another activity, it is concluded that LEy = 0.

5.4 Net GHG Emission Reductions and Removals

The monitoring period for which GHG emission reductions were achieved spans 01/01/2013 to 06/10/2019, split by vintage as follows, based on net GHG emission reductions equation ERy = BEy – PEy – LEy :

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)
Year 2013	42,153	-	-	42,153
Year 2014	54,128	-	-	54,128
Year 2015	47,984	-	-	47,984
Year 2016	41,006	-	-	41,006

Year 2017	19,996	-	-	19,996
Year 2018	48,423	-	-	48,423
2019 (until Oct 6th)	27,655	-	-	27,655
Total	**281,345**	-	-	**281,345**

Comparison of ERs in between actual ER achieved and ex-ante estimated values:

The monitoring period total Emission Reductions of 281,345 tCO_2 are lower than ex-ante ERs estimate of 51 074 tCO_2/y *(6+9/12+6/365) = 345,589 tCO_2, because the ex-ante estimate was based on a power generation of 82,000 MWh per year when actual performances were found lower due to hydrological conditions.