



Monitoring report form for CDM project activity
(Version 06.0)

MONITORING REPORT

Title of the project activity	Optimisation of Kiambere Hydro Power Project
UNFCCC reference number of the project activity	7783 ¹
Version number of the PDD applicable to this monitoring report	10
Version number of this monitoring report	01
Completion date of this monitoring report	19/02/2019
Monitoring period number	02 th (Second)
Duration of this monitoring period	01/07/2013 to 30/09/2018 (both days included)
Monitoring report number for this monitoring report	Not Applicable
Project participants	<ol style="list-style-type: none"> 1. Kenya - Kenya Electricity Generating Company Ltd. 2. Netherlands - International Bank for Reconstruction and Development as Trustee of the Community Development Carbon Fund (CDCF) ; Netherlands' Ministry of Infrastructure and the Environment (IenM) 3. Germany - BASF SE ; KfW 4. Belgium - Bruxelles Environnement - IBGE ; Walloon Region: Walloon Air and Climate Agency 5. Spain - Kingdom of Spain - Ministry of Agriculture, Food and Environment and Ministry of Economy and Competitiveness ; Endesa Generacion, S.A. ; Gas Natural SDG, S.A. ; Hidroelectrica del Cantabrico, S.A. 6. Japan - Daiwa Securities Co., Ltd. ; Fujifilm Corporation ; Idemitsu Kosan Co., Ltd. ; JX Nippon Oil & Energy Corporation ; The Okinawa Electric Power Co., Inc. 7. Austria - Kommunalkredit Public Consulting GmbH 8. Italy - Italian Ministry for the Environment Land and Sea 9. Luxembourg - Ministry of Sustainable Development and Infrastructure
Host Party	Kenya

¹ <https://cdm.unfccc.int/Projects/DB/DNV-CUK1350546075.48/view>

Sectoral scopes	1 : Energy industries (renewable / non-renewable sources)	
Applied methodologies and standardized baselines	ACM0002/Version 13 Consolidated baseline methodology for grid-connected electricity generation from renewable sources	
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	0 tCO ₂ e	145,793 tCO ₂ e
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	216,519 tCO ₂ e	

SECTION A. Description of project activity

A.1. General description of project activity

The objective of the Optimisation of Kiambere Hydro Power project is to rehabilitate the Kiambere Power Plant, including the upgrade of the turbines with new efficient runners at the Kiambere power plant. The old 2 x 72 MW turbines were replaced with new 2 x 84.5 MW turbines with efficient runners. Thus, the upgrade increased the plant's generation capacity by 25 MW from its original capacity of 144 MW to 169 MW. However, of this additional capacity, at present only 20 MW is the contracted capacity to be supplied to the Kenyan grid and hence restricting its generation capacity.

From 2003-2008, the previous 144 MW capacity supplied on average annual electricity amounting to 917.4 GWh to the Kenyan grid. The additional contracted capacity of 20 MW is to supply an estimated annual incremental power of 75.0 GWh to the Kenyan grid. Hence, with this additional contracted capacity, the total electricity supply to the grid from the Kiambere power plant is expected to be 992.4 GWh per year.

The project activity has operated continuously since the commissioning of the two units (exact commissioning dates for Unit 1 and 2 are 5/11/2009 and 29/3/2009 respectively).

The project activity results in greenhouse gas (GHG) emission reductions by displacing fossil fuel-dominated electricity generation in the Kenyan grid with clean hydropower.

The total emission reductions achieved in this current monitoring period is 145,793 tCO₂e.

A.2. Location of project activity

The project activity is located at Latitude 0° 38' 24" S (-0.6400) and Longitude 37° 54' 36" E (+37.9100). The Kiambere power station is the last of the five hydropower stations on the Tana River. The Kiambere Hydro Power Project is located, downstream of Kindaruma Power station, along the Tana cascade.

A.3. Parties and project participants

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Germany	BASF SE ; KfW	No
Belgium	Bruxelles Environnement - IBGE ; Walloon Region: Walloon Air and Climate Agency	No
Spain	Kingdom of Spain - Ministry of Agriculture, Food and Environment and Ministry of Economy and Competitiveness ; Endesa Generacion, S.A. ; Gas Natural SDG, S.A. ; Hidroelectrica del Cantabrico, S.A.	No
Japan	Daiwa Securities Co., Ltd. ; Fujifilm Corporation ; Idemitsu Kosan Co., Ltd. ; JX Nippon Oil & Energy Corporation ; The Okinawa Electric Power Co., Inc.	No
Austria	Kommunkredit Public Consulting GmbH	No
Italy	Government of Italy - Ministry for the Environment, Land and Sea	No
Luxembourg	Ministry of Sustainable Development and Infrastructure	No

A.4. Reference to applied methodologies and standardized baselines

Methodology used: Approved consolidated baseline and monitoring methodology ACM0002/Version 13.0: “Consolidated baseline methodology for grid-connected electricity generation from renewable sources”²

Sectoral Scope: 01, Energy industries (renewable - / non-renewable sources)

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

- Tool for the demonstration and assessment of additionality, Version 06.1.0³
- Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion, Version 02⁴
- Combined tool to identify the baseline scenario and demonstrate additionality, Version 04.0.0⁵
- For Build Margin Emission Factor “Tool to calculate emission factor for an electricity system”, Version 04.0⁶
- For Operation Margin Emission Factor, latest version of “Tool to calculate emission factor for an electricity system”, Version 7.0, EB 100, Annex 4⁷

² <http://cdm.unfccc.int/methodologies/DB/8W400U6E7LFHHYH2C4JR1RJWWO4PVN>

³ <http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v6.1.0.pdf>

⁴ <http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v2.pdf>

⁵ <http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-02-v4.0.0.pdf>

⁶ <http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v4.0.pdf>

⁷ <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v7.0.pdf>

A.5. Crediting period type and duration

Fixed crediting period of 10 years is chosen for project activity,
Crediting Period: 01/11/2012 – 31/10/2022

SECTION B. Implementation of project activity**B.1. Description of implemented project activity**

The Kiambere Project has an underground powerhouse that is situated 4 km away from the saddle dam where the intake structure is located. The water conveyance is by a 6 m diameter headrace. The previous 144 MW plant, consisted of 2 x 72 MW units, and supplied on average annual electricity of about 917.4 GWh to the Kenyan grid from 2003 to 2008. The Rehabilitation of the Power Plant, which included the upgrading of the turbines with new runners, has increased the plant's generation capacity by 25 MW in the Kiambere Power Station.

The details for the rehabilitation included the following:

- Replacement of the whole turbine with a more efficient, powerful and cavitations-free runner (installed capacity with new runner of 84.5 MW x 2 sets instead of existing 72 MW x 2 sets)
- Replacement of the head cover, guide vanes, bottom ring
- Installation of a new electronic governor and adoption to the existing hydraulic parts of governor
- Installation of new excitation system
- Installation of additional power cable to carry the extra power

Commissioning and plant performance

The project activity was implemented in one stage and the entire project was commissioned prior to achieving the CDM registration status and the commencement of the monitoring period.

- The Optimization of Kiambere Unit 1 was commissioned on 5/11/2009 while Unit 2 was commissioned on 29/3/2009.
- The entire project plant was commissioned prior to the start of the crediting period; therefore the full project capacity was available prior to commencement of the first monitoring period.
- The rated output of the power plant is in accordance with the project description in the PDD.

B.2. Post-registration changes**B.2.1. Temporary deviations from the registered monitoring plan, applied methodologies or standardized baselines**

No request for deviation has been applied from registered monitoring plan or applied methodology.

B.2.2. Corrections

No corrections have made to the registered monitoring plan or applied methodology.

B.2.3. Changes to the start date of the crediting period

Not Applicable, as there is no change of start date of crediting period

B.2.4. Inclusion of monitoring plan

Not Applicable

B.2.5. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other applied standards or tools

Not Applicable, as there are no Permanent changes to the registered monitoring plan applicable during the current monitoring period.

B.2.6. Changes to project design

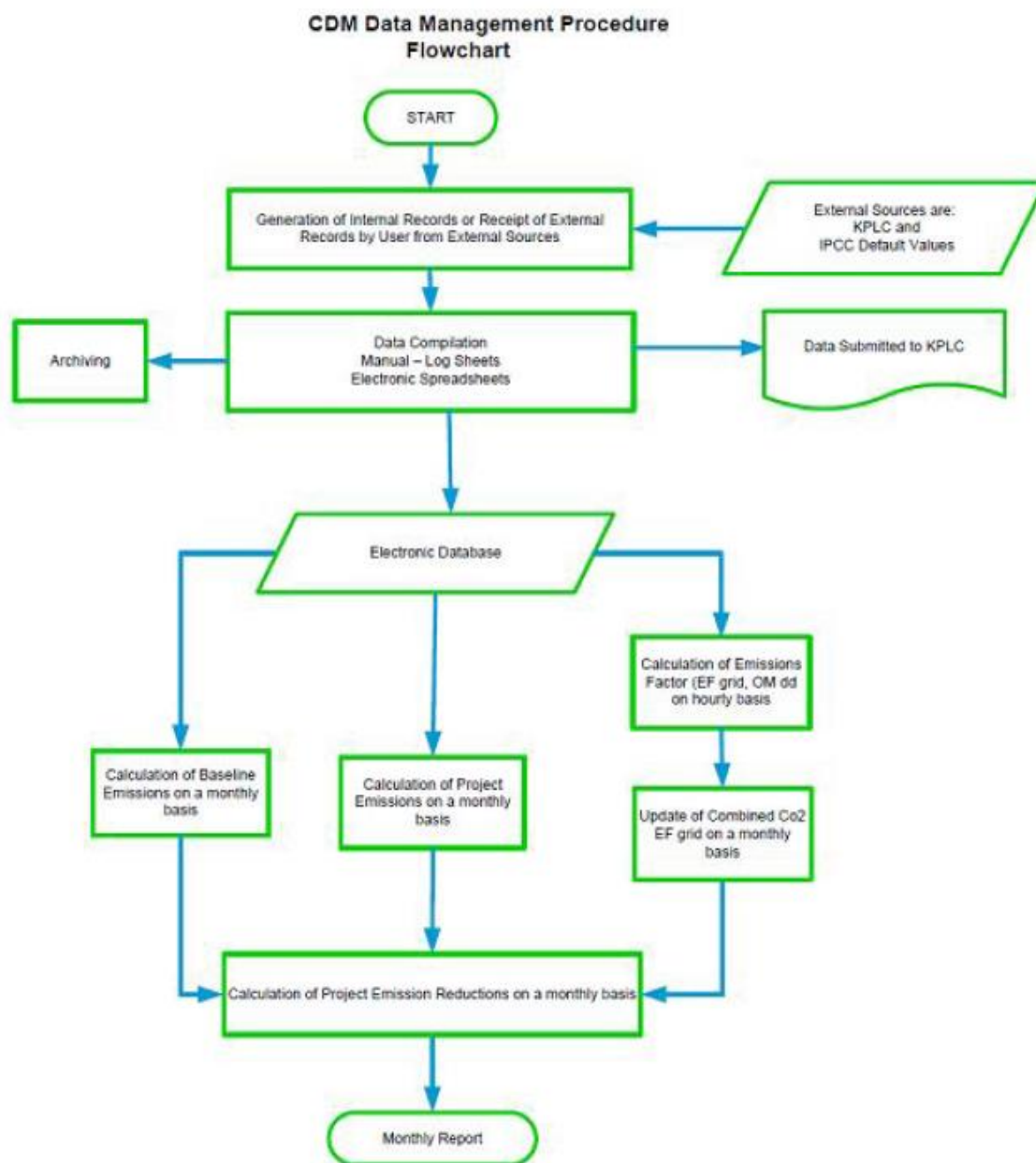
No changes have been made to the project design of registered project activity.

SECTION C. Description of monitoring system

Monitoring will take place from the registration date up to the end of the last crediting period. Since project emissions were not identified in this project activity, and since ACM0002/Version 13.0.0 does not consider emissions due to leakage, there will be no need to monitor the parameters for these cases.

KenGen has developed an elaborated monitoring procedure along with formats for data measurement, storage and equipment calibration. The monitoring methodology is developed to measure and monitor data for the Project.

All data collected as part of monitoring will be archived electronically and be kept at least for 2 years after the end of the last crediting period. KenGen is ISO 9001 certified for all their plants in Kenya and all measurements will be conducted with calibrated measurement equipment according to relevant industry standards. The Information / Process Flow is as below;



The monitoring system involves the monitoring of the following:

- i. Electricity generated and fed into the grid by the CDM project.
- ii. Public data on dispatch of electricity by all other power units connected to the Kenyan grid and other relevant information from Kenya Power Lighting Company (KPLC).

Calibration and Maintenance Procedures

KenGen has established calibration and maintenance procedures. The project's main monitoring equipment is the energy meters.

Monitoring and Data Collection Procedures

The procedures for dispatching, meter testing, reading and correcting inaccuracies, if observed are included in the PPA between KenGen and KPLC.

The monitoring occurs as follows:

- The quantity of electricity exported to the grid by the project activity is metered by KenGen and KPLC, and readings of meters are done jointly by the two. Readings are double checked by receipts of sales each month. In accordance with the approved methodology,

continuous measurement and monthly recording are done. Meters are subjected to a regular maintenance regime to ensure accuracy.

- Specific fuel consumption (and hence the amount of fossil fuel consumption) for each thermal power unit in the grid, for calculation of grid emission factor, is collected on a yearly basis from the Energy Regulatory Commission
- Net electricity generated and delivered to the grid by each power unit connected to the grid is measured and recorded. Readings of meters are done jointly by KPLC and KenGen, and crosschecked with receipts of sales. Meters are regularly maintained to ensure accuracy.
- CO₂ Combined Margin emission factor of the Kenyan grid are estimated based on KPLC hourly dispatch data, on specific fuel consumption (and hence the amount of fossil fuel consumption) for each thermal power unit in the grid and electricity delivered to grid by each power unit. Accuracy of data reporting by KPLC and KenGen is monitored through consistency in meter readings and sales receipts.

The recording of monitoring data occurs as follows:

- Data is recorded manually by the power plant operators and electronically by the SCADA system.
- Electricity meter readings are recorded hourly from the bulk energy meters onto log sheets and electronic spreadsheets each day. In addition, at the end of each month the total electricity exported to the grid is calculated in the SCADA system from the first and last meter reading for the month.
- The electricity data is summarized in a monthly report, which is checked and approved by each section's supervisor.

Monitored data required for verification and issuance of CERs is to be kept for two years after the end of the crediting period or the last issuance of CERs, whichever occurs later.

Procedures identified for Calibration of Monitoring equipment and its maintenance

Equipment maintenance procedures are followed by all staff involved in checking and maintaining all on-site meters.

- I. KenGen Senior Technician and Senior Engineer are responsible for calibration and maintenance of the energy meters, and ensuring that records are retained.
- II. The monitoring equipment were calibrated as per defined calibration frequency

Procedures identified for emergencies

Emergency procedures used in case main meter malfunctioning or failure is the use of back-up metering. The meter shall also be repaired, adjusted or replaced. Details of the procedures are documented in the PPA.

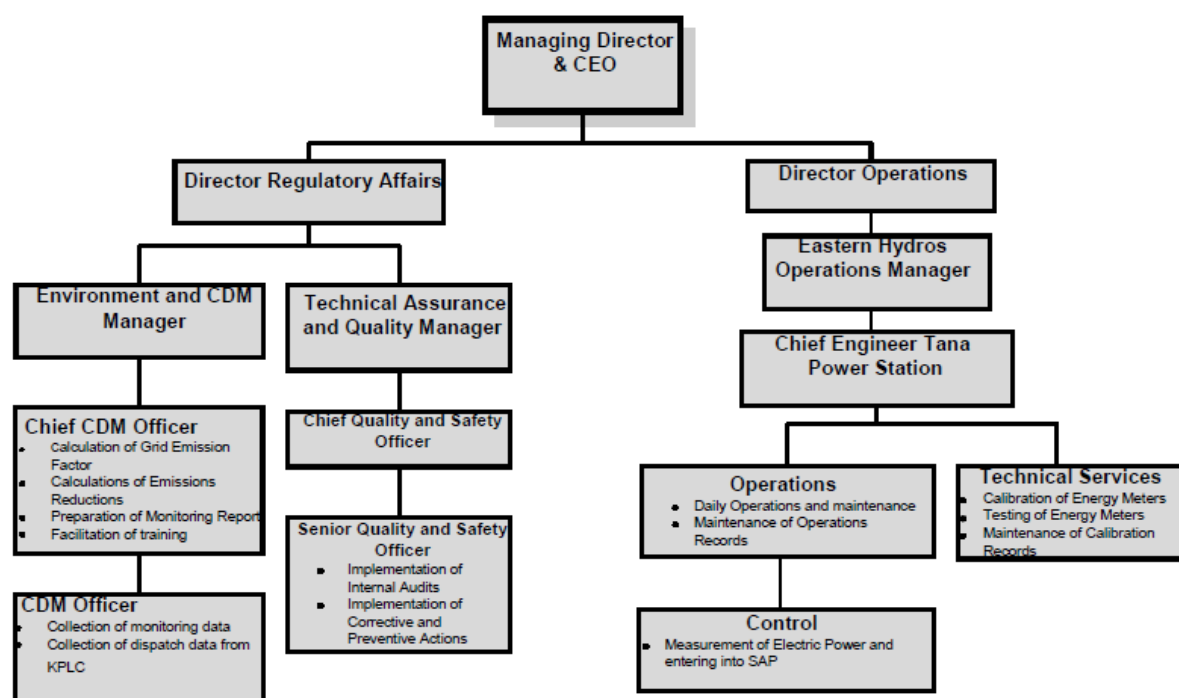
A draft procedure was identified for internal audits of GHG project compliance with operational requirements however no systematic GHG project compliance audit was undertaken, but regular data checks for accuracy were done.

Project training

A formal class room CDM training requirement has not been identified at present as a necessity to power plant operators instead focus was made on providing on-the-job training about CDM data requirements and associated guidance to the operators.

KenGen's Organizational Structure for Power Plant

The diagram below provides an overview of the general management structure of KenGen, as it directly affects the implementation of this CDM project.



The power plant operators are responsible for recording the daily logs of monitoring parameters. The daily log sheets and monthly reports are checked and signed by the section supervisor to ensure all data has been collated correctly.

Each section supervisor also ensures the maintenance and calibration of measurement equipment as scheduled.

The monthly, daily and quarterly reports are then submitted by each section supervisor to the Chief CDM Officer who prepares the monthly emission reduction calculations. The Chief CDM Officer also prepares the annual and quarterly monitoring reports, which are supervised by the Environment & CDM Manager. The annual monitoring report is archived to make it available for the external audit & verification purposes.

The Environment & CDM Manager ensures implementation of monitoring procedures laid down, and for ensuring that the emission reduction calculations and quarterly and annual monitoring reports are submitted.

Additionally, the specific monitoring and reporting tasks and responsibilities for all project operator staff involved in implementing the OMP are documented. The documents are accessible to all persons working on the project.

Table 3. Roles and responsibilities for implementing the CDM Project

Task and Area of Responsibility	Method Used	Frequency	Responsible person
Who operates the monitoring equipment?	Bulk energy meters used for measuring electricity	Half-hourly measurement of electricity	Chief Engineer
Who ensures the quality (e.g. calibration responsibilities etc) of the monitoring equipment?	Calibration of energy meters	Every 2 years	Senior Technician

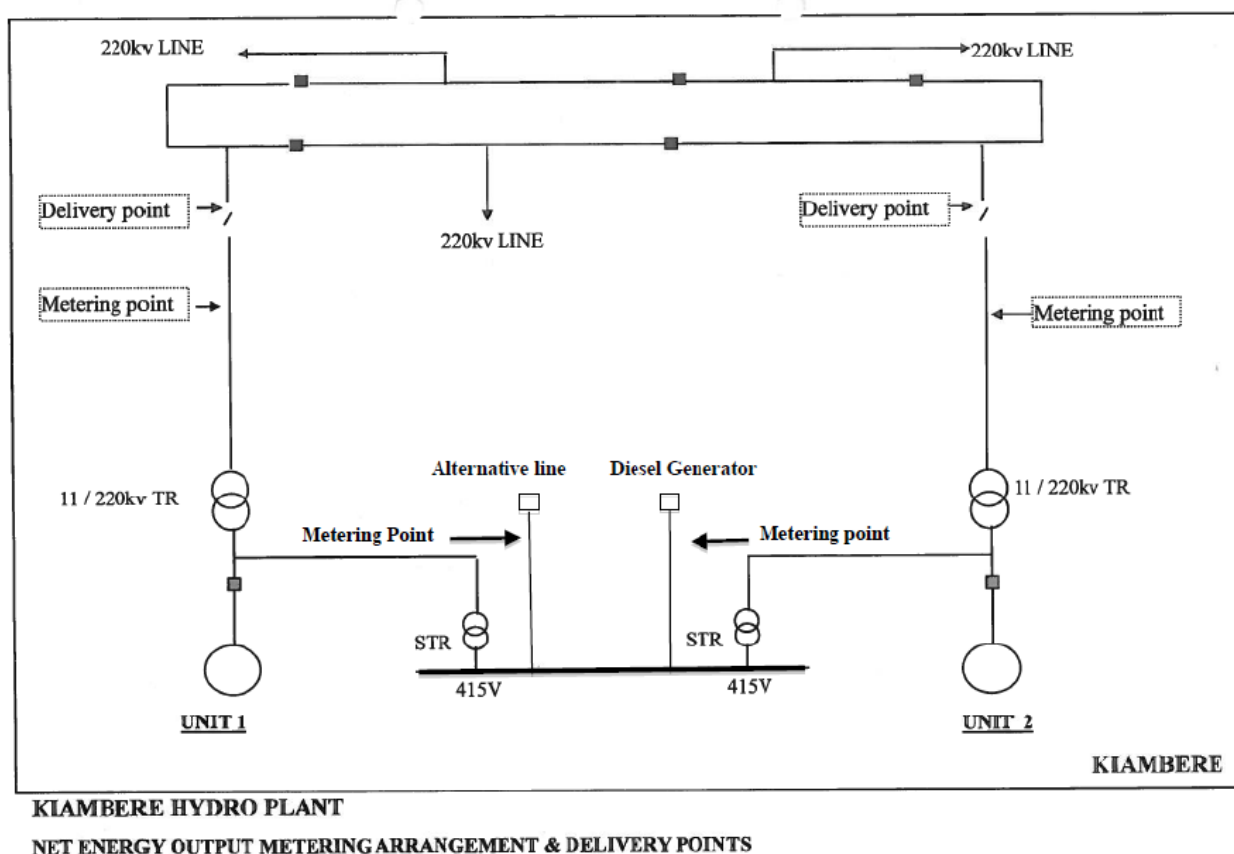
Who collects the required data (emission data, activity data,)?	Data is collected by operators and signed off by responsible persons as indicated in next column	Daily electricity data	Senior Technician
Who calculates the emission reductions and any deviations from projections?	Data is retrieved monthly from the compiled electronic data base. It is then put in the workbook for calculation.	Monthly	Chief CDM Officer
Who stores the data (measured calculated, estimated data)?	Operation data is entered onto an excel worksheet. While electricity data is entered into SAP database directly. Paper Log sheets are no longer in use here in Kiambere. External data from KPLC is compiled and archived into a database Copy of workbook with calculated emission reductions and monitoring report archived All records will be checked for completeness, before data and records are stored and archived electronically.	Half hourly Weekly Quarterly	Senior Technician CDM Officer CDM Officer
Who undertakes QA/QC?	To include CDM requirements in the current Internal Audit procedures	Half yearly	Senior Quality & Safety Officer
Who trains staff involved in the monitoring system?	Internal Training	At beginning of monitoring period	Environment and CDM Manager
Who signs off on monitoring reports and achieved ERs?	Signed off before submission for CDM Verification	As per monitoring period	Chief CDM Officer

KenGen has designated competent staff who will be in charge of, and accountable for, the generation of ERs – including ERPA supervision, monitoring, record keeping, computation of ERs, audits and verification.

In addition, KenGen ensures that internal training is made available to its operational staff, if needed, to enable them to undertake all the required tasks in executing the CDM project.

The monthly reports are then submitted to the CDM Officer who prepares the monthly emission reduction calculations and the quarterly monitoring report. The Environment & CDM Manager is responsible for ensuring that the emission reduction calculations and monitoring report are submitted.

The location of the energy metering points for Kiambere are shown in the diagram below. Single line schematic showing energy metering points for Kiambere power plant.



The energy meters involved in the project activity are as below

Meter name	Make/Type	Serial Number	Accuracy Class	Calibration dates	Calibration Due date
Main Meter (Unit 1)	ABB	G003083753	0.2s	15/03/2013	15/03/2015
				16/06/2015	16/06/2017
				15/06/2017	15/06/2019
				23/05/2018	23/05/2020
Main Meter (Unit 2)	ABB	G003083759		15/03/2013	15/03/2015
				16/06/2015	16/06/2017
				15/06/2017	15/06/2019
				23/05/2018	23/05/2020
Check Meter (Unit 1)	ABB	G003086151	0.2s	15/03/2013	15/03/2015
				16/06/2015	16/06/2017
				15/06/2017	15/06/2019
				23/05/2018	23/05/2020
Check Meter (Unit 2)	ABB	G003083737	0.2s	15/03/2013	15/03/2015
				16/06/2015	16/06/2017
				15/06/2017	15/06/2019
				23/05/2018	23/05/2020

Considering two years calibration frequency, there is delay in calibration from 15/03/2015 to 15/06/2015, and result of delayed calibration is within permissible limit, thus 0.2% error factor is applied for complete month of March 2015 to June 2015 conservatively.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

Data/Parameter	EG _{historical}
Unit	MWh/yr
Description	Annual average historical net electricity generation delivered to the grid by the existing facility that was operated at the project site prior to the implementation of the project activity
Source of data	KPLC (Kenya Power and Lighting Company Ltd.) and KenGen.
Value(s) applied	917,400
Choice of data or measurement methods and procedures	Historical data on electricity sold to the grid over the last five years, from 2003/04 to 2007/08, prior to the implementation of the project activity. Measurements were done using electricity meters. 2003/04: 1,010 GWh; 2004/05: 814 GWh; 2005/06: 852 GWh; 2006/07: 973 GWh; 2007/08: 938 GWh
Purpose of data/parameter	This data is used to Calculate of baseline emissions
Additional comments	This parameter is fixed as ex-ante for crediting period

Data/Parameter	σ historical
Unit	MWh/yr
Description	Standard deviation of the annual average historical net electricity generation delivered to the grid by the existing renewable energy plant that was operated at the project site prior to the implementation of the project activity
Source of data	Calculated from data used to establish EG _{historical}
Value(s) applied	82,248
Choice of data or measurement methods and procedures	Parameter is calculated as the standard deviation of the annual generation data used to calculate EG _{historical} for retrofit or replacement project activities
Purpose of data/parameter	This data is used to calculate baseline emissions
Additional comments	This parameter is fixed as ex-ante for crediting period

Data/Parameter	DATE _{BaselineRetrofit}
Unit	Date
Description	Point in time when the existing equipment would need to be replaced in the absence of the project activity
Source of data	KenGen
Value(s) applied	31/12/2022
Choice of data or measurement methods and procedures	As per provisions in ACM0002/Version 13.0.0. See Section B.6.1 of the PDD on Calculation of DATE _{BaselineRetrofit} for the existing Kiambere plant
Purpose of data/parameter	This data is used to calculate baseline emissions
Additional comments	This parameter is fixed as ex-ante for crediting period

Data/Parameter	$EF_{CO_2,n,i,y}$ and $EF_{CO_2,m,i,y}$
Unit	tCO ₂ /TJ
Description	Average CO ₂ emission factor of fossil fuel type <i>i</i> in power unit <i>m</i> or <i>n</i> in year <i>y</i>
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 1 of Vol. 2(Energy), Table 1.4, p.1.23
Value(s) applied	Automotive Gas Oil (AGO): 67.5; Diesel:72.6; Fuel Oil:75.5; and Kerosene: 70.8
Choice of data or measurement methods and procedures	Default data from IPCC has been used as Country specific data is not available
Purpose of data/parameter	Calculation baseline emissions
Additional comments	This parameter is fixed as ex-ante for crediting period. IPCC default values at the lower limit of the uncertainty at a 95% confidence interval

Data/Parameter	$NCV_{i,y}$
Unit	GJ/ton
Description	Net calorific value (energy content) of fossil fuel type <i>i</i> in year <i>y</i>
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 1 of Vol. 2(Energy), Table 1.2, p.1.18-1.19. of the PDD
Value(s) applied	Automotive Gas Oil (AGO): 42.5; Diesel: 41.4; Fuel Oil: 39.8; and Kerosene: 42.4
Choice of data or measurement methods and procedures	Default data from IPCC has been used as Country specific data is not available
Purpose of data/parameter	Calculation baseline emissions
Additional comments	This parameter is fixed as ex-ante for crediting period. IPCC default values at the lower limit of the uncertainty at a 95% confidence interval

Data/Parameter	$EF_{grid,BM,y}$
Unit	tCO ₂ /MWh
Description	Build Margin CO ₂ emission factor in year <i>y</i>
Source of data	KPLC Dispatch Centre and IPCC default factors
Value(s) applied	0.4665 tCO ₂ /MWh
Choice of data or measurement methods and procedures	Calculated using the latest version of the tool i.e Version 02.2.1 of "Tool to calculate the emission factor for an electricity system." at the time of registration
Purpose of data/parameter	Calculation baseline emissions
Additional comments	This parameter is fixed as ex-ante for crediting period

D.2. Data and parameters monitored

Data/Parameter	$EG_{facility,y}$
Unit	MWh
Description	Quantity of net electricity generation supplied by the project activity to the Kenyan Grid in year <i>y</i>

Measured/calculated/default	Calculated - $EG_{\text{facility},y}$ is calculated as the difference between (i) quantity of electricity supplied by the project plant/unit to the grid and quantity of electricity delivered to the project plant/unit from the grid
Source of data	KenGen
Value(s) of monitored parameter	4708,716.63 (Without application of error factor due to delay in calibration)
Monitoring equipment	Electricity is measured using meters that comply with industry standards in the country. Energy Meters (Main and backup/check meters) (see Section C of MR)
Measuring/reading/recording frequency	Measuring: Continuously Reading: Continuously Recording: data is aggregated hourly/monthly and yearly
Calculation method (if applicable)	-
QA/QC procedures	Measurements based on electricity meters cross-checked against sales receipts.
Purpose of data/parameter	Calculation baseline emissions
Additional comments	-

Data/Parameter	$EF_{\text{grid,OM-DD},y}$														
Unit	tCO ₂ e/MWh														
Description	Dispatch data analysis Operating Margin CO ₂ emission factor														
Measured/calculated/default	Calculated														
Source of data	KPLC Dispatch Centre, IPCC default factors and Specific fuel consumption of thermal plants from ERC guidelines														
Value(s) of monitored parameter	<table border="1"> <thead> <tr> <th>Year</th><th>$EF_{\text{grid,OM-DD},y}$</th></tr> </thead> <tbody> <tr><td>2013</td><td>0.6431</td></tr> <tr><td>2014</td><td>0.6269</td></tr> <tr><td>2015</td><td>0.6126</td></tr> <tr><td>2016</td><td>0.5947</td></tr> <tr><td>2017</td><td>0.6335</td></tr> <tr><td>2018</td><td>0.6220</td></tr> </tbody> </table>	Year	$EF_{\text{grid,OM-DD},y}$	2013	0.6431	2014	0.6269	2015	0.6126	2016	0.5947	2017	0.6335	2018	0.6220
Year	$EF_{\text{grid,OM-DD},y}$														
2013	0.6431														
2014	0.6269														
2015	0.6126														
2016	0.5947														
2017	0.6335														
2018	0.6220														
Monitoring equipment	Not Applicable														
Measuring/reading/recording frequency	Yearly														
Calculation method (if applicable)	Calculated using the latest version of the "Tool to calculate the emission factor for an electricity system."														
QA/QC procedures	Calculation is done after KPLC energy balance to ensure data validity														
Purpose of data/parameter	Calculation baseline emissions														
Additional comments	-														

Data/Parameter	$EG_{n,h}$ and $EG_{m,y}$
Unit	MWh
Description	Net electricity generated and delivered to the Kenyan grid by power plant/unit m in year y or n in hour h
Measured/calculated/default	Calculated
Source of data	KenGen and KPLC Dispatch Centre
Value(s) of monitored	Please refer excel sheet of GEF calculation for each year

parameter	
Monitoring equipment	Energy readings from the Dispatch Center
Measuring/reading/recording frequency	Hourly for Dispatch data OM; For BM, once ex-ante for the crediting period.
Calculation method (if applicable)	-
QA/QC procedures	Electricity supplied by the power units to the grid will be double checked by receipt of sales.
Purpose of data/parameter	Calculation baseline emissions
Additional comments	-

Data/Parameter	EG _{PJ,h}
Unit	MWh
Description	Electricity displaced by the project activity in hour h in year y
Measured/calculated/default	Measured
Source of data	KenGen and KPLC Dispatch Centre
Value(s) of monitored parameter	Please refer excel sheet of GEF calculation for each year
Monitoring equipment	Please refer meter details in section C of MR
Measuring/reading/recording frequency	Electricity displaced by the project activity measured every hour and recorded. Hourly measurement and monthly recording
Calculation method (if applicable)	-
QA/QC procedures	Total electricity displaced by the project activity double checked against sales receipts.
Purpose of data/parameter	Calculation baseline emissions
Additional comments	-

D.3. Implementation of sampling plan

Not Applicable

SECTION E. Calculation of emission reductions or net anthropogenic removals

E.1. Calculation of baseline emissions or baseline net removals

In accordance with ACM0002: "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (Version 13.0), the baseline emissions are calculated using the methods described in the registered PDD as follows:

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

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

EF_{grid,CM,y} : Combined margin CO₂ emission factor for grid-connected power generation in year y (tCO₂e/MWh)

Calculation of EG_{PJ,y}

EG_{PJ,y} is calculated using the following formula:

$$EG_{PJ,y} = EG_{facility,y} - (EG_{historical} + \sigma_{historical})$$

Where:

$EG_{facility,y}$: Total electricity generation from existing and added power units supplied to the grid in year y (MWh/yr)

$EG_{historical}$: Annual average historical net electricity generation delivered to the grid by the existing renewable energy plant that was operated at the project site prior to the implementation of the project activity (MWh/yr). This value is fixed ex-ante in the PDD to 917,400 MWh

$\sigma_{historical}$: Standard deviation of the annual average historical net electricity generation delivered to the grid by the existing renewable energy plant that was operated at the project site prior to the implementation of the project activity (MWh/yr). This value is fixed ex-ante in the PDD to 82,248 MWh

Since $EF_{CM,grid,y}$ varies from year to year due to change in $EF_{grid,OM-DD,y}$, the baseline emissions are calculated in ER spreadsheet.

For sample purpose, the baseline emission calculations for month of July 2013 has shown below.

The factor 12 is used below as $EG_{historical}$ and $\sigma_{historical}$ values are for year and calculations are done on monthly basis.

$$\begin{aligned} EG_{PJ,y} &= EG_{facility,y} - (EG_{historical} + \sigma_{historical})/12 \\ &= 101,245 - (917,400 + 82,248)/12 \\ &= 17,941 \text{ MWh} \end{aligned}$$

$$\begin{aligned} BE_y &= EG_{PJ,y} * EF_{grid,CM,y} \\ &= 17,941 \text{ MWh} * 0.5548 \text{ tCO}_2/\text{MWh} \\ &= 9,953.67 \text{ tCO}_2 \end{aligned}$$

Also for few months $EG_{facility,y}$ is lower than monthly constant factor $(EG_{historical} + \sigma_{historical})/12$, thus baseline emissions are coming negative. As per latest version of methodology ACM0002, such baseline emissions are considered as zero.

The total baseline emissions for complete monitoring period are 145,793 tCO₂. (Rounded Down)

E.2. Calculation of project emissions or actual net removals

Based on ACM0002/Version 13.0, the project emissions (PE_y) are equal to zero.

$$PE_y = 0 \text{ tCO}_2\text{e}$$

The project activity is a replacement of an existing hydropower plant and does not result in new reservoir or an increase of existing reservoir

E.3. Calculation of leakage emissions

In accordance with ACM0002/Version 13.0, no leakage emissions are considered for the project activity.

$$LE_y = 0 \text{ tCO}_2\text{e}$$

E.4. Calculation of emission reductions or net anthropogenic removals

	Baseline GHG emissions or	Project GHG emissions or actual net	Leakage GHG emissions	GHG emission reductions or net anthropogenic GHG removals (t CO ₂ e)
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				Before 01/01/2013	From 01/01/2013	Total amount
Total	145,793	0	0	0	145,793	145,793

E.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the registered PDD

Amount achieved during this monitoring period (t CO ₂ e)	Amount estimated ex ante (t CO ₂ e)
145,793	216,519

E.6. Remarks on increase in achieved emission reductions

The actual emission reductions are less than estimated due to low PLF and for few months $EG_{\text{facility},y}$ is lower than monthly constant factor $(EG_{\text{historical}} + \sigma_{\text{historical}})/12$. Thus no any further explanation is required here.

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Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
06.0	7 June 2017	Revision to: <ul style="list-style-type: none"> • Ensure consistency with version 01.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN); • Make editorial improvements.
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: <ul style="list-style-type: none"> • Include provisions related to delayed submission of a monitoring plan; • Provisions related to the Host Party; • Remove reference to programme of activities; • Overall editorial improvement.
04.0	25 June 2014	Revisions to: <ul style="list-style-type: none"> • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from <i>F-CDM-MR</i> to <i>CDM-MR-FORM</i>; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB 70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01.0	28 May 2010	EB 54, Annex 34. Initial adoption.
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