



Monitoring report form for CDM project activity
(Version 06.0)

MONITORING REPORT		
Title of the project activity	Kainji Hydropower Rehabilitation Project, Nigeria	
UNFCCC reference number of the project activity	7726	
Version number of the PDD applicable to this monitoring report	03	
Version number of this monitoring report	02	
Completion date of this monitoring report	31/01/2019	
Monitoring period number	01	
Duration of this monitoring period	01/01/2013 – 31/12/2017 (both days included)	
Monitoring report number for this monitoring report	n/a	
Project participants	<ul style="list-style-type: none"> • Mainstream Energy Solutions • Government of Sweden - Swedish Energy Agency • International Bank for Reconstruction and Development as Trustee of the Umbrella Carbon Facility Tranche 2 (UCFT2) • Electrabel SA • Enel Global Trading S.p.A. Statkraft Markets GmbH 	
Host Party	Nigeria	
Sectoral scopes	1 : Energy industries (renewable - / non-renewable sources)	
Applied methodologies and standardized baselines	ACM0002 ver. 12 - 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	2,651,087
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	4,336,017	

SECTION A. Description of project activity

A.1. General description of project activity

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The purpose of the project covers the rehabilitation of Units 5, 6 and 12 at the Kainji Hydropower Station. The result of the project is the enhanced harmonization of power production units, rehabilitated auxiliary services and priority units and upgraded dam safety equipment and practices, which are essential for reliable generation of electricity at the dam and a significant contribution to the easing of the Nigeria's power shortages.

The Kainji Hydropower Station, when it was fully commissioned, was equipped with 8 turbines (numbered 5 to 12) with a total installed capacity of 760 MW. Units 1-4 were not installed at commissioning but left as open bays with installed penstocks and other structural works. The first units of the Kainji Hydropower powerhouse were put into operation in 1968 (Unit 9 and Unit 7) and other units were added in 1969 (Unit 8 and Unit 10), 1975 (Unit 11), 1976 (unit 12) and 1978 (Unit 5 and Unit 6). The following table provides information on the power units at the Kainji Hydropower Station, including their installed capacity and the year of commissioning of each unit:

Units	Installed Capacity (MW)	Commissioning Date
Kainji Unit 5	120	1978
Kainji Unit 6	120	1978
Kainji Unit 7	80	1968
Kainji Unit 8	80	1969
Kainji Unit 9	80	1968
Kainji Unit 10	80	1969
Kainji Unit 11	100	1975
Kainji Unit 12	100	1976
Total	760	

Over time, the production of electricity at the Kainji Hydropower plant gradually declined since Unit 5 was taken out of service in November 2000 as a result of a runaway event that severely damaged the unit; and lack/shortage of replacement parts for all the other units.

The generators of the rehabilitated Units 5, 6 and 12 at the Kainji Hydropower Station have been replaced as a result of the project activity. Unit 5 and 6 have been installed with new Kaplan turbines. Installation of the new governors and excitation system have been carried out for units 5, 6 and 12 as well.

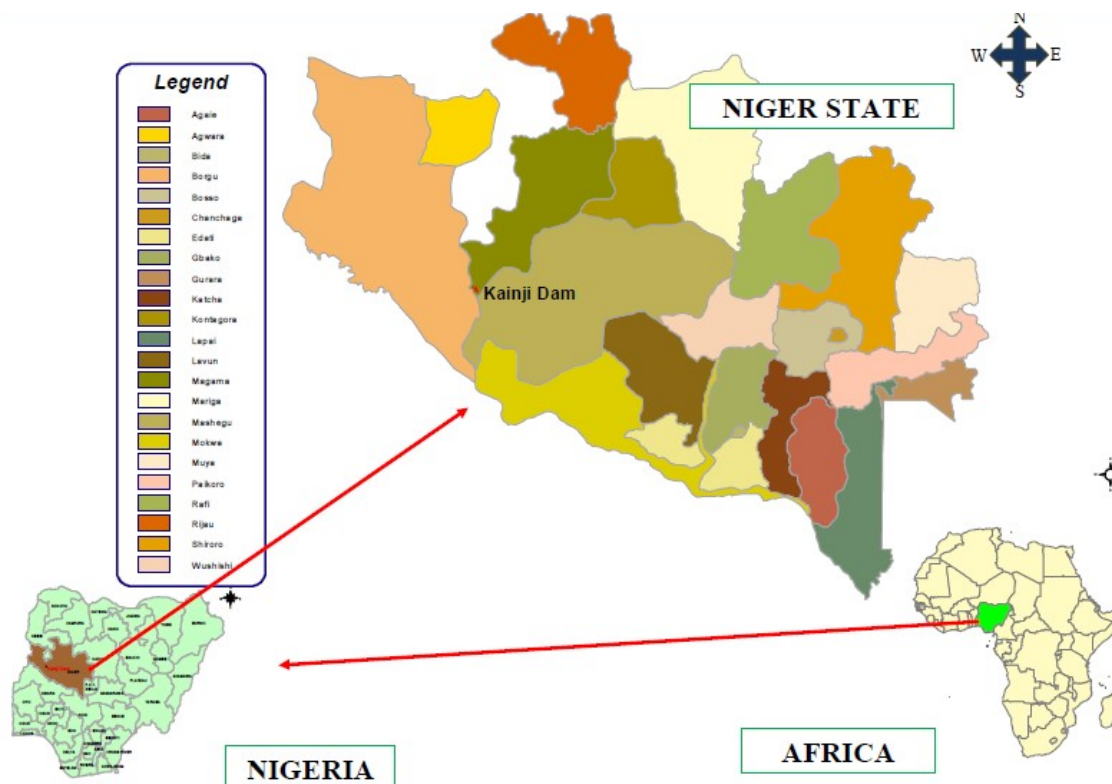
The baseline scenario is the same as the scenario existing prior to the start of the implementation of the project activity. The project activity enhances the availability of carbon free electricity generation from the hydro resources, thereby making generation from the revamped Kainji Hydropower plant displace some of the thermal capacities that would have hitherto been used to meet demand for electrical energy supplies from the grid. Reduced GHG emissions thus occur as a result of displacement of thermal generation by non-emission generation from the hydropower plant. In the absence of this project, GHG emissions occur from the combustion of fossil fuel, mainly natural gas.

The project activity achieved the reduction of 2,651,087 tCO₂ during this monitoring period covering from 01/01/2013 to 31/12/2017 (both days included)

A.2. Location of project activity

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The Kainji Hydropower Station is located on the Niger River, in Niger State, approximately 800 km upstream of the river delta which is located near Port Harcourt. The coordinates of the project are: Latitude: (+) 9.8625, Longitude: (+) 4.6133. The following map summarizes its location:

**A.3. Parties and project participants**

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Nigeria (host Party)	Mainstream Energy Solutions	No
Sweden	Government of Sweden - Swedish Energy Agency International Bank for Reconstruction and Development as Trustee of the Umbrella Carbon Facility Tranche 2 (UCFT2)	Yes
Belgium	Electrabel SA	No
Italy	Enel Global Trading S.p.A.	No
Germany	Statkraft Markets GmbH	No

A.4. Reference to applied methodologies and standardized baselines

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The applied baseline and monitoring methodology for the project is:

- ACM0002 ver. 12 - Consolidated baseline methodology for grid-connected electricity generation from renewable sources¹.

The applied methodology refers to the following tools:

- “Tool for the Demonstration and Assessment of Additionality” - Version 6.0.0².
- “Tool to calculate the emission factor for an electricity system” – Version 2.2.1³
- “Combined tool to identify the baseline scenario and demonstrate additionality” – Version 4.0.0⁴

A.5. Crediting period type and duration

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The crediting period (fixed duration of 10 years) of the project started on 01/01/2013 and will end on 31/12/2022.

¹<http://cdm.unfccc.int/methodologies/DB/VJI9AX539D9MLOPXN2AY9UR1N4IYGD>

² <https://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-01-v6.0.0.pdf>

³ <https://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-07-v2.2.1.pdf>

⁴ <https://cdm.unfccc.int/methodologies/PAMethodologies/tools/am-tool-02-v4.0.0.pdf>

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

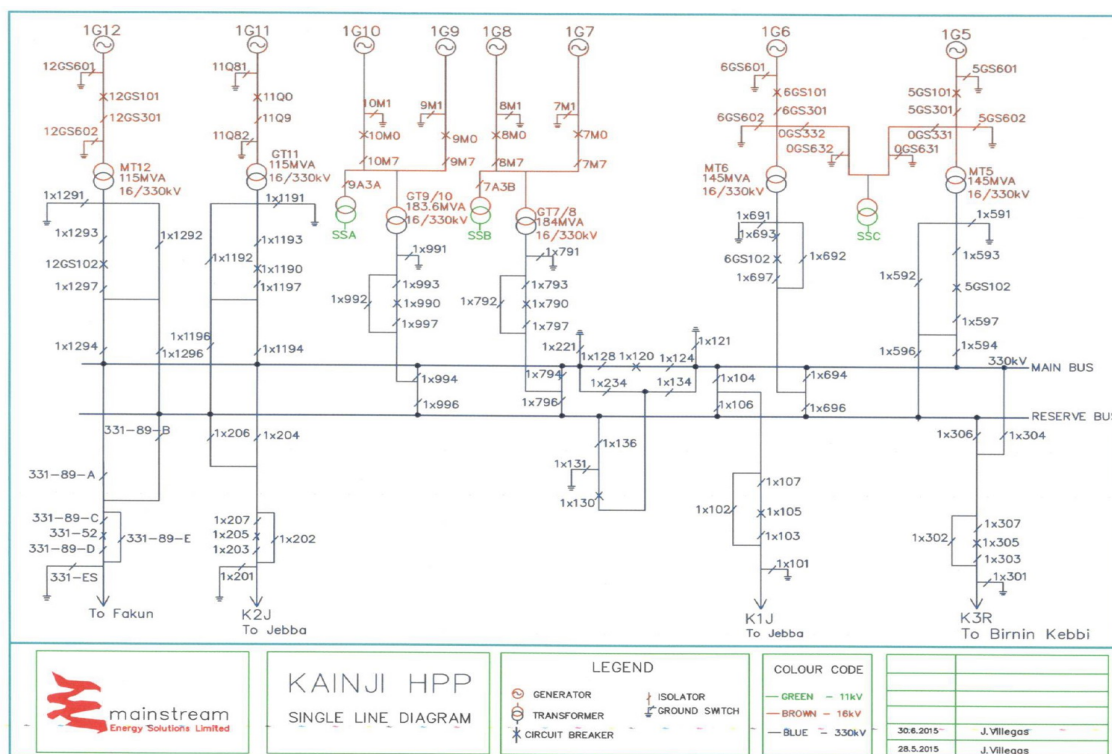
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The components in the rehabilitation of Units 5, 6 and 12 that have been implemented at the Kanji Hydropower site can be summarized as follows:

- **Rehabilitation and Harmonization of Productive Electromechanical Equipment:** Units 5, 6, and 12 have benefit from major rehabilitation and harmonization works, including:
 - Supply and installation of new Kaplan turbines for Units 5 and 6 (presently equipped with Francis propeller turbines) and rehabilitation of stationary and rotating parts for Unit 12;
 - Installation of new generators for all three units, and generator circuit breakers for unit 12;
 - Overhaul of draft tube gates and intake gates for all units;
 - Installation of the new governors and excitation system for units 5, 6 and 12;
- **Rehabilitation of Auxiliary Services:** Activities under this component have included:
 - Supply and installation of new unit control systems;
 - Supply and installation of new medium voltage (MV), LC circuit (LC) and Direct Current (DC) systems, a new diesel generator, new water supply and sewerage and new cooling, fire detection and compressed air systems;
 - Upgrading of the ventilation system;
 - Supply of dewatering and drainage pumps; and
 - Overhaul of cranes, the fire fighting system, and the oil storage distribution and treatment systems
- **Upgrading of Instrumentation and Monitoring Equipment:** Most of the equipment (turbines, rotating and stationary components, generators and generator circuit breakers, governors and excitation systems etc.) that have been used for this project are best available technologies imported into Nigeria and therefore meet the highest standards for environmental safe and sound technology. The rehabilitation project also includes special training for the operation of the new systems and equipment, thus ensuring adequate technology transfer for the sustainability of the facility.

The rehabilitation activity has been carried out in phases, including procurement, conception, ordering/supply and work/commissioning. According to the commissioning certificates, the generation unit 5, 6 and 12 were commissioned on 25/05/2015, 31/08/2015 and 13/05/2016, respectively.

The following line diagram summarizes the Kainji Hydropower plant installation, including the rehabilitation of Units 5, 6 and 12 as the proposed project activity:



B.2. Post-registration changes

B.2.1. Temporary deviations from the registered monitoring plan, applied methodologies or standardized baselines

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Not applicable. This section has been left in blank on purpose.

B.2.2. Corrections

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Not applicable. This section has been left in blank on purpose.

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

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Not applicable. This section has been left in blank on purpose.

B.2.4. Inclusion of monitoring plan

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Not applicable. This section has been left in blank on purpose.

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

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Not applicable. This section has been left in blank on purpose.

B.2.6. Changes to project design

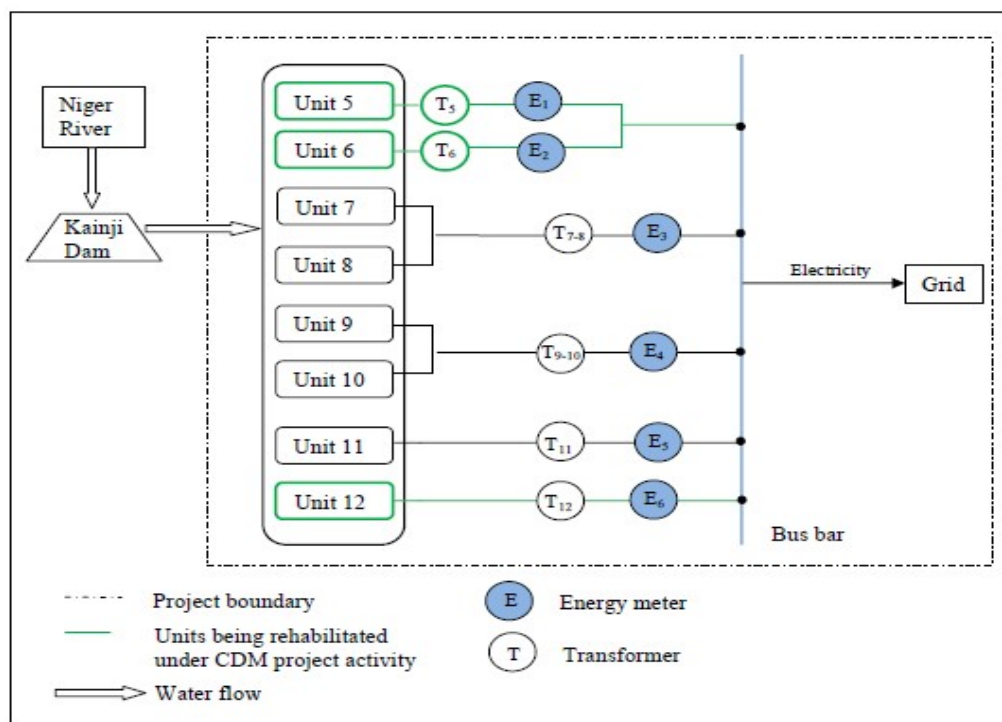
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Not applicable. This section has been left in blank on purpose.

SECTION C. Description of monitoring system

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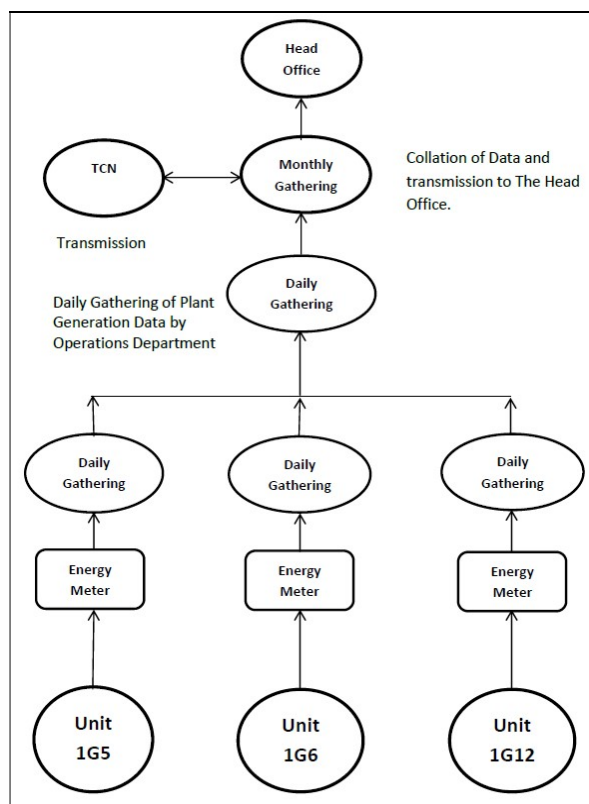
The monitoring system is composed by power meters (installed at Units 5, 6 and 12) which measure the quantity of net electricity generation supplied by the power plant to the grid. The following line diagram shows all relevant monitoring points of the project activity:



The following paragraphs describe the monitoring system:

- **Management Structure of CDM at Kainji Hydropower Station:** In order to meet the CDM monitoring and reporting requirements, a CDM Coordinating Team at the Kainji Hydropower Station has been put in place. The team is headed by Senior Personnel at the plant, who report directly to the Chief Executive Officer of the Power Station. The CDM Coordinating Team supervises the following activities:
 - Data collection and instrument calibration by Kainji Hydropower Plant's Technical Department;
 - Consolidation of results from various units (on a monthly basis) by the Production Department;
 - Preparation of emission reduction and monitoring reports for the purpose of verification by Kainji Hydropower Plant's Finance and Investment Department.
 - Ensures that the data has been collected as per the requirements of the PDD and they contain no errors.
- **Training of the personnel:** A training program has been developed for all personnel involved in proposed project activity. The site's manager ensures that only trained and skilled staff work in the project. The training program's content depends on the trainees' background who also receive comprehensive information on the general and technical aspects of the hydro power plant.
- **Monitoring Plan and Tasks:** The monitoring plan defines the process of gathering the data required for:
 - The preparation of the annual report on the monitoring of reductions in CO2 emissions attributable to the rehabilitation of the Kainji Hydroelectric Plant, which should be verified for the annual presentation of the CERs.
 - The collection of data related to environmental, social and economic impacts, in order to monitor the contribution to sustainable development.

The following diagram shows the data gathering system applied by the CDM Coordinating Team:



SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

Data/Parameter	GWP_{CH4}
Unit	-
Description	Global warming potential for methane
Source of data	IPCC
Value(s) applied	21
Choice of data or measurement methods and procedures	This value was adopted at the registration stage of the project activity.
Purpose of data/parameter	Not used
Additional comments	For the first commitment period of Kyoto Protocol, the GWP _{CH4} value 21 was adopted.

Data/Parameter	EG_{historical}
Unit	MWh/y
Description	Historical average electricity generation by Kanji generation facility (in the absence of the CDM project activity, the existing facility would continue to provide electricity to the grid at historical average levels)

Source of data	2002-2008 power generation data based on generation delivered to the grid by the existing renewable energy generation units that were operated at the project site prior to the implementation of the project activity, i.e. all publicly available data published by the National Control Center, PHCN, Osogbo, Nigeria.
Value(s) applied	2,584,473
Choice of data or measurement methods and procedures	Official and publicly available information.
Purpose of data/parameter	Baseline emission calculations in the registered PDD ex-ante
Additional comments	n/a

Data/Parameter	$\sigma_{\text{historical}}$
Unit	MWh/y
Description	Standard deviation of the annual average historical net electricity generation delivered to the grid by Kainji hydro power plant prior to the implementation of the project activity
Source of data	2002-2008 power generation data based on generation delivered to the grid by the existing renewable energy generation units that were operated at the project site prior to the implementation of the project activity, i.e. all publicly available data published by the National Control Center, PHCN, Osogbo, Nigeria.
Value(s) applied	268,997
Choice of data or measurement methods and procedures	Official and publicly available information.
Purpose of data/parameter	Baseline emission calculations in the registered PDD ex-ante
Additional comments	n/a

Data/Parameter	DATE _{baseline retrofit}
Unit	Date
Description	Baseline retrofit date (the time at which the hydro generation facility would probably be replaced or retrofitted in the absence of the CDM project activity)
Source of data	Technical assessment report by USACE TAT
Value(s) applied	01/01/2026
Choice of data or measurement methods and procedures	Official and publicly available information that determines the average technical lifetime of the type of equipment, taking into account common practices in the sector and country, based on industry surveys and official sources of information.
Purpose of data/parameter	Baseline emission calculations in the registered PDD ex-ante
Additional comments	n/a

Data/Parameter	DATE _{hist}
Unit	Date
Description	Point in time from which the time span of historical data for retrofit may start
Source of data	PHCN
Value(s) applied	2002

Choice of data or measurement methods and procedures	As per ACM0002-version 12.3, DATE _{hist} is chosen as the latest point in time between: (i) The commercial commissioning of the plant/unit (1968); (ii) If applicable: the last capacity addition to the plant/unit (N/A); or (iii) If applicable: the last retrofit of the plant (N/A) Year 2002 was chosen to allow a better reflection of the technical circumstances observed during the recent years as per the methodology.
Purpose of data/parameter	Baseline emission calculations in the registered PDD ex-ante
Additional comments	n/a

Data/Parameter	EF_{grid, CM, y}
Unit	tCO2/MWh
Description	Nigerian grid emission factor for year 2006-2008
Source of data	Ex-ante calculations by using the operating margin and build margin emission factors as per the "Tool to calculate the emission factor for an electricity system"- version 2.2.1
Value(s) applied	0.59
Choice of data or measurement methods and procedures	As per the "Tool to calculate the emission factor for an electricity system"- version 2.2.1
Purpose of data/parameter	Baseline emission calculations in the registered PDD ex-ante
Additional comments	n/a

D.2. Data and parameters monitored

Data/Parameter	EG_{facility,y}
Unit	MWh/yr
Description	Quantity of net electricity generation supplied by the power plant to the grid
Measured/calculated/default	Measured
Source of data	Power meters (installed at Units 5, 6 and 12) which measure the quantity of net electricity generation supplied by the power plant to the grid
Value(s) of monitored parameter	4,493,369.382 MWh

Monitoring equipment	<p>UNIT 5 MAIN METER: Meter Type: EDMl Mk6E Serial No.: 212372608 Accuracy class: 0.2 Calibration frequency: No calibration allowed to be conducted by the PP as per the Market Rules and Metering Market Procedure in Nigeria Installation: 25/05/2015 Date of last calibration: 25/05/2015 Status: operating</p> <p>UNIT 6 MAIN METER: Meter Type: EDMl Mk6E Serial No.: 212372442 Accuracy class: 0.2 Calibration frequency: No calibration allowed to be conducted by the PP as per the Market Rules and Metering Market Procedure in Nigeria Installation: 31/08/2015 Date of last calibration: 31/08/2015 Status: operating</p> <p>UNIT 12 MAIN METER: Meter Type EDMl Mk6E Serial No. 212372553 Accuracy class: 0.2 Calibration frequency: No calibration allowed to be conducted by the PP as per the Market Rules and Metering Market Procedure in Nigeria Installation: 13/05/2016 Date of last calibration: 13/05/2016 Status: operating</p>
Measuring/reading/recording frequency	Continuous
Calculation method (if applicable)	The energy meters record the energy exported and imported cumulatively and the reading is taken as the difference between the two.
QA/QC procedures	As per the Metering Code of Nigeria
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	n/a

D.3. Implementation of sampling plan

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Not applicable.

SECTION E. Calculation of emission reductions or net anthropogenic removals

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

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Baseline emissions are calculated with the following equation:

$$BE_y = EG_{\text{facility},y} * EF_{\text{grid},CM,y}$$

Where:

BE_y = Baseline Emissions (tCO₂e)

$EG_{\text{facility},y} = EG_{PJ,y}$ = Quantity of net electricity generation supplied by the power plant to the grid (MWh)⁵

$EF_{\text{grid},CM,y}$ = Baseline emission factor (tCO₂e/MWh) calculated ex-ante as per the "Tool to calculate the emission factor for an electricity system"- version 2.2.1.

The following table summarizes the results obtained for the baseline emissions during the monitoring period:

From	To	Ex Post	Ex Post	Ex Post	Ex Ante	BE _y
				EG _{facility,y}	EF _{grid,CM,y}	
		Gross electricity supplied to the grid (exported)	Electricity used from the grid (imported)	Quantity of net electricity generation supplied by the power plant to the grid	Combined margin emission factor	
		(MWh)	(MWh)	(MWh)	(tCO ₂ e/MWh)	
01/01/2013	31/12/2013	-	-	-	0.5900	-
01/01/2014	31/12/2014	-	-	-	0.5900	-
01/01/2015	31/12/2015	506,053.000	1,245.586	504,807.414	0.5900	297,836
01/01/2016	31/12/2016	1,891,554.000	4,348.600	1,887,205.400	0.5900	1,113,451
01/01/2017	31/12/2017	2,105,962.000	4,605.432	2,101,356.568	0.5900	1,239,800
01/01/2013	31/12/2015	4,503,569.000	10,199.618	4,493,369.382	0.5900	2,651,087

Baseline emissions for the monitoring period results in:

$$BE_y = 2,651,087 \text{ tCO}_2\text{e}$$

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

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As the project activity is a renewable power generation project, the project emissions are zero. Project emissions for the monitoring period results in:

$$PE_y = 0$$

E.3. Calculation of leakage emissions

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No leakage emissions are involved in the project.

⁵ Considering that the data for energy consumption available is for the whole plant (5 to 12 units) and there is data for the operation of each unit, the PP has divided the total energy consumption proportionally to the running hours of each unit considered by the project activity (unit 5, 6 and 12).

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

	Baseline GHG emissions or baseline net GHG removals (t CO ₂ e)	Project GHG emissions or actual net GHG removals (t CO ₂ e)	Leakage GHG emissions (t CO ₂ e)	GHG emission reductions or net anthropogenic GHG removals (t CO ₂ e)		
				Before 01/01/2013	From 01/01/2013	Total amount
Total	2,651,087	0	0	0	2,651,087	2,651,087

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)
2,651,087	4,336,017

E.6. Remarks on increase in achieved emission reductions

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The actual emission reductions achieved during the current monitoring period have been lower than expected in the registered CDM-PDD hence no remarks on increase is found to be necessary.

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.
Decision Class: Regulatory Document Type: Form Business Function: Issuance Keywords: monitoring report		