Monitoring report form for CDM programme of activities (Version 03.0)

Complete this form in accordance with the instructions attached at the end of this form.

MONITORING REPORT		
Title of the PoA	Tanzania Renewable Energy Programme	
UNFCCC reference number of the PoA	9904	
Version numbers of the PoA-DD applicable to this monitoring report	Version 8 dated 23/04/2014	
Version number of this monitoring report	04	
Completion date of this monitoring report	27/05/2020	
Monitoring period number	Third monitoring period	
Duration of this monitoring period	From 01/01/2018 to 31/12/2018 (first and last days included).	
Monitoring report number for this monitoring period	01 (for five CPAs in the PoA)	
Coordinating/managing entity	Rural Energy Agency (REA)	
Host Parties	Host Party of the PoA	Is this the host Party of a CPA covered in this monitoring report? (yes/no)
	United Republic of Tanzania	Yes
Applied methodologies and standardized baselines	• AMS I.D. Grid connected renewable electricity generation, Version 17, EB 61. • AMS I.F. Renewable electricity generation for captive use and mini-grid, Version 02, EB 61.	
Sectoral scopes	01 – Energy Industries (renewable/non-renewable sources)	
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by all CPAs covered in this monitoring report in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	0 tCO_{2e}	21,227 tCO_2e
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the CPA-DDs for the CPAs covered in this monitoring report	45,487 tCO_2e	

PART I Monitoring of programme of activities (PoA)

SECTION A. Description of PoA

A.1. General description of PoA

Tanzania has, over the years, strived to create an appropriate policy environment to attract private investments to the renewable energy generation sector. The National Energy Policy 2003 sets national energy objectives to ensure the availability of reliable and affordable energy supplies and to promote energy efficiency in order to support national development goals. The policy recognizes that, the main thrust should be private initiatives and investments for exploring the local energy sources. The policy sets an entirely new approach to modern energy in the rural areas of Tanzania and the government has committed itself to develop and implement the new strategy to address modern energy needs of over 85% of Tanzanians living in the rural areas.

For these reasons, the Rural Energy Board (REB), the Rural Energy Agency (REA) and the Rural Energy Fund (REF) were established and entrusted with the role of promoting, stimulating and facilitating improved access to modern energy services in the rural areas through empowering both public and private sector initiatives in the rural energy.

The main objective of this programme of activities (PoA) is to increase the access to modern energy services in Tanzania by promoting both off-grid (isolated mini-grid) and national grid renewable energy projects in the country using photovoltaic, wind, hydro and biomass technologies for electricity generation. The generated electricity from these renewable energy sources under the component project activities (CPAs) will replace the equivalent electricity, which would be otherwise generated using fossil fuels either in the national grid and/or in the isolated mini-grid, resulting in the emission reductions. The program also aims for further assisting the project developers to invest and implement renewable energy projects. It provides a platform for overcoming the institutional, financial and structural hurdles for the development of small scale renewable energy projects in Tanzania.

REA, under the Ministry of Energy and Minerals (MEM) of the United Republic of Tanzania, is the nodal agency to promote rural electrification projects in Tanzania. REA is responsible for implementing the PoA and acts as the coordinating and managing entity (CME).

REA, with the assistance from the World Bank, is supporting small rural and renewable energy initiatives through (i) an enabling policy and regulatory framework including standardized power purchase agreements (SPPA) and simplified regulatory rules, which reduce some of the transaction costs for the small renewable power projects, (ii) a subsidy scheme for new connections in rural areas (performance grants) and technical assistance/pre-investment support (matching grants) for the project developers and (iii) a line of credit (LOC) to the Tanzanian financial institutions for long-term lending to the small renewable energy projects.

As the CME for the registered small-scale PoA, REA performs the following main activities: (i) coordinating the implementation of the PoA, (ii) screening and accepting the CPAs under the program, (iii) supporting the effective commercialization of Certified Emission Reductions (CERs), (iv) liaising with the project developers for maintaining the required database for verification and (v) following up any other functions that need to be performed as per the PoA rules.

The CPAs are implemented by the project developers. Building on the existing relationship with the individual project developers, REA entered into a contractual agreement with each of the individual power projects (CPAs). The signed contracts give REA the legal rights to deal with the carbon credits that are generated from these projects, monitor the project implementation and all necessary parameters that are required for calculating the emission reductions from each CPA.

This is the third monitoring period of the PoA from 01/01/2018 to 31/12/2018 (first and last days included). The cumulative net electricity exported to the national grid and mini-grids

(Isolated/TANESCO) by five CPAs covered in this report during the monitoring period is 30,848 MWh. The CERs generated during this monitoring period is 21,227 tCO_2e.

A.1.1. Corresponding generic component project activities (CPAs)

Title and reference number of the corresponding generic CPA	Version of the PoA-DD	Sectoral scopes	Applied methodologies and standardized baselines
Renewable energy technology (hydro, wind, biomass or PV) connected to the national utility main grid avoiding generation from mix of fuels. Ref no: CPA category 01	Version 08 dated 23/04/2014	01 - Energy Industries (Renewable / Non-renewable sources)	AMS I.D. Grid connected renewable electricity generation, Version 17[1].
Renewable energy technology (hydro, wind, biomass or PV) connected to the existing or new isolated mini-grids replacing existing dedicated diesel based power generation Ref no: CPA category 02			AMS I.F. Renewable electricity generation for captive use and mini-grid, Version 02[2].
Renewable energy technology (hydro, wind, biomass or PV) supplies electricity to both the national grid and the existing or new isolated mini-grids. Ref no: CPA category 03			AMS I.D. Grid connected renewable electricity generation, Version 17. AND AMS I.F. Renewable electricity generation for captive use and mini-grid, Version 02.

A.1.2. CPAs included in the PoA

Title and UNFCCC reference number of the CPA	Version of the PoA-DD	Title and reference number of the corresponding generic CPA	Crediting period type and duration	Covered in this monitoring report? (yes/no)
Mapembasi hydro power project, Njombe district,	Version 08 dated 23/04/2014	Renewable energy technology (hydro, wind, biomass or PV) supplies electricity to both national grid and existing or new isolated mini-grids. Ref no: CPA category 03	Renewable crediting type, 01/01/2015 - 31/12/2021	No[3]

[1] https://cdm.unfccc.int/methodologies/DB/W3TINZ7KKWCK7L8WTXFQQOFQQH4SBK

[2] https://cdm.unfccc.int/methodologies/DB/9KJWQ1G0WEG6LKHX21MLPS8BQR7242

[3] Project is delayed.

Title and UNFCCC reference number of the CPA	Version of the PoA-DD	Title and reference number of the corresponding generic CPA	Crediting period type and duration	Covered in this monitoring report? (yes/no)
9904-P1-0001-CP1				
NextGen solar project, Kigoma region, 9904-P1-0002-CP1		Renewable energy technology (hydro, wind, biomass or PV) connected to existing or new isolated mini-grids replacing existing dedicated diesel based power generation Ref no: CPA category 02	Renewable crediting type, 04/06/2014 - 03/06/2021	No[4]
Mbinga hydroelectric project, 9904-P1-0003-CP1		Renewable energy technology (hydro, wind, biomass or PV) supplies electricity to both national grid and existing or new isolated mini-grids Ref no: CPA category 03	Renewable crediting type, 01/12/2015 - 30/11/2022	No[5]
Yovi small hydro power project, 9904-P1-0004-CP1		Renewable energy technology (hydro, wind, biomass or PV) supplies electricity to both national grid and existing or new isolated mini-grids. Ref no: CPA category 03	Renewable crediting type, 01/12/2015 - 30/11/2022	Yes
Tulila hydro-electric plant, 9904-P1-0005-CP1		Renewable energy technology (hydro, wind, biomass or PV) supplies electricity to both national grid and existing or new isolated mini-grids. Ref no: CPA category 03	Renewable crediting type, 01/12/2015 - 30/11/2022	Yes
Maguta small hydro power project, 9904-P1-0006-CP1		Renewable energy technology (hydro, wind, biomass or PV) supplies electricity to both national grid and existing or new isolated mini-grids. Ref no: CPA category 03	Renewable crediting type, 01/11/2016 - 31/10/2023	No[6]

[4] Project is delayed

[5] Project is reported in separate Monitoring Report 02

[6] Project is not yet commissioned

Title and UNFCCC reference number of the CPA	Version of the PoA-DD	Title and reference number of the corresponding generic CPA	Crediting period type and duration	Covered in this monitoring report? (yes/no)
Ngombeni biomass power plant project, 9904-P1-0007-CP1		Renewable energy technology (hydro, wind, biomass or PV) connected to existing or new isolated mini-grids replacing existing dedicated diesel based power generation Ref no: CPA category 02	Renewable crediting type, 01/09/2016 - 31/08/2023	Yes[7]
Ikondo micro hydro power plant, 9904-P1-0008-CP1		Renewable energy technology (hydro, wind, biomass or PV) supplies electricity to both national grid and existing or new isolated mini-grids. Ref no: CPA category 03	Renewable crediting type, 14/10/2016 - 13/10/2023	Yes
Darakuta mini hydro project, 9904-P1-0009-CP1		Renewable energy technology (hydro, wind, biomass or PV) connected to the national utility main grid avoiding generation from mix of fuels. Ref no: CPA category 01	Renewable crediting type, 12/12/2017- 11/12/2024	Yes
Mpanda Solar Photovoltaic Power Plant 9904–P1-0010-CP1		Renewable energy technology (hydro, wind, biomass or PV) connected to existing or new isolated mini-grids replacing existing dedicated diesel based power generation Ref no: CPA category 02	Renewable crediting type, 01/06/2020- 31/05/2027	Not applicable

A.2. Coordinating/managing entity

The coordinating/managing entity (CME) of the PoA is the “Rural Energy Agency (REA)”.

SECTION B. Implementation of PoA

B.1. Description of implemented PoA

Management system

The management system was developed in accordance with the “Standard for demonstration of additionality, development of eligibility criteria and application of multiple methodologies for programme of activities”, Version 3, EB74.

[7] Power plant is not in operation due to technical issues. So no CER is claimed from this CPA in this monitoring period.

REA is the PoA managing entity. The operational and management arrangements established by the REA for the implementation of the PoA are described below.

The operational and management structure provided information and data flow channel between the CME and the CPA implementer. At the CPA level, REA ensured the actual involvement of field personnel (power plant operators/technicians) in the monitoring, data collection and record keeping activities. REA requested each CPA to designate a CPA manager at the project developer head office and an engineer in-charge of the power plant operation. Figure 1 gives the implementation structure of the program.

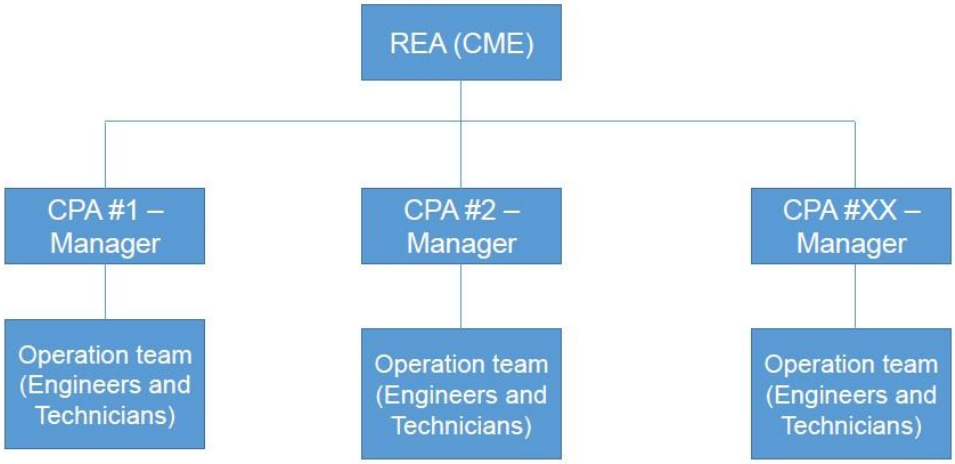

Figure 1. Operational and management structure

Operation and management plan

The operation and management plan is described below.

i) A record keeping system for each CPA under the PoA

A record keeping system was established by REA, which contained the following details providing the unique identity for each SSC-CPA. The details include, but not limited to:

- Name of the CPA.
- CPA number.
- Name of the CPA implementer.
- Contact details of the implementing entity (Address/Contact person/Phone/e-mail/fax).
- Location of the CPA (e.g., GPS coordinates of the power house and the water intake for a hydro power plant).
- Type of renewable energy source.
- Installed capacity of the CPA.
- The record on technical specification of each renewable energy plant participating in the PoA.
- Type and name of the grid (national grid, TANESCO mini-grid, existing isolated grid, new isolated grid) fed by the project.
- Gross electricity generation.
- Net electricity generation and electricity sales.
- Meter calibration.
- Commissioning date.

Two databases were developed by REA for record keeping – one at the CPA level and the other at the PoA level.

At the CPA level, the CPA implementer was responsible for managing the records and the data associated with each SSC-CPA. They maintained a proper electronic database for these records. A

hard copy backup of all these records was also made available. In case of failure in the electronic data transfer system, manually recorded project details at the site were collected and compiled, which was sent to REA. The record keeping was carried out using the field instruments, hardware and software installed in every project site and/or manual data recording in the log book. The recorded data was submitted to REA, which was responsible to archive the data as per the individual CPA.

At the PoA level, REA managed and maintained a record of complete database on all CPAs and the entire PoA. REA cross-checked the data from all the CPAs to ensure completeness, accuracy and consistency. The PoA level database was obtained from the CPA level database after REA's own review work.

Paper and electronic records will be kept during the entire crediting period for each CPA and for additional two years after the crediting period.

ii) Records of arrangements for training and capacity development for personnel

REA was responsible for keeping the record on training and capacity development activities provided to the relevant personnel. The record includes:

- Date, time and venue of each training and capacity development event
- Participants record for each event
- Agenda for each training and capacity development event
- Manuals and training materials for each training and capacity development event

All relevant project staff were trained in various aspects of the CPA operation and management. Operators also pursued on-site training.

iii) Measures for continuous improvements of the PoA management system

The Project Manager of the PoA organized a meeting with all his/her staff and CPA personnel to review the performance of the PoA management system to identify issues to be addressed and to obtain continuous improvements of the PoA management system.

B.2. Post-registration changes to PoA

B.2.1. Corrections

Not applicable.

B.2.2. Inclusion of monitoring plan

Not applicable

B.2.3. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents

Not applicable

B.2.4. Changes to programme design

Not applicable.

B.2.5. Changes specific to afforestation or reforestation activities

Not applicable.

PART II Monitoring of CPAs

Though the CPAs are categorized as 01, 02 and 03 based on the type of power export (grid or mini-grid or both), there is not much difference in their operation, monitoring and reporting of estimated CERs. So all the CPAs reported in this MR are clubbed under one group and reported in Part II of this MR.

This report is prepared as monitoring report number 01 for five CPAs (Yovi, Tulila, Ngombeni, Ikondo and Darakuta) under the PoA[8]. All the five CPAs covered in this monitoring report were commissioned and out of these, only four CPAs (Yovi, Tulila, Ikondo and Darakuta) were in operation during this monitoring period from 01/01/2018 to 31/12/2018 (first and last days included). Due to technical issues, the Ngombeni biomass power plant CPA was not in operation during this entire monitoring period.

SECTION C. Implementation of CPAs

C.1. Description of implemented CPAs

Currently the PoA has included ten CPAs, out of which four CPAs are not yet implemented. Table 1 provides the details of the five CPAs considered in this report. Out these, one CPA (Ngombeni biomass power plant project) could not generate any power during the monitoring period due to technical issues and hence no CER is claimed from that CPA.

Table 1. CPAs of the PoA covered in this monitoring period

CPA reference no.	CPA name[9]	Registered / Included[10]	Total capacity (MW)	Project implementer
9904-P1-0004-CP1	Yovi small hydro power project	06/11/2015	2.3	Yovi Hydro Power Company Limited
9904-P1-0005-CP1	Tulila hydroelectric plant	06/11/2015	7.5	Tulila Hydroelectric Plant Company Limited
9904-P1-0007-CP1	Ngombeni biomass power plant project	11/08/2016	2.5	Ngombeni Power Limited
9904-P1-0008-CP1	Ikondo micro hydro power plant	14/10/2016	0.430	Matembwe Village Company Limited
9904-P1-0009-CP1	Darakuta mini hydro project	12/12/2017	1.075	Darakuta Hydropower Development Company Limited

Table 2 provides the major milestones during the project implementation of five CPAs.

[8] One CPA (Mbinga) will be reported separately in the monitoring report number 02

[9] For simplicity, in this monitoring report, these CPAs are shortly referred to as Yovi, Tulila, Ngombeni, Ikondo and Darakuta respectively.

[10] https://cdm.unfccc.int/ProgrammeOfActivities/poa_db/DEI4JOVUTN7A0936CP1WLMSGYB58ZF/viewCPAs

Table 2. Milestone for the CPAs

Description	Yovi	Tulila	Ngombeni	Ikondo	Darakuta
CPA start date	19/07/2012	11/10/2013	31/01/2012	19/12/2013	04/03/2015
CPA inclusion date	06/11/2015	06/11/2015	11/08/2016	14/10/2016	12/12/2017
Start date of the first crediting period	01/12/2015	01/12/2015	01/09/2016	14/10/2016	12/12/2017
Commissioning date	06/11/2015[11]	12/09/2015[12]	27/01/2014[13]	26/01/2016[14]	19/04/2016[15]

Technical description of the CPA

Yovi:

This CPA supplies power to the TANESCO grid and the isolated mini-grid and comes under CPA category 03.

Yovi CPA is a run-of-the-river hydroelectric power plant with a capacity of 2.3 MW (1 MW + 1.3 MW) installed in two phases. In the first phase, a 1 MW Pelton turbine was installed and 33 kV transmission line was constructed to supply electricity to the national grid. In the next phase, additional 1.3 MW Pelton turbine will be installed later. Also, an isolated mini-grid network will be developed.

The hydropower plant utilizes a natural head in the Yovi river. The powerhouse is constructed in a flat area at an elevation of 867 m height above mean sea level (AMSL) near the right bank of the river and is a one floor building with a pitched roof, that lodge the Pelton turbines and all the related electrical and mechanical equipment. Table 3 provides the main features of the 2.3 MW hydro power plant.

Table 3. Specification of 2.3 MW hydro power plant

Parameter	Value
Water level at the diversion weir (minimum)	1,225.01 m above mean sea level (AMSL)
Water level in the fore bay	1,224.30 m AMSL
Powerhouse elevation	867.00 m AMSL
Tail water level	864.48 m AMSL
Head	357.30 m
Plant flow	360 l/s – 520 l/s

[11] Yovi-TANESCO interconnection report dated 26/11/2015

[12] Date as per TANESCO interconnection certificate

[13] Ngombeni-TANESCO interconnection report dated 04/02/2014

[14] Provisional acceptance certificate

[15] Date as per TANESCO interconnection certificate

Parameter	Value
Mean flow	360 l/s – 520 l/s
Installed capacity	2.3 MW
Penstock diameter	600 mm
Penstock length	1,725 m
Expected generation	15.1GWh/y

Table 4 provides the technical specification of installed 1 MW hydro power plant (first phase).

Table 4. Specification of installed power plant for phase 1

Turbine	Type	Horizontal Pelton Turbine
	Rated speed	1,000 rpm
	Rated capacity	995 kW
Generator	Frequency	50 Hz
	Rated voltage	3,000 V
	Rated capacity	1,800 kVA
	Power factor	0.8 PF

Tulila:

This CPA supplies power to the national grid and the isolated mini-grid and comes under CPA category 03.

The CPA is a run-of-the-river hydroelectric power plant with an installed capacity of 7.5 MW (5 MW + 2.5 MW) in two phases. The power plant uses the natural base slope of the Ruvuma river at Tulila. It is constructed as a run-of-the-river hydroelectric power plant with earth fill dam and a weir system to divert the water to the power plant and utilize the naturally available high head. The surface area of the reservoir created by permanent impoundment is about 74,000 m^2. Water depth at the intake is 7.5 m, which results in a total gross head of around 22.5 m.

The plant design consists of headworks including weirs, dams and intake, the tailworks, electromechanical machines and the powerhouse equipped with governors, transformers, medium voltage switchgear, indoor crane, drainage and dewatering system, control, monitoring and communication systems and an emergency power unit.

The whole weir system including dam and intake structure is constructed. The powerhouse will be equipped with three equisized turbines and is located at about 190 m downstream of the intake structure. It is connected to the intake structure by three separate penstocks in staggered diameters 2.3 / 2.5 m each. Due to the short distance, a surge shaft is not necessary. The water after passing through the turbines is diverted back to the Ruvuma river by a 100 m long tailrace channel. An existing branch of the river can be used for this purpose.

In phase 1, two turbine-generator units (2 x 2.5 MW) and two penstocks were installed. From 01/01/2018 to 17/09/2018, the power plant supplied power to the Songea mini-grid network. On 18/09/2018, the Songea mini-grid was connected to the TANESCO national grid through the interconnection of Makambako – Songea 132 kV transmission line. Thereafter, from 18/09/2018 to 31/12/2018, the power plant supplied power to the TANESCO national grid.

In phase 2, third identical turbine-generator unit and a penstock will be installed and will be connected to the national grid as well through the same interconnection of Makambako – Songea 132 kV transmission line. Table 5 provides the main features of the Tulila power plant.

Table 5. Technical specification of power plant.

Parameter	Value
Turbine specifications	
Turbine type	Kaplan, axial flow with vertical axis
Rated output	2,581 kW (3 units: 2 in phase 1 and 1 in phase2)
Rated speed	375 rpm
Rated efficiency	92%
Generator specifications	
Generator type	Synchronous
Generator capacity	3.044 MVA (3 units; 2 in phase 1 and 1 in phase 2)
Power factor	0.8
Generation voltage	6.6 kV
Efficiency	96%

Ngombeni:

This CPA supplies power to the TANESCO mini-grid and comes under CPA category 02. The plant was not in operation during the reported monitoring period due to technical issues with the power plant boiler.

Ngombeni CPA is a 2.5 MW biomass power project, which covers an area of about 7,000 acres of land in Mafia Island. The area is comprised of sawmill, log yard, workshop, one office building and two staff houses nearby. The project is designed to use various biomass such as coconut palm tree wastes, different species of trees, bushes, etc., which are readily available as the main feed stock for electricity generation. The feed stock in general is derived from the discarded section of the coconut palm, trees, bushes, off-cuts, etc.

The feed stock from the chipper machine passes through the fire box in the boiler, which is burnt to generate heat. The heat generated boils the water in the boiler to produce steam at a pressure of 27–30 bar and at 280-300 ˚C. The produced steam is then introduced into the turbine and is converted into mechanical energy through expansion in steam turbine. The mechanical energy rotates the generator, which in turn produces desired electric power. Table 6 provides the main features of the Ngombeni power plant.

Table 6. Technical specification of power plant

Parameter	Value
Boiler capacity	10 ton/hr
Turbine capacity	2,500 kW
Generator capacity	3,125 kVA
Plant load factor	0.8
Expected electricity generation	15,023 MWh/y

Ikondo:

This CPA supplies power to both the national grid and the isolated mini-grid and comes under the CPA category 03.

Ikondo CPA is a run-of-the-river hydroelectric power plant with an installed capacity of 430 kW (80 kW + 350 kW), where water is diverted from Kyepa River and channeled through a 300 m long concrete lined canal into the head tank, which has been located at the hill enabling the water to move downwards to the 22 m penstock effortlessly. The total amount of power generated in the hydroelectric power plant depends on the height of head tank and the amount of water flowing through the penstock. The flow from the penstock is forced into the turbine and the electricity is produced in the generator. At the end of the process, the utilized water from the power plant is normally released through a tailrace channel back into the Kyepa River.

The generated electricity is supplied to the national grid and to the isolated mini-grid. The generated power is directed into the step-up transformer and fed into the distribution grid of Medium Voltage (MV) Lines.

Only the 350 kW unit is considered for CDM purpose. It is a capacity addition to the existing 80 kW unit. As per registered CPA DD, it was assumed that 350 and 80 kW units will be connected to single energy meter before power off-take. But there are synchronisation issues in connecting 350 kW and 80 kW to the same export point. Therefore, 80 kW unit is still not connected to 350 kW unit energy meter. So electricity export recorded in 350 kW unit energy meter is from this unit alone. The same is used for CER estimations. Table 7 provides the main technical features of the Ikondo power plant.

Table 7. Technical specification of power plant

Parameter	Value
Penstock material	Steel
Penstock diameter	32 inches
Turbine type	Francis
Shaft orientation	Vertical
Speed	500 rpm
Net head	17 m
Maximum flow rate	2.3 m^3/s

Parameter	Value
Mechanical power	350 kW
Minimum global efficiency at 80% of the flow rate	92%
Nominal electrical power	450 kVA
Power factor	0.85
Excitation	Brushless

Darakuta:

This CPA supplies power to the national grid and comes under the CPA category 01.

The CPA consists of a run-of-the-river power plant with installed capacity of 1 MW (320 kW + 680 kW) installed in two phases and supplies power to the national grid. The CPA implementer has been operating an existing 75 kW micro hydro power plant (not a CDM project and not covered under this PoA) which continues to supply power primarily for internal consumption of the ranch.

The water flow from the Kou river down the rift valley had scope for generating additional power. Hence, the CPA implementer planned to construct an additional 1 MW hydro power plant in two phases for supplying electricity to the TANESCO national grid. The phase 1 of 320 kW (160 kW +160 kW) was installed in April 2016 and is currently in operation. The remaining 680 kW is planned in phase 2, which is yet to be installed. These additional power plants have been planned as the CDM project units under this CPA. It is to be noted that 320 kW hydro power plant (phase 1) and the existing 75 kW hydro power plant are located within the same power house. The 680 kW unit will be housed in a different location. Table 8 provides the main technical features of the Darakuta power plant.

Table 8. Technical specification of power plant.

No.	Parameter	Value
Turbine specification		
1	Number of units	2
2	Make	KSB
3	Type	Pump turbine
4	Rated capacity (kW)	160
5	Rated speed (RPM)	1,500
Generator specification		
1	Number of units	2
2	Make	Siemens
3	Frequency (Hz)	50

No.	Parameter	Value
4	Rated voltage (V)	400
5	Rated capacity (kVA)	184
6	Power factor (P.F)	0.87
7	Rated capacity (kW)	160

Net GHG emission reduction:

Out of five CPAs included in this monitoring report, four CPAs operated normally during the monitoring period without any special events or situations, which may impact the applicability of the methodology. One CPA (CPA 07) was not in operation at all due to technical issues.

Table 9 gives the net emission reduction achieved in each CPA during this monitoring period.

Table 9. Net emission reduction of each CPA

No.	CPA	Actual net emission reduction achieved (tCO_2e)
1	Yovi	3,468
2	Tulila	16,985
3	Ngombeni	0
4	Ikondo	67
5	Darakuta	707
	Total	**21,227**

It is also confirmed here that the power plant electricity export readings for each month are metered and the meter values are supported by monthly invoices for each CPA. Hence, the double counting of power generation and emission reduction is avoided.

C.2. Location of CPAs

Detail	Yovi	Tulila	Ngombeni	Ikondo	Darakuta
Host party	United Republic of Tanzania				
Region / State / Province, etc.	Morogoro	Ruvuma	Pwani	Njombe	Manyara
City / Town / Community, etc.	Msolwa village, Kilosa district	Mpepai – Tulila village, Mbinga / Songea district	Ngombeni, Dundani, Minaki, Chunguruma, RasMbisi Estates	Ikondo village, Njombe district	Darakuta ranch, Babati district

			Village, Mafia district		
Geographical reference of project site					
Latitude (°S)	7.1934	11.0947	7.6555	9.0754	3.9675
Longitude (°E)	36.7141	35.2769	39.6608	35.2330	35.6292

Figure 2 provides the location maps of the respective CPAs.

Figure 2. Location map of the reported CPAs

C.3. Post-registration changes to CPAs

C.3.1. Temporary deviations from the monitoring plans in the included CPA-DDs, applied methodologies, standardized baselines or other methodological regulatory documents

Darakuta CPA:

As per the registered CPA DD, the existing 75 kW power plant at project site will be connecting to the TANESCO grid along with the proposed 320 kW project power plant. The monitoring plan

required a separate energy meter to be installed on the existing 75 kW power plant to monitor its power generation and deduct it from the total power exported to the grid from the project site.

But during whole reported monitoring period (01/01/2018 to 31/12/2018), the existing 75 kW unit was used for internal consumption of the ranch and was not yet connected to the grid. Therefore, the project developer did not install a separate meter for this existing power plant. Only the project power plant of 320 kW was supplied power to the grid. This is a temporary deviation from the registered monitoring plan.

For the ER calculation, the maximum power from the existing 75 kW unit ($EG_{actual,y}$ / $EG_{BL,Existing,y,\ grid}$) will be estimated and deducted from the power supplied to grid by 320 kW project power plant. This is conservative on following basis:

- Existing 75 kW unit is not yet connected to grid, but still expected maximum power is deducted from total power exported to grid from site, assuming that it would have contributed to grid export in case it was connected the grid.

- Maximum power export from the existing 75 kW unit is calculated as plant capacity (kW) times the total annual hours (365 x 24 hours). This is conservative as the plant capacity factor (around 45% for small hydro plants) is not taken into consideration at all.

- Even in case it was connected to grid, some portion of power from 75 kW unit would have been used for internal purpose (which is its main purpose). But for the ER calculation, all of these maximum power is deducted from total power export to the grid from the site.

Ikondo CPA

The Ikondo CPA was designed to supply power to both the national grid and the isolated mini-grid. The energy meter installed at the national grid export point was properly calibrated as per the requirement for this monitoring period. However, the energy meters at the distribution point of minigrid was not calibrated after end of its validity, i.e., the energy meters at the distribution point of the mini-grid was calibrated on 12/01/2017 and only valid up to 12/01/2018 (refer Table 15 in section D of this MR). Hence, for conservativeness, the emission reductions due to the electricity exported to the mini-grid was assumed as zero during this monitoring period (refer section F.1 of this MR).

C.3.2. Corrections

Ngombeni CPA:

As per included CPA DD, the parameter “Moisture content ($MC_{biomass}$)” was fixed ex-ante. It is now made as the monitoring parameter under “section B.5.1.Data and parameters to be monitored” of the CPA. Values of different biomass fuels were provided. In cases where a lab test of sampling is not possible (due to several project barriers) for any biomass type, provision is added to use the value from standard international sources for that particular biomass type.

Similarly, the net calorific value (NCV) for different types of biomass used in the plant is provided for the parameter “$NCV_{Biomass}$” in “section B.5.1.Data and parameters to be monitored” of the CPA. In cases where a lab test of sampling is not possible (due to several project barriers) for any biomass type, provision is added to use the value from standard international sources for that particular biomass type.

The change comes under option 2 (a) “Corrections that have been notified to the secretariat as applicable from the period prior to this monitoring period” as provided in the guidelines in updating the MR. The revised CPA DD, version 06 dated 14/07/2018 was approved by EB on 21/08/2018.

C.3.3. Changes to the start date of the crediting period

Not applicable

C.3.4. Inclusion of monitoring plan

Not applicable

C.3.5. Permanent changes to the included monitoring plans, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents

Not applicable

C.3.6. Changes to project design

Yovi CPA:

Yovi CPA was registered under category 02 – power supply to TANESCO mini-grid. However, during actual implementation, the power is supplied to TANESCO national grid and isolated mini-grid. A post registration change (PRC) request was submitted for this aspect as part of verification process. The revised Yovi CPA DD version 05 dated 31/01/2018 was approved by the EB on 31/01/2019.

The change comes under option 2 (a) “Changes that have been notified to the secretariat as applicable from the period prior to this monitoring period” as provided in the guidelines in updating the MR.

C.3.7. Changes specific to afforestation or reforestation CPA

Not applicable

SECTION D. Description of monitoring system of CPAs

The monitoring plan of the PoA is consistent with the methodology AMS-I.D (version 17) and AMS-I.F (Version 02). The monitoring structure and plan for a SSC-CPA is an integrated part of the management and monitoring plan of the PoA as described in section C and section B.7.2 (Part II) of the PoA.

The management system is developed in accordance with the “Standard for demonstration of additionality, development of eligibility criteria and application of multiple methodologies for programme of activities”.

Various parameters with respect to the project category were monitored in the power plants. Various data used for the estimation of emission reduction were also monitored. The data are archived electronically and will be stored for additional 2 years after the end of the crediting period of the CPA. REA as the CME, has supervised the implementation of the monitoring plan. REA also ensured that all the relevant staff of the CPAs as well as their own personnel are trained adequately in this task.

To ensure that the data is reliable and transparent, the CME also established quality assurance and quality control (QA & QC) measures to effectively control and manage the data reading, recording, auditing as well as archiving data and all relevant documents.

Project Category

Category 1 - Power projects connected to grid
Category 2 - Power projects connected to mini-grid
Category 3 - Power projects connected to both grid and mini-grid

Monitored parameters

Table 10 provides the parameters to be monitored by each CPA.

Table 10. Parameters to be monitored for each CPA

Parameter	Yovi	Tulila	Ngombeni	Ikondo	Darakuta
Net electricity generation supplied to the national grid	√	√		√	√
Net electricity supplied to the mini-grids	√	√	√	√	
Quantityof biomass consumed in a year			√		
Net calorific value of the biomass			√		
Moisture content of the biomass			√		

The above parameters were monitored by the plant operators at their project site and were entered in the data sheets.

Monitoring procedure

The gross electricity generation, if possible (for CPA that energy meters are installed just after generation) and the quantity of net electricity supplied to the grid were continuously measured using the energy meters with a maximum rated error of 0.5% as mandated by Energy and Water Utilities Regulatory Authority (EWURA).

Cumulative measurements were entered into an electronic database at the end of each month. Any problems observed in the monitoring equipment were also captured. The CPA implementers produced the reports containing the monthly monitoring data files and details of any equipment faults and/or loss of data. The reports were submitted to the CME and project participants for review and acceptance. All records will be retained for at least two years after the end of the crediting period.

The following measures were taken relating to the monitoring equipment owned by the CPA implementer, its installation and operation.

- All meters are designed and manufactured to the accepted standards (Regulatory standards shall be followed for each electricity meter). Each CPA shall provide all information regarding the metering devices including accuracy class and calibration frequency required, at least annually.

- All monitoring equipment should be located in secure locations free from the possibility of accidental damage.

- Routine maintenance and calibration of all monitoring equipment will be performed in accordance with the utility standards, regular standards or the manufacturer’s specification, whenever applicable, to ensure that the data remains accurate.

When all the generated electricity was delivered to the national grid, then the emission reductions (ER) were calculated based on the amount of electricity measured by the buyer. The project records were used primarily for cross-checking and secondarily for ER calculation in case, the buyer could not measure the purchased electricity. In all the cases, the agreed amount of electricity used for billing purpose was the main base for ER calculation.

Table 11 provides the technical details of the power meters installed at Yovi power plant.

Table 11. Technical details of the power meters installed at the grid export point in Yovi

Parameter	Main meter	Check meter
Model	EDMI Mk 6N	EDMI Mk 6N
Type	Bi-directional	Bi-directional
Accuracy	0.5s	0.5s
Serial No.	208304008	208302546
First calibration date	06/11/2015	06/11/2015
Second calibration date	03/03/2017	03/03/2017
Third calibration	24/02/2018	24/02/2018

Figure 3 depicts the metering point of Yovi CPA.

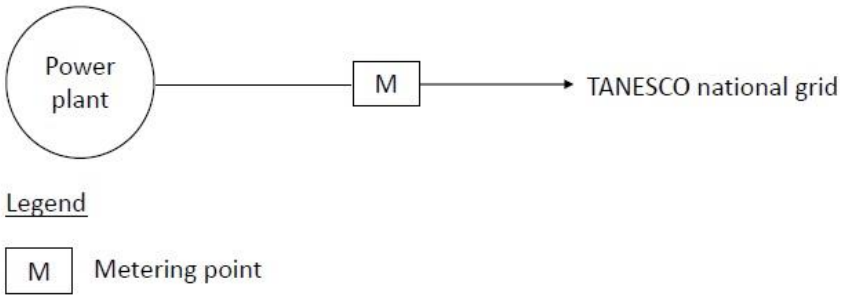

Figure 3: Metering points for Yovi CPA

The Tulila power plant supplied energy to the TANESCO mini-grid from 01/01/2018 to 17/09/2018. However, due to the establishment of TANESCO national grid, the existing TANESCO mini grid was connected with the national grid. Hence, the CPA supplies power to TANESCO national grid from 18/09/2018 at the same metering point, where TANESCO minigrid is connected. Table 12 gives the technical details of power meters installed in the Tulila power plant.

Table 12. Technical details of the power meters installed at the export point in Tulila

Parameter	Main meter	Check meter
Model	EDMI Mk10E	EDMI Mk 10E
Type	Bi-directional	Bi-directional
Accuracy	0.5s	0.5s
Serial No.	211112553	211112571
First calibration date	12/09/2015	12/09/2015

Parameter	Main meter	Check meter
Second calibration date	03/03/2017	03/03/2017
Third calibration date	28/02/2018	28/02/2018

Figure 4 depicts the metering points of the Tulila CPA supplying power to mini-grid and national grid.

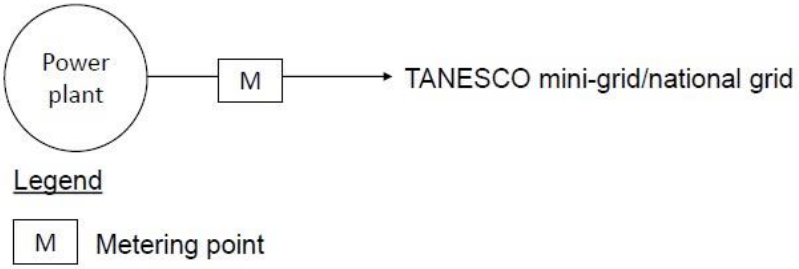

Figure 4: Metering points for Tulila CPA

Table 13 provides the technical details of the installed power meter at Ngombeni power plant.

Table 13. Technical details of the power meters installed at the mini-grid export point in Ngombeni

Parameter	Main meter	Check meter
Model	EDMI Mk 10E	EDMI Mk 10E
Type	Bi-directional	Bi-directional
Accuracy	0.5S	0.5S
Serial number	211108280	211108294
First calibration date	27/01/2014	27/01/2014
Second calibration date	03/03/2017	03/03/2017
Third calibration date	Plant not in operation	

Figure 5 depicts the metering points of the Ngombeni power plant

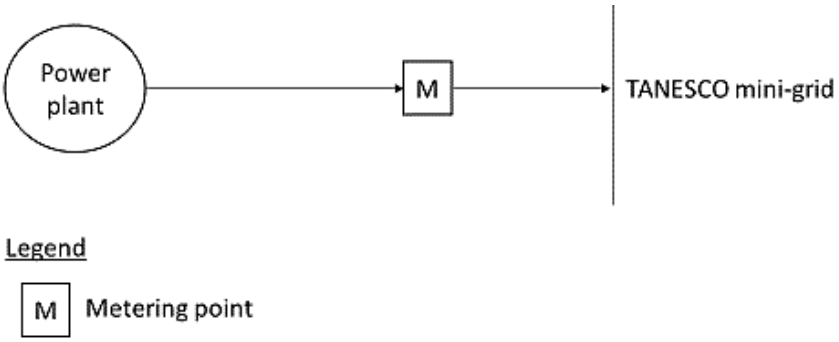

Figure 5. Metering points for Ngombeni CPA

Table 14 provides the technical details of the Ikondo power meter connected to the national grid.

Table 14. Technical details of the power meters installed at the grid export point in Ikondo

Parameter	Main meter	Check meter
Model	EDMI Mk 10E	EDMI Mk 10E
Type	Bi-directional	Bi-directional
Accuracy	0.5s	0.5s
Serial No.	212556509	212556508
First calibration date	11/11/2016	11/11/2016
Second calibration date	03/03/2017	03/03/2017
Third calibration date	18/03/2018	18/03/2018

In Ikondo, for supplying electricity to the isolated minigrid, the metering points are installed at the distribution point of the mini-grid itself (refer figure 6). Table 15 provides the technical details of the Ikondo power meters connected to the distribution points of the minigrid. No calibration of these meters was done after its first calibration dated 12/01/2017, which was valid until 12/01/2018. Hence, for conservativeness, the emission reductions due to the electricity exported to the mini-grid was assumed as zero during this monitoring period.

Table 15. Technical details of the power meters installed at the distribution point of the minigrid in Ikondo

Location name	Serial No.	First calibration date
Igumbilo	07-010631	12/01/2017
Matembwe HQ	2015-0513598	12/01/2017
Lung'angali	800153	12/01/2017
Matembwe mission	800175	12/01/2017
CEFA HQ Ikondo	2015-051356A	12/01/2017
Ikondoofisini	800235	12/01/2017
Ukalawa	800199	12/01/2017
Nyave	25094292	12/01/2017
Isoliwaya	800200	12/01/2017
Kanikelele (Igoga)	800041	12/01/2017
Kanikelele (ofisini)	27349792	12/01/2017
Uheni	900064	12/01/2017
Mulunga	800182	12/01/2017
Mkondoa	750085	12/01/2017
Manyunyu	800198	12/01/2017

Figure 6 depicts the metering point for Ikondo CPA.

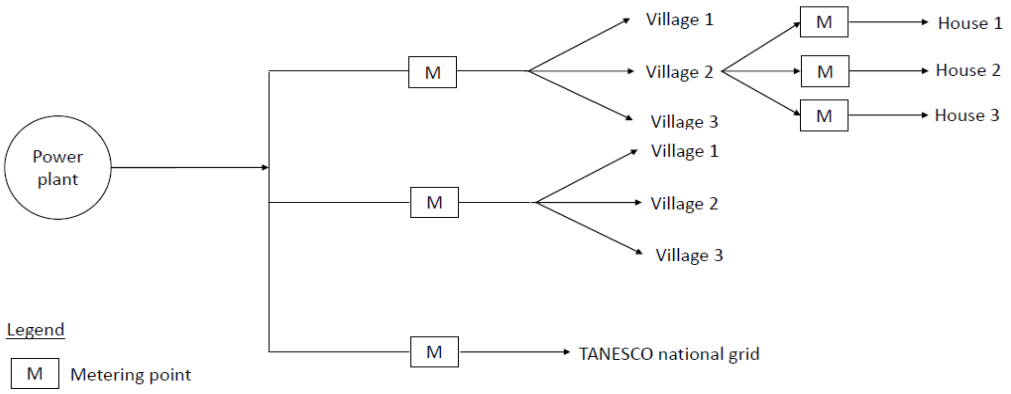

Figure 6. Metering points for Ikondo CPA

Table16 provides the technical details of the power meters installed at Darakuta power plant

Table 16. Technical details of the power meters installed at the grid export point in Darakuta

Parameter	Main meter	Check meter
Model	EDMI Mk 10E	EDMI Mk 10E
Type	Bi-directional	Bi-directional
Accuracy	0.5s	0.5s
Serial No.	215281802	215281805
First calibration date	03/03/2017	03/03/2017
Second calibration date	28/02/2018	28/02/2018

Figure 7 depicts the metering points of Darakuta CPA.

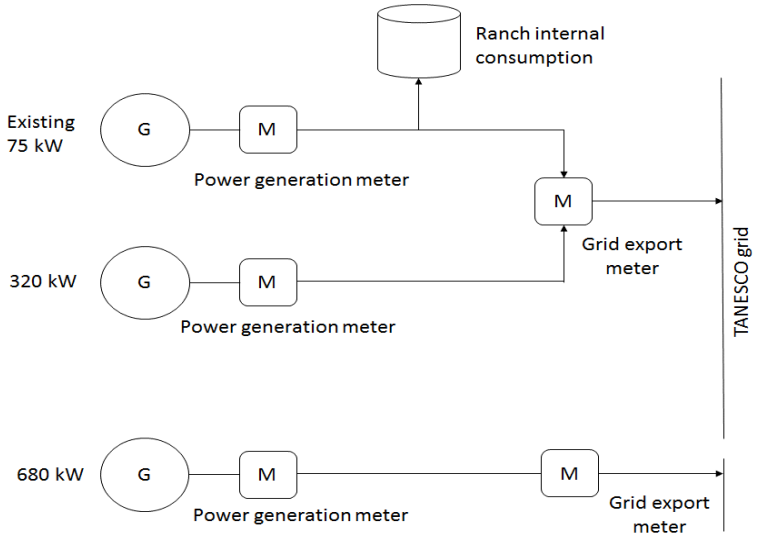

Figure 7. Metering points for Darakuta CPA

During the reported monitoring period, the existing 75 kW unit was not yet connected to the grid. Therefore, no metering was done for 75 kW unit as of now, as mentioned in the figure 7. Metering

was done only for 320 kW unit. A temporary deviation from the monitoring plan is considered for this and conservative actions are taken in ER calculation. Please refer section C.3.1.

Quality assurance (QA) and quality control (QC)

QA & QC procedures for recording, maintaining and archiving data were implemented as a part of this CDM project activity. The CPA owner implemented QA & QC measures to calibrate and guarantee the accuracy of metering (for meters under his responsibility) and safety of the project operation.

Data collection, reporting, archiving and preparation for periodic verification

Data was recorded daily by the plant operator and any data outages were recorded in an operational log and reported to the plant engineer. The plant engineer at each project site has prepared a report consisting of the above parameters in electronic format. The soft copy of data as well as the electronic report, were forwarded to the CPA Manager, who manages the database for CPAs in line with the CDM requirements under the supervision of REA.

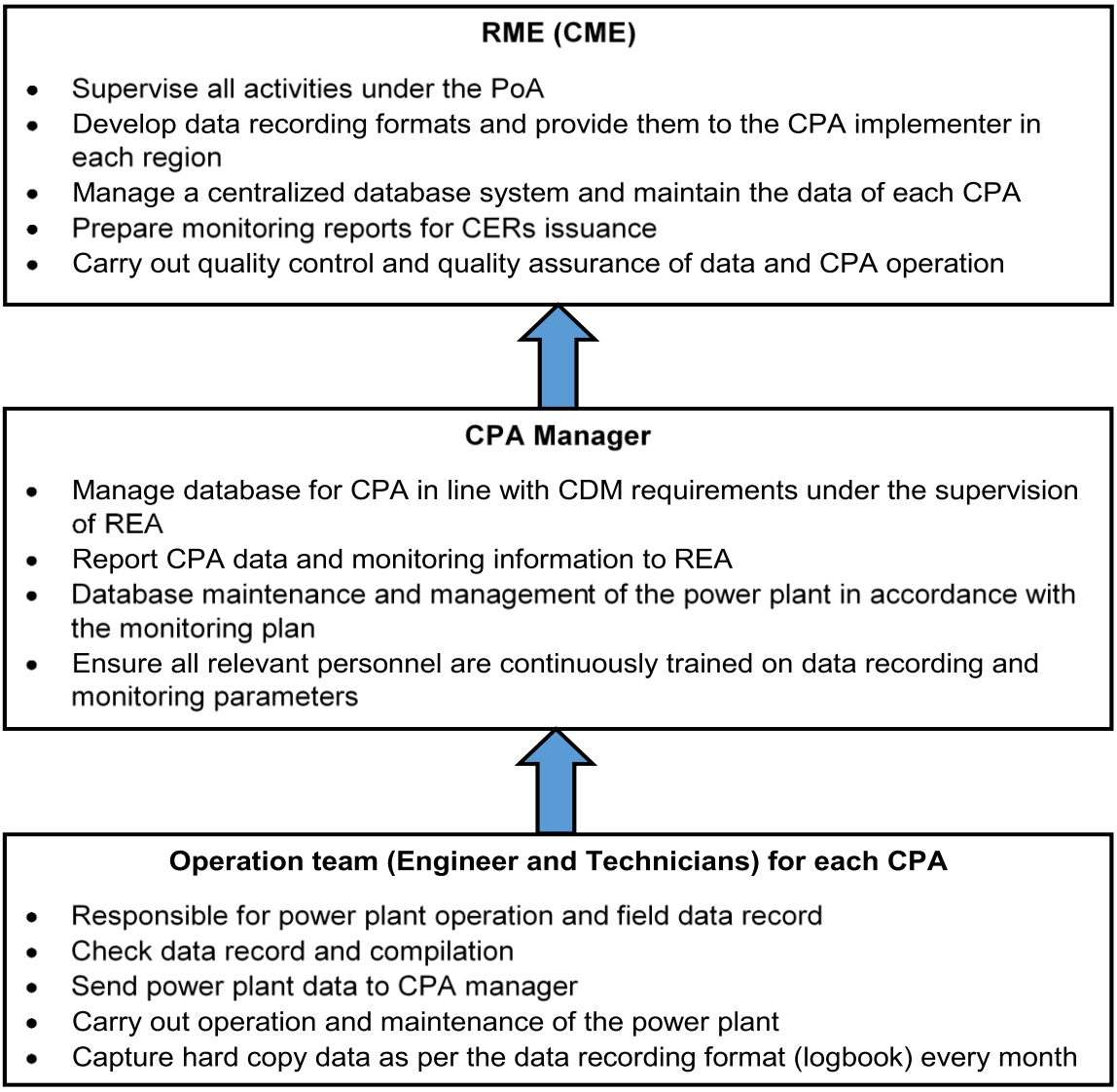

Figure 8: Operational and management structure for monitoring

After the quality control, the CPA manager has sent the consolidated data collected to the REA. Being the CME, REA is responsible for the management of records and data associated with each SSC-CPA. REA maintains the overall programme database for these records. The Project Manager of the PoA is responsible for the overall programme database and maintains the records of all the

CPAs under this program. Figure 8 gives the operation and management structure for the monitoring of the PoA.

To ensure the quality of the recorded data, all the personnel were trained in accordance with this monitoring plan.

If applicable, the net electricity supplied to a grid was cross checked as gross energy generation in the project activity power plant minus the auxiliary/station electricity consumption, technical losses and electricity import from the grid to the project power plant measured at the grid interface/connection used for billing purposes.

SECTION E. Data and parameters

E.1. Data and parameters fixed ex ante

CPA Category 1: CPAs supplying to the national grid (AMS I.D. Grid connected renewable electricity generation).

(Copy this table for each data or parameter.)

Data/Parameter	**$EF_{CO2,grid,y}$**
Unit	tCO_2e/MWh.
Description	CO_2 emission factor of the grid in year y.
Source of data	Calculated as described in part II section B.6.3 of PoA DD. Details of Tanzania national grid obtained from TANESCO.
Value(s) applied	0.530
Choice of data or measurement methods and procedures	The grid emission factor is calculated using the latest version of the "Tool to calculate the emission factor for an electricity system". The power generation data of Tanzania national grid for years 2012-14 is used.
Purpose of data/parameter	Calculation of baseline emission
Additional comments	The value is fixed ex-ante for the first crediting period.

Data/Parameter	**$EF_{CO2,m,i,y.}$**
Unit	tCO_2/GJ.
Description	CO_2 emission factor of fossil fuel type i used in power unit m in year y.
Source of data	IPCC[16] default values at the lower limit of uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol.2 (Energy) of the 2006 IPCC Guidelines on National GHG inventories.
Value(s) applied	Gas Oil/Diesel Oil - 0.0726 tCO_2/GJ. Natural Gas - 0.0543 tCO_2/GJ.
Choice of data or measurement methods and procedures	No data for the fuels used in Tanzania is available. Hence IPCC defaults are used. For the calculation of the Simple Adjusted Operating Margin (OM), these figures shall be updated once, at the start of each crediting period in accordance with the applicable IPCC data at that time. For the build margin (BM), these figures shall be updated once, at the start of each crediting period with the applicable IPCC data at the time.
Purpose of data/parameter	Calculation of baseline emission.
Additional comments	Not applicable.

[16] Intergovernmental Panel on Climate Change

Data/Parameter	$EF_{EL,m,y.}$
Unit	tCO_2/MWh
Description	CO_2 emission factor of power unit m considered in grid emission factor calculation in year.
Source of data	TANESCO
Value(s) applied	

Plants	Emission Factor $EF_{(EL,m,y)}$ (tCO_2/MWh)
Zuzu	0.69
Tegeta Gas Plant (TGP)	0.46
Ubungo Gas Plant (UGP)	0.45
SONGAS UGT1&2	0.57
SONGAS UGT3,4,5&6	0.54
IPTL	0.70
NYAKATO	0.69
AGR (TG)	0.66
AGR (UB)	0.66
UGP 2	0.53
SYMB UB GP	0.49
SYMB UB JET A	0.66
SYMB (AR)	0.66
SYMB (DD)	0.66

Choice of data or measurement methods and procedures	Calculated based on the approach provided under Option A of the OM method using annual electricity generation, fuel type and efficiency of each power unit, m.
Purpose of data/parameter	Calculation of baseline emission.
Additional comments	This data will be used if available from TANESCO. Otherwise, it should be calculated.

Data/Parameter	$\eta_{m,y}$
Unit	%
Description	Average net energy conversion efficiency of power unit m in year y.
Source of data	TANESCO and default values as per Appendix 1 of "Tool to calculate the emission factor for an electricity system", version 04.0.0
Value(s) applied	

Plants	Type of fuels	Technology Used	Efficiency (%)
Zuzu	Diesel & Industrial Oil	Open Cycle	37.8%
Tegeta Gas Plant(TGP)	Natural Gas	Open Cycle	42.4%
Ubungo Gas Plant(UGP)	Natural Gas	Open Cycle	43.0%
SONGAS UGT1&2	Natural Gas	Open Cycle	34.1%
SONGAS UGT3,4,5&6	Natural Gas	Open Cycle	36.4%
IPTL	HFO	Open Cycle	39.0%
NYAKATO	Diesel & Industrial Oil	Open Cycle	38.00%
AGR(TG)	Diesel & Industrial Oil	Open Cycle	39.50%
AGR(UB)	Diesel & Industrial Oil	Open Cycle	39.50%

	<table><tr><td>UGP 2</td><td>Natural Gas</td><td>Open Cycle</td><td>37.00%</td></tr><tr><td>SYMB UB GP</td><td>Natural Gas</td><td>Open Cycle</td><td>39.50%</td></tr><tr><td>SYMB UB JET A</td><td>Diesel & Industrial Oil</td><td>Open Cycle</td><td>39.50%</td></tr><tr><td>SYMB {AR}</td><td>Diesel & Industrial Oil</td><td>Open Cycle</td><td>39.50%</td></tr></table> Efficiency factor of AGR and SYMB plants are taken from Appendix 1 of the "Tool to calculate the emission factor for an electricity system" for plant built after 2000.
Choice of data or measurement methods and procedures	Data from the Tanzanian grid company are used as available. Default values are used for the plants where data are not available.
Purpose of data/parameter	Calculation of baseline emission
Additional comments	Not applicable.

Data/Parameter	**$EG_{m,y.}$**
Unit	MWh.
Description	Net quantity of electricity generated and delivered to the grid by power unit m in year y.
Source of data	TANESCO.
Value(s) applied	See grid emission factor calculation spreadsheet
Choice of data or measurement methods and procedures	As per "Tool to calculate the emission factor for an electricity system" method for simple OM.
Purpose of data/parameter	Calculation of baseline emission.
Additional comments	Not applicable.

Data/Parameter	**$EG_{k,y.}$**
Unit	MWh
Description	Net quantity of electricity generated and delivered to the grid by power unit k in year y (by low cost/must run power plants).
Source of data	TANESCO.
Value(s) applied	See grid emission factor calculation spreadsheet
Choice of data or measurement methods and procedures	As per "Tool to calculate the emission factor for an electricity system" method for simple OM.
Purpose of data/parameter	Calculation of baseline emission.
Additional comments	Not applicable

CPA Category 2: CPAs supplying to a mini-grid (AMS I.F. Renewable electricity generation for captive use and mini-grid).

Data/Parameter	**$EF_{CO2,y.}$**
Unit	tCO_2e/MWh.
Description	CO_2 emission factor for displacement of electricity in the minigrid and /or the captive power plant in year y.
Source of data	Table I.F.1. of AMS – I.F
Value(s) applied	0.8

Choice of data or measurement methods and procedures	The portion of electricity supplied to mini-grids replaces electricity production through diesel generators, that would have been used in the absence of the project activity. As per AMS-I.F, for a mini-grid system, where all the generators use exclusively fuel oil and/or diesel fuel, an emission factor for a modern diesel generating unit of the relevant capacity operating at optimal load as given in Table I.F.1 can be used. The installed capacity is larger than 200 kW. Thus, the value of 0.8 tCO_2e/MWh is used. This is the emission factor for a modern diesel generating unit of capacity larger than 200 kW.
Purpose of data/parameter	Calculation of baseline emission.
Additional comments	Not applicable.

CPA category 3: CPAs using both AMS I.D and AMS I.F

All parameters mentioned above for the category 1 and 2 are also applicable for the category 3. In addition to the parameters of category 3, the following parameters are applicable to Ikondo CPA.

Data/Parameter	**$EG_{BL,existing,y,grid}$**
Unit	MWh.
Description	Estimated net electrical energy that would have been produced and supplied to grid by the existing units.
Source of data	Ikondo 80 kW power plant records for years 2010- 2015.
Value(s) applied	69
Choice of data or measurement methods and procedures	The annual average actual power produced from 80 kW unit was calculated from the historic data from 2010-2015. Similarly, the estimated electricity generation from the 80 kW unit was calculated using standard operating hours and plant load factor. The design factor (that only 28.5% of electricity generated would be exported to grid) is applied. As per methodology, the maximum of the two values, i.e., $EG_{estimated,y}$ is considered for $EG_{BL,existing,y,grid.}$
Purpose of data/parameter	Calculation of baseline emission.
Additional comments	Not applicable.

Data/Parameter	**$EG_{BL,existing,y,MG}$**
Unit	MWh.
Description	Estimated net electrical energy that would have been produced and supplied to mini - grid by existing units.
Source of data	Ikondo 80 kW power plant records for years 2010- 2015.
Value(s) applied	175
Choice of data or measurement methods and procedures	The annual average actual power produced form 80 kW unit was calculated from the historic data from 2010 – 2015. Similarly, the estimated electricity generation from the 80 kW unit was calculated using standard operating hour and plant load factor. The design factor that only 71.5% of electricity generated would be exported to mini - grid is applied. As per methodology, the maximum of the two values, i.e. $EG_{estimated,y}$ is considered for $EG_{BL,existing,y,grid.}$
Purpose of data/parameter	Calculation of baseline emission.
Additional comments	Not applicable.

E.2. Data and parameters monitored

Category 1: CPAs supplying to the national grid (AMS I.D. Grid connected renewable electricity generation).

(Copy this table for each data or parameter.)

Data/Parameter	$EG_{PJ,add,y,grid}$
Unit	MWh/Year
Description	Total net electrical energy supplied to a grid in year y by all units, existing and new project units
Measured/calculated/ Default	The data were measured and then calculated to obtain net electricity by subtracting the auxiliary/station electricity consumption, technical losses and the electricity import from the grid to the project power plant measured at the grid interface/connection used for billing purposes.
Source of data	Measured by energy meters
Value(s) of monitored parameter	**CPA**: Darakuta; **Power supplied to the grid (MWh) from all existing and new sources**: 1,333
Monitoring equipment	Bidirectional energy meters.
Measuring/reading/ recording frequency	Continuous monitoring, hourly measurement and at least monthly recording. The data will be archived for two years after the crediting period.
Calculation method (if applicable)	Measurements are taken using energy meters. Bidirectional meters are installed so that the electricity supplied by the grid to the project or to the communities is not included in the calculation of ERs. Measurement results are cross checked with records for sold / purchased electricity (e.g., invoices/receipts). The net electricity export/supplied to a grid is the difference between the measured quantities of the grid electricity export and the import. Cross check is done on net electricity supplied to a grid as the gross energy generation in the project activity power plant minus the auxiliary/station electricity consumption, technical losses and the electricity import from the grid to the project power plant measured at the grid interface/connection used for billing purposes.
QA/QC procedures	The device was calibrated and tested as per the instructions (schedules, procedures) for QA of the technology provider and EWURA's standard. There was strict compliance with the maintenance schedule recommended by the technology provider and EWURA. The quality control was ensured by EWURA's SPPA that mandates monthly readings, with rated error no greater than 0.5%. Quality control and assurance was achieved through a monthly check of the monitoring log sheet, which was signed by plant staff to acknowledge that the parameters are correct.
Purpose of data/parameter	Calculation of baseline emission.
Additional comments	The data will be kept in reserve for two years after verification.

Data/Parameter	$EG_{actual,y}/EG_{BL,existing,y,grid}$
Unit	MWh/Year
Description	Quantity of net electricity supplied to the national grid by the existing units in year y.

Measured/calculated/ Default	Calculated since there was no separate meter installed to measure the power output to the national grid from the existing 75 kW unit.
Source of data	Calculation
Value(s) of monitored parameter	<table><tr><th>CPA</th><th>Power supplied to the grid (MWh) from existing 75 kW unit</th></tr><tr><td>Darakuta</td><td>657</td></tr></table>
Monitoring equipment	None
Measuring/reading/ recording frequency	Not applicable
Calculation method (if applicable)	Estimated maximum power output from 75 kW unit is [(75 * 8,760)/1000 = 657 MWh]
QA/QC procedures	Quality control and assurance was achieved through a monthly check of the monitoring log sheet, which was signed by plant staff to acknowledge that the parameters are correct.
Purpose of data/parameter	Calculation of baseline emission.
Additional comments	The data will be kept in reserve for two years after verification.

CPA Category 2: CPAs supplying to a mini-grid alone (AMS-I.F. Renewable electricity generation for captive use and mini-grid).

Data/Parameter	$EG_{BL,y}$
Unit	MWh/Year
Description	Quantity of net electricity displaced in year y.
Measured/calculated/ Default	For electricity supplied to the communities, the data were measured by the energy meters. For the electricity supplied to TANESCO mini-grid, the data were measured and then calculated by subtracting the auxiliary/station electricity consumption, technical losses and the electricity import from the TANESCO mini grid to the project power plant measured at the TANESCO mini grid interface/connection used for billing purposes.
Source of data	Measured by energy meters
Value(s) of monitored parameter	<u>To TANESCO mini-grid:</u> <table><tr><th>CPA</th><th>Power supplied to the mini-grid (MWh/year)</th></tr><tr><td>Ngombeni</td><td>0</td></tr></table>
Monitoring equipment	Unidirectional and bidirectional energy meters.
Measuring/reading/recording frequency	Continuous monitoring & daily measurement was done for the electricity generated at the plant and monthly recording was also done for power supplied to TANESCO mini-grid and communities. The data will be held in reserve for the two years after the verification.

Calculation method (if applicable)	Measurements are taken using energy meters. Bidirectional meters are installed so that the electricity supplied by the grid to the project or to the communities is not included in the calculation of ERs. Measurement results are cross checked with records for sold/purchased electricity (e.g., invoices/receipts). The net electricity export/supplied to a grid is the difference between the measured quantities of the grid electricity export and the import. Cross check is done on net electricity supplied to a grid as the gross energy generation in the project activity power plant minus the auxiliary/station electricity consumption, technical losses and the electricity import from the grid to the project power plant measured at the grid interface/connection used for billing purposes.
QA/QC procedures	The device was calibrated and tested as per the instructions (schedules, procedures) for QA of the technology provider and EWURA's standard. There was strict compliance with the maintenance schedule recommended by the technology provider and EWURA. The quality control was ensured by EWURA's SSPA that mandates monthly readings, with rated error no greater than 0.5%. Quality control and assurance was achieved through a monthly check of the monitoring log sheet, which was signed by plant staff to acknowledge that the parameters are correct.
Purpose of data/parameter	Calculation of baseline emission.
Additional comments	The data will be kept in reserve for two years after the crediting period.

For Ngombeni CPA:

Data/parameter	Biomass Consumption
Unit	Tonnes/year
Description	Quantity of biomass consumed in year y
Measured/calculated/ default	Measured
Source of data	The fuel consumed by the power plant will be measured at the fuel delivery system or taken from the plant records and log books.
Value(s) of monitored parameter	0
Monitoring equipment	Weigh bridge
Measuring/reading/ recording frequency	The quantity of biomass was measured in batches.
Calculation method (if applicable)	Use mass or volume based measurements. If more than one type of biomass fuel was consumed, each was monitored separately. During the monitoring period, only single type of biomass, i.e., the biomass residue from coconut plantations was used in the CPA.
QA/QC procedures	Quality control and assurance was achieved through a daily check of the monitoring log sheet, which was signed by plant staff to acknowledge that the parameters are correct.

Purpose of data	Cross-check of the measurements with an annual energy balance was done based on purchased quantities (e.g., with sales/receipts) and stock changes. The consistency of measurements ex post was checked with annual data on energy generation, biomass used and the efficiency of energy generation as determined ex ante. Here the amount of biomass brought into the power plant area is considered to be consumed for the power generation. The cross check showed that energy generated was not more than energy made available from biomass consumption reported during same period.
Additional comments	Parameter listed as per methodology and PoA DD. This parameter is not used in the emission calculation.

Data/parameter	$NCV_{Biomass}$
Unit	MJ/kg
Description	Net calorific value of biomass type k
Measured/calculated/ default	Calculated
Source of data	Lab reports or standard sources such as IPCC
Value(s) of monitored parameter	0
Monitoring equipment	Measurement in the laboratories according to relevant national/international standards. NCV was measured based on wet biomass basis
Measuring/reading/ recording frequency	Determined once in the first year or when a new biomass type is used and the value can be used for the rest of the crediting period.
Calculation method (if applicable)	Not applicable. NCV value is lab tested or referred from relevant national/international standards.
QA/QC procedures	Consistency of the measurements were checked by comparing the measurement results with relevant data sources (e.g., values in the literature, values used in the national GHG inventory, etc.) and default values by the IPCC.
Purpose of data	Parameter listed as per methodology and PoA DD. This parameter is not used in the emission calculations
Additional comments	The data will be archived for two years after the crediting period.

CPA Category 3: CPAs supplying to both the national grid and the mini grid (TANESCO/Isolated).

Data/Parameter	$EG_{actual,y}$/$EG_{BL,y(Category\ 1)}$
Unit	MWh/Year
Description	Quantity of net electricity supplied to the national grid in year y.
Measured/calculated/ Default	Measurements were taken using energy meters. Bidirectional meters were installed so that any electricity supplied by the grid to the project or to the project /to the community is not included in the ER calculation. Measurement results are checked with records for sold/purchased electricity (e.g., invoices/receipts). The net electricity exported/supplied to a grid is the difference between the measured quantities of the grid electricity export and the import. The net electricity supplied to a grid are cross checked with the gross energy generation in the project activity power plant minus the auxiliary/station electricity consumption, technical losses and electricity import from the grid to the project power plant measured at the grid interface/connection used for billing purposes.
Source of data	Measured by energy meters.

Value(s) of monitored parameter	<table><tr><th>CPA</th><th>Power supplied to the grid (MWh/year)</th></tr><tr><td>Yovi</td><td>6,544</td></tr><tr><td>Tulila</td><td>4,336</td></tr><tr><td>Ikondo</td><td>128</td></tr></table>
Monitoring equipment	Bidirectional energy meters.
Measuring/reading/recording frequency	Continuous monitoring & daily measurement was done for the electricity generated at the plant and monthly recording was also done for electricity supplied to TANESCO national grid. The data will be held in reserve for the two years after the verification.
Calculation method (if applicable)	Measurements are taken using energy meters. Bidirectional meters are installed so that the electricity supplied by the grid to the project or to the communities is not included in the calculation of ERs. Measurement results are cross checked with records for sold/purchased electricity (e.g., invoices/receipts). The net electricity export/supplied to a grid is the difference between the measured quantities of the grid electricity export and the import. Cross check is done on net electricity supplied to a grid as the gross energy generation in the project activity power plant minus the auxiliary/station electricity consumption, technical losses and the electricity import from the grid to the project power plant measured at the grid interface/connection used for billing purposes. <u>For Ikondo:</u> The 350 kW unit and 80 kW are connected and export power through single energy meter only. The power generation meters installed next to both the generators are instantaneous meters only and the power generation from individual unit is not available. Because of this, the conservative estimation approach as described in the registered CPA DD is used in CER estimation during this monitoring period.
QA/QC procedures	The device was calibrated and/or tested as per the instructions (schedules, procedures) for QA of the technology provider and EWURA's standard. There was strict compliance with the maintenance schedule recommended by the technology provider and EWURA. The quality control was ensured by EWURA's SSPA that mandates monthly readings, with rated error no greater than 0.5%. Quality control and assurance was achieved through a monthly check of the monitoring log sheet, which was signed by plant staff to acknowledge that the parameters are correct.
Purpose of data/parameter	Calculation of baseline emission.
Additional comments	The data will be kept in reserve for two years after the crediting period.

Data/Parameter	$EG_{BL,y.}$
Unit	MWh/Year
Description	Quantity of net electricity displaced in year y.
Measured/calculated/ Default	For electricity supplied to the communities, the data were measured by the energy meters. For the electricity supplied to TANESCO mini-grid, the data were measured and then calculated by subtracting the auxiliary/station electricity consumption, technical losses and the electricity import from the TANESCO mini-grid to the project power plant measured at the TANESCO mini-grid interface/connection used for billing purposes.

<table>
<tr><td>Source of data</td><td>Measured by energy meters</td></tr>
<tr><td>Value(s) of monitored parameter</td><td><u>To TANESCO mini-grid</u>

<table><tr><th>CPA</th><th>Power supplied to TANESCO mini-grid (MWh/year)</th></tr><tr><td>Tulila</td><td>18,358</td></tr></table>
<u>To Isolated mini-grid</u>

<table><tr><th>CPA</th><th>Power supplied to isolated mini-grid (MWh/year)</th></tr><tr><td>Ikondo</td><td>149</td></tr></table></td></tr>
<tr><td>Monitoring equipment</td><td>Unidirectional and bidirectional energy meters.</td></tr>
<tr><td>Measuring/reading/recording frequency</td><td>Continuous monitoring & daily measurement was done for the electricity generated at the plant and monthly recording was also done for power supplied to TANESCO mini-grid and communities. The data will be held in reserve for the two years after the verification.</td></tr>
<tr><td>Calculation method (if applicable)</td><td>Measurements are taken using energy meters. Bidirectional meters are installed so that the electricity supplied by TANESCO mini-grid to the project or to the communities is not included in the calculation of ERs.

Measurement results are cross checked with records for sold / purchased electricity (e.g., invoices/receipts).

The net electricity export/supplied to a grid is the difference between the measured quantities of the grid electricity export and the import. Cross check is done on net electricity supplied to a grid as the gross energy generation in the project activity power plant minus the auxiliary/station electricity consumption, technical losses and the electricity import from the grid to the project power plant measured at the grid interface/connection used for billing purposes.

<u>For Ikondo:</u>

The 350 kW unit and 80 kW are connected and export power through single energy meter only. The power generation meters installed next to both the generators are instantaneous meters only and the power generation from individual unit is not available. Because of this, the conservative estimation approach as described in the registered CPA DD is used in CER estimation during this monitoring period.</td></tr>
<tr><td>QA/QC procedures</td><td>The device was calibrated and/or tested as per the instructions (schedules, procedures) for QA of the technology provider and EWURA’s standard.

There was strict compliance with the maintenance schedule recommended by the technology provider and EWURA. The quality control was ensured by EWURA’s SSPA that mandates monthly readings, with rated error not greater than 0.5%.

Quality control and assurance was achieved through a monthly check of the monitoring log sheet, which was signed by plant staff to acknowledge that the parameters are correct.</td></tr>
<tr><td>Purpose of data/parameter</td><td>Calculation of baseline emission.</td></tr>
<tr><td>Additional comments</td><td>The data will be kept in reserve for two years after the crediting period.</td></tr>
</table>

E.3. Implementation of sampling plan

Not applicable

SECTION F. Calculation of emission reductions or net anthropogenic removals

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

CPA category 1: For electricity supplied to the national grid (AMS I.D. Grid connected renewable electricity generation).

For the part of electricity generated that was fed to the national grid, the CPA uses the AMS-I.D. (Version 17) and relevant equations.

Darakuta:

Darakuta hydro power plant is a capacity addition project to the existing 75 kW micro hydro power plant and supplies power to the national grid.

As the CPA is a renewable energy based capacity addition to an existing renewable energy power plant, the baseline emissions are calculated as per "*For capacity addition with renewable energy units other than photovoltaic, wind plants"* approach provided in the registered PoA DD, version 08 page 42.

The baseline emissions from the electricity supply to the grid are calculated as,

$$BE_{Add,co2,y,grid} = (EG_{PJ,add,y,grid} - EG_{BL,exiting,y,grid}) \times EF_{CO2,grid,y}$$

Where,

$EG_{PJ,add,y,grid}$ = The total net electrical energy supplied to a grid in year y by all units, existing and new project units; (MWh)

$EG_{BL,exiting,y,grid}$ = The estimated net electrical energy that would have been produced and supplied to a grid by existing units (installed before the project activity) in year y in the absence of the project activity; (MWh)

Where,

$$EG_{BL,existing,y,grid} = MAX\ (EG_{actual,y} or EG_{estimated,y})\ until DATE_{baselinecapacityaddition}$$

and

$EG_{BL,existing,y,grid}$ *is 0 on/after* $DATE_{baselinecapacityaddition}$

Where,

$EG_{actual,y}$ = The actual, measured net electrical energy produced and supplied to the grid by the existing units in year y (MWh).

$EG_{estimated,y}$ = The estimated net electrical energy produced and supplied to the grid by the existing units in year y (MWh).

Table 17 provides the details of net power supplied to the national grid.

Table 17. Net electricity exported to grid from all existing and new units in Darakuta

Time period		Electricity supplied to TANESCO grid	Electricity imported from TANESCO grid	Net electricity supplied ($EG_{PJ,add,y,grid}$)
From	To	(MWh)	(MWh)	(MWh)
		A	B	C=A-B
01/01/2018	31/12/2018	165.07	0.00	165.07
01/02/2018	28/02/2018	124.09	0.00	124.09
01/03/2018	31/03/2018	152.61	0.00	152.61
01/04/2018	30/04/2018	140.68	0.00	140.68
01/05/2018	31/05/2018	172.07	0.00	172.07
01/06/2018	30/06/2018	173.64	0.00	173.64
01/07/2018	31/07/2018	174.05	0.00	174.05
01/08/2018	31/08/2018	187.89	0.00	187.89
01/09/2018	30/09/2018	173.88	0.02	173.86
01/10/2018	31/10/2018	179.21	0.00	179.21
01/11/2018	30/11/2018	172.60	0.00	172.60
12/12/2018	31/12/2018	175.19	0.00	175.19
Total		**1,990.98**	**0.02**	**1,990.00**

Table 18 provides the net electricity supplied to the grid from Darakuta hydro power plant. The existing power plant was used for internal purpose and there was no monitoring of the power generation so far. Due to this, there is no historic data for the existing plant to calculate parameter $EG_{actual,y.}$ The annual estimated electricity produced and supplied to grid ($EG_{esmated,y}$) from the 75 kW unit was calculated as 657 MWh using standard operating hours. This is conservative as some part of this will be used for internal consumption also.

The normal lifetime of hydro power plants is 20 years. The date of baseline capacity additions is 2035. Therefore, this CPA will not claim any CERs after 31/12/2034.

Table 18. Net electricity supplied by Darakuta project to the grid

Time period		Total electricity supply to grid from all existing units ($EG_{PJ,add,y,grid}$)	Electricity supplied from 75 kW unit (Estimated) ($EG_{estimated,y}$)	Net electricity supplied ($EG_{PJ,add,y,grid}$- $EG_{estimated,y}$)
From	To	(MWh)	(MWh)	(MWh)
		C	D	E=C-D
01/01/2018	31/12/2018	165.07	54.75	110.32
01/02/2018	28/02/2018	124.09	54.75	69.34
01/03/2018	31/03/2018	152.61	54.75	97.86
01/04/2018	30/04/2018	140.68	54.75	85.93
01/05/2018	31/05/2018	172.07	54.75	117.32
01/06/2018	30/06/2018	173.64	54.75	118.89
01/07/2018	31/07/2018	174.05	54.75	119.30
01/08/2018	31/08/2018	187.89	54.75	133.14
01/09/2018	30/09/2018	173.86	54.75	119.11
01/10/2018	31/10/2018	179.21	54.75	124.46
01/11/2018	30/11/2018	172.60	54.75	117.85
12/12/2018	31/12/2018	175.19	54.75	120.44
Total		**1990.96**	**657.00**	**1,333**

The sample calculations for the baseline emissions under the CPA category 1

$BE_{Add,co2,y,grid}$= $(EG_{PJ,add,y,grid} - EG_{BL,exiting,y,grid})$ x $EF_{\mathrm{CO2,\,grid,y}}$

= (1990.96 – 657.00) MWh x 0.530 tCO_2/MWh

= 707 tCO_2

CPA Category 2: For the CPAs supplying to a mini-grid (AMS-I.F. Renewable electricity generation for captive use and mini-grid).

For the electricity fed into the isolated/TANESCO mini-grids, the CPA should use the methodology, AMS-I.F. (Version 02) and the relevant equations.

Baseline emissions

For new power plants at the site where there was no renewable energy power plant operating prior to the implementation of the project activity (greenfield plant):

$BE_{y(Category2)} = EG_{BL,y(Category2)} \times EF_{CO2,y}$

Where:

$BE_{y(Category2)}$ = Baseline emissions in year *y* (tCO_2) for mini-grids

$EG_{BL,y(Category2)}$ = Quantity of net electricity supplied to the mini-grid as a result of the implementation of the CDM project activity in year y (MWh)

$EF_{CO2,y}$ = CO_2 emission factor (tCO_2/MWh)

For the mini-grids, the emission factor is as of a modern diesel generating unit of the relevant capacity operating at optimal load as given in Table I.F.1. of AMS-I.F.

Ngombeni:

There was no power generation from this CPA during this monitoring period.

CPA Category 3: For CPAs supplying to both the national grid and the mini-grid (AMS-I.D. and AMS-I.F.)

All the procedures for baseline estimations of Category 1 and 2 (Greenfield/capacity addition projects) are also applicable to Category 3.

Yovi:

Yovi small power plant is a green field project and supplies power to national grid and it is expected to develop an isolated minigrid by the end of 2019.

Baseline emissions

As the Yovi CPA is a new power plant at the site, where there was no renewable energy power plant operating prior to the implementation of the project activity (greenfield plant), the baseline emissions are calculated as follows:

a) For power supplied to TANESCO grid (category 1):

$BE_{y(Category\ 1)} = EG_{BL,y,(Catogory1)} \times EF_{CO2,grid,y}$

$BE_{y(Category\ 1)}$ = Emission reductions in year y (tCO_2/y) resulting from part of electricity fed to the national grid

$EG_{BL,y,(Catogory1)}$ = Quantity of net electricity supplied to the national grid as a result of the implementation of the CDM project activity in year y (MWh)

$EF_{CO2,grid,y}$ = CO_2 emission factor of the grid in year y (tCO_2/MWh)

b) For power supplied to mini-grid (category 2):

$BE_{y\ (Category\ 2)} = EG_{BL,y,(Catogory2)} \times EF_{CO2,y}$

Where:

$BE_{y(Category\ 2)}$ = Emission reductions in year y (tCO_2/y) resulting from part of electricity fed to the mini-grid

$EG_{BL,y,(Catogory2)}$ = Quantity of net electricity supplied to the mini-grid as a result of the implementation of the CDM project activity in year y (MWh)

$EF_{CO2,y}$ = CO_2 emission factor in year y (tCO_2/MWh)

Table 19 provides the details of net electricity exported to the national grid.

Table 19. Net electricity exported to grid from Yovi

Time period		Electricity exported to grid	Electricity imported from grid	Net electricity exported $EG_{facility,y}$
From	To	(MWh)	(MWh)	(MWh)
		A	B	C=A-B
01/01/2018	31/01/2018	274.529	0.000	274.529
01/02/2018	28/02/2018	405.375	0.000	405.375
01/03/2018	31/03/2018	596.158	0.000	596.158
01/04/2018	30/04/2018	573.613	0.000	573.613
01/05/2018	31/05/2018	623.063	0.000	623.063
01/06/2018	30/06/2018	583.309	0.006	583.303
01/07/2018	31/07/2018	689.909	0.000	689.909
01/08/2018	31/08/2018	682.007	0.000	682.007
01/09/2018	30/09/2018	547.794	0.000	547.794
01/10/2018	31/10/2018	635.339	0.000	635.339
01/11/2018	30/11/2018	490.492	0.000	490.492
01/12/2018	31/12/2018	442.514	0.001	442.513
Total		**6,544.102**	**0.007**	**6,544.00**

The sample calculations for the baseline emissions under the CPA category 3

a) For power supplied to TANESCO grid:

$BE_{y(Catogory1)} = EG_{BL,y,(Catogory1)} \times EF_{CO2,grid,y}$

= 6,544 MWh x 0.530 tCO_2/MWh

= 3,468 tCO_{2e}

b) For power supplied to mini grid:

$BE_{y(Catogory2)} = EG_{BL,y,(Catogory2)} \times EF_{CO2,y}$

= 0 (since the mini-grid is not yet established under Yovi CPA)

Tulila:

Tulila hydroelectric power plant is a green field project and supplies power to the national grid as well as to the mini-grid. Currently, Tulila power plant is supplying power to the mini-grid as well as national grid, the CPA started to supply to the national grid in September 2018 after extention of the national grid to Ruvuma region.

a) For power supplied to TANESCO grid (category 1):

$BE_{y(Category\ 1)} = EG_{BL,y,(Catogory1)} \times EF_{CO2,grid,y}$

$BE_{y(Category\ 1)}$	=	Emission reductions in year y (tCO_2/y) resulting from part of electricity fed to the national grid
$EG_{BL,y,(Catogory1)}$	=	Quantity of net electricity supplied to the national grid as a result of the implementation of the CDM project activity in year y (MWh)
$EF_{CO2,grid,y}$	=	CO_2 emission factor of the grid in year y (tCO_2/MWh)

b) For power supplied to mini grid (category 2):

$BE_{y\ (Category\ 2)} = EG_{BL,y,(Catogory2)} \times EF_{CO2,y}$

Where:

$BE_{y(Category\ 2)}$	=	Emission reductions in year y (tCO_2/y) resulting from part of electricity fed to the mini-grid
$EG_{BL,y,(Catogory2)}$	=	Quantity of net electricity supplied to the mini-grid as a result of the implementation of the CDM project activity in year y (MWh)
$EF_{CO2,y}$	=	CO_2 emission factor in year y (tCO_2/MWh)

Table 20 and 21 provides the details of the net electricity supplied to TANESCO mini-grid and national grid.

Table 20. Net electricity exported to the mini-grid from Tulila (from 01/01/2018 to 17/09/2018)

Time period		Electricity supplied to TANESCO mini-grid	Electricity imported from TANESCO mini-grid	Net electricity supplied ($EG_{facility,y}$)
From	To	(MWh)	(MWh)	(MWh)
		A	B	C=A-B
01/01/2018	31/01/2018	1,899.712	0.00	1,899.712
01/02/2018	28/02/2018	1,579.416	0.00	1,579.416
01/03/2018	31/03/2018	2,157.640	0.00	2,157.640
01/04/2018	30/04/2018	2,347.712	0.00	2,347.712

01/05/2018	31/05/2018	2,402.528	0.00	2,402.528
01/06/2018	30/06/2018	2,531.032	0.00	2,531.032
01/07/2018	31/07/2018	2,523.592	0.00	2,523.592
01/08/2018	31/08/2018	1,952.576	0.00	1,952.576
01/09/2018[17]	30/09/2018	964.552	0.00	964.552
01/10/2018	31/10/2018	0.000	0.00	0.000
01/11/2018	30/11/2018	0.000	0.00	0.000
01/12/2018	31/12/2018	0.000	0.00	0.000
Total		**18,385.760**	**0**	**18,358.760**

$BE_{y(Category2)} = EG_{BL,y(Category2)} \times EF_{CO2,y}$

$= 18,358.76 \text{ MWh} \times 0.8 \text{ tCO}_2/\text{MWh}$

$= 14,687 \text{ tCO}_2$

Table 21. Net electricity exported to and imported from the grid by Tulila (from 18/09/2018 to 31/12/2018)

Time period		Electricity supplied to TANESCO grid	Electricity imported from TANESCO grid	Net electricity supplied ($EG_{facility,y}$)
From	To	(MWh)	(MWh)	(MWh)
		A	B	C=A-B
01/01/2018	31/01/2018	0.000	0.000	0.000
01/02/2018	28/02/2018	0.000	0.000	0.000
01/03/2018	31/03/2018	0.000	0.000	0.000
01/04/2018	30/04/2018	0.000	0.000	0.000
01/05/2018	31/05/2018	0.000	0.000	0.000
01/06/2018	30/06/2018	0.000	0.000	0.000
01/07/2018	31/07/2018	0.000	0.000	0.000
01/08/2018	31/08/2018	0.000	0.000	0.000

[17] Tulila CPA was supplying power to the TANESCO mini-grid from 01/01/2018 to 17/09/2018. However, due to the national grid extension, Tulila CPA was connected to the national grid on 18/09/2018.

Time period		Electricity supplied to TANESCO grid	Electricity imported from TANESCO grid	Net electricity supplied ($EG_{facility,y}$)
From	To	(MWh)	(MWh)	(MWh)
		A	B	C=A-B
01/09/2018[18]	30/09/2018	530.512	0.00	530.512
01/10/2018	31/10/2018	1,188.736	0.00	1,188.736
01/11/2018	30/11/2018	774.544	0.00	774.544
01/12/2018	31/12/2018	1,842.480	0.00	1,842.480
Total		**4,336.272**	**0.00**	**4,336.272**

$BE_{y(Catogory1)} = EG_{BL,y,(Catogory1)} \times EF_{CO2,grid,y}$

= 4,336 MWh x 0.530 tCO_2/MWh

= 2,298 tCO_{2e}

Ikondo:

Ikondo micro hydro power plant is a capacity addition project to the existing 80 kW micro hydro power plant and supplies power to the national grid as well as to the isolated mini-grid.

As the CPA is a renewable energy based capacity addition to an existing renewable energy power plant, the baseline emissions are calculated as per "*For capacity addition with renewable energy units other than photovoltaic, wind plants"* approach provided in the registered PoA DD, version 08 page 42.

a) For power supplied to the TANESCO grid:

The baseline emissions from the electricity supply to the grid are calculated as,

$$BE_{Add,co2,y,grid} = \left(EG_{PJ,add,y,grid} - EG_{BL,exiting,y,grid}\right) \times EF_{co2,grid,y}$$

Where,

$EG_{PJ,add,y,grid}$ = The total net electrical energy supplied to a grid in year y by all units, existing and new project units; (MWh)

$EG_{BL,exiting,y,grid}$ = The estimated net electrical energy that would have been produced and supplied to a grid by existing units (installed before the project activity) in year y in the absence of the project activity; (MWh)

Where,

$$EG_{BL,existing,y,grid} = MAX\ (EG_{actual,y} or EG_{estimated,y})\ until DATE_{baselinecapacityaddition}$$

[18] The Tulila CPA was connected with the TANESCO national grid on 18/09/2018. Hence from 18/09/2018 to 31/12/2018, the energy generated from the Tulila CPA is supplied to the national grid.

and

$EG_{BL,existing,y,grid}$ *is 0 on/after* $DATE_{baselinecapacityaddition}$

Where,

$EG_{actual,y}$ = The actual, measured net electrical energy produced and supplied to the grid by the existing units in year y (MWh).

$EG_{estimated,y}$ = The estimated net electrical energy produced and supplied to the grid by the existing units in year y (MWh).

The annual average actual power produced from the 80 kW unit was calculated using the historic data from 2010-2015. Similarly, the estimated electricity generation from the 80 kW unit was calculated using the standard operating hours and the plant load factor. Table 22 provides the values of power supply considering the grid export.

Table 22. The value of power supply considering export to the grid

Parameter	Total estimated (MWh)	Percentage supply to grid	Value to be considered (MWh)
$EG_{actual,y}$	79	28.5	22
$EG_{estimated,y}$	245		69

As per methodology, the maximum of the two values, i.e., $EG_{estimated,y}$ is considered for $EG_{BL,existing,y,grid}$ = 69 MWh.

The existing 80 kW unit was installed in 2005. Considering the standard operating life of 25 years for hydro power plants, the $DATE_{baselinecapacityaddition}$ for existing 80 kW plant is 31/12/2024.

During the monitoring period, a separate energy meter was not installed to measure the power generation from the 80 kW unit. So as a conservative measure, the estimated power supply from 80 kW unit to the grid, i.e., 69 MWh as per CPA-DD is considered. Table 23 provides the net electricity export to grid from Ikondo power plant.

Table 23. Net electricity exported to grid from Ikondo

Time period		Electricity supplied to TANESCO grid	Electricity contribution from the 80 kW unit (MWh)[19]	Net electricity supplied ($EG_{facility,y}$)
From	To	(MWh)	(MWh)	(MWh)
		A	B	C=A-B
01/01/2018	31/01/2018	0.000	0.000	0.000
01/02/2018	28/02/2018	0.000	0.000	0.000

[19] 69 MWh for 12 months. For one month = 69/12 = 5.75 MWh

Time period		Electricity supplied to TANESCO grid	Electricity contribution from the 80 kW unit (MWh)[19]	Net electricity supplied ($EG_{facility,y}$)
From	To	(MWh)	(MWh)	(MWh)
		A	B	C=A-B
01/03/2018	31/03/2018	27.540	5.750	21.790
01/04/2018	30/04/2018	29.990	5.750	24.240
01/05/2018	31/05/2018	40.300	5.750	34.550
01/06/2018	30/06/2018	29.630	5.750	23.880
01/07/2018	31/07/2018	21.410	5.750	15.660
01/08/2018	31/08/2018	13.640	5.750	7.890
01/09/2018	30/09/2018	0.000	0.000	0.000
01/10/2018	31/10/2018	0.000	0.000	0.000
01/11/2018	30/11/2018	0.000	0.000	0.000
01/12/2018	31/12/2018	0.000	0.000	0.000
Total		**162.510**	**34.500**	**128.000**

$$BE_{Add,co2,y,grid} = \left(EG_{PJ,add,y,grid} - EG_{BL,exiting,y,grid}\right) \text{ x } EF_{co2,grid,y}$$

= (162.51 – 34.5) MWh x 0.530 tCO_2/MWh

= 67 tCO_2

b) <u>For power supplied to the mini-grid</u>

The baseline emissions from the electricity supplied to mini-grid are calculated as,

$$BE_{Add,co2,y,MG} = \left(EG_{PJ,add,y,MG} - EG_{BL,exiting,y,MG}\right) \text{ x } EF_{co2,grid,y}$$

Where,

$EG_{PJ,add,y,MG}$ = The total net electrical energy supplied to a mini-grid in year *y* by all units, existing and new project units; (MWh)

$EG_{BL,exiting,y,MG}$ = The estimated net electrical energy that would have been produced and supplied to a mini-grid by existing units (installed before the project activity) in year *y* in the absence of the project activity; (MWh)

Where,

$$EG_{BL,existing,y,MG} = MAX\left(EG_{actual,y} \; or \; EG_{estimated,y}\right) until \; DATE_{baselinecapacityaddition}$$

and

$EG_{BL,existing,y,MG}$ is 0 on/after $DATE_{baselinecapacityaddition}$

Where,

$EG_{actual,y}$ = The actual, measured net electrical energy produced and supplied to the mini-grid by the existing units in year *y* (MWh)

$EG_{estimated,y}$ = The estimated net electrical energy produced and supplied to the mini-grid by the existing units in year *y* (MWh)

The annual average actual power produced from 80 kW unit was calculated from the historic data from 2010-2015. Similarly, the estimated electricity generation from the 80 kW unit was calculated using standard operating hours and plant load factor. The values of power supply considering mini-grid export are given in the table 24.

Table 24. The value of power supply considering export to the mini-grid

Parameter	Total estimated (MWh)	Percentage supply to mini-grid	Value to be considered (MWh)
$EG_{actual,y}$	79	71.50	57
$EG_{estimated,y}$	245		175

As per methodology, the maximum of the two values, i.e., $EG_{estimated,y}$ is considered for $EG_{BL,existing,y,MG}$ = 175 MWh.

During the monitoring period, a separate energy meter was not installed to measure the power generation from the 80 kW unit. So as a conservative measure, the estimated power supply from 80 kW unit to mini-grid i.e., 175 MWh as per CPA DD is considered.

Table 25 provides the details of net electricity exported to the mini-grid.

Table 25. Net electricity exported to mini-grid from Ikondo

Time period		Electricity exported to mini- grid	Electricity contribution from 80 kW unit	Net electricity generation ($EG_{facility,y}$)
From	To	(MWh)	(MWh)	(MWh)
01/01/2018	31/01/2018	35.729	14.583	21.146
01/02/2018	28/02/2018	31.974	14.583	17.391
01/03/2018	31/03/2018	35.508	14.583	20.925
01/04/2018	30/04/2018	23.610	14.583	9.027
01/05/2018	31/05/2018	13.836	14.583	0.000
01/06/2018	30/06/2018	17.329	14.583	2.746

Time period		Electricity exported to mini- grid	Electricity contribution from 80 kW unit	Net electricity generation ($EG_{facility,y}$)
From	To	(MWh)	(MWh)	(MWh)
01/07/2018	31/07/2018	22.178	14.583	7.595
01/08/2018	31/08/2018	20.347	14.583	5.764
01/09/2018	30/09/2018	19.236	14.583	4.653
01/10/2018	31/10/2018	19.456	14.583	4.873
01/11/2018	30/11/2018	52.122	14.583	37.539
01/12/2018	31/12/2018	32.025	14.583	17.442
Total		**323.350**	**175.000**	**149.097**

$$BE_{Add,co2,y,MG} = \left(EG_{PJ,add,y,MG} - EG_{BL,exiting,y,MG}\right) \text{ x } EF_{co2,grid,y}$$

= (323.35 – 175) MWh x 0.8 tCO_2/MWh

= 119 tCO_2

However, the calibration of meters was not carried out for the energy meters in the mini-grid. The CERs generated during this period is considerd as zero. This is conservative.

$$BE_{Add,co2,y,MG} = 0$$

Table 26 gives the baseline emissions for each of the CPA based on the power supply to the grid or mini-grid.

Table 26. Baseline emissions from the CPAs

Time period		Net electricity generation $EG_{facility,y}$	Grid emission factor	Baseline emission BEy
From	To	(MWh)	(tCO_2/MWh)	(tCO_2)
		C	D	E =C*D
Yovi				
01/01/2018	31/12/2018	6,544	0.53	3,468
Tulila				
01/01/2018	18/09/2018	18,358	0.80	14,687
18/09/2018	31/12/2018	4,336	0.53	2,298
Ngombeni				
01/01/2018	31/12/2018	0	0	0

Time period		Net electricity generation $EG_{facility,y}$	Grid emission factor	Baseline emission BEy
From	To	(MWh)	(tCO_2/MWh)	(tCO_2)
		C	D	E =C*D
Ikondo				
01/01/2018	31/12/2018	128	0.53	67
01/01/2018	31/12/2018	149	0.80	0
Darakuta				
01/01/2018	31/12/2018	1,333	0.53	707
Total baseline emissions				**21,227**

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

All the CPAs generating power from hydro sources are run-of-the-river type power projects. Hence, the project emission is considered as zero.

$PE_{y(Category1)} = 0$

F.3. Calculation of leakage emissions

As per the AMS I.D and AMS I.F, the leakage has to be considered, if there is any energy generating equipment transfer from another activity. The CPAs (Tulila, Yovi, Ngombeni, Ikondo and Darakuta) under this PoA were not involved any transfer of equipment from another activity. All systems having comprised only newly procured equipment. Hence, the leakage emission due to equipment transfer was not considered for the CPAs under this PoA.

$LE_{y(Category3)} = 0$

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

CPA UNFCCC reference number	Baseline GHG emissions or baseline net GHG removals (tCO_2e)	Project GHG emissions or actual net GHG removals (tCO_2e)	Leakage GHG emissions (tCO_2e)	GHG emission reductions or net anthropogenic GHG removals (tCO_2e)		
				Before 01/01/2013	From 01/01/2013	Total amount
9904-P1-0004-CP1	3,468	0	0	0	3,468	3,468
9904-P1-0005-CP1	16,985	0	0	0	16,985	16,985

CPA UNFCCC reference number	Baseline GHG emissions or baseline net GHG removals (tCO_2e)	Project GHG emissions or actual net GHG removals (tCO_2e)	Leakage GHG emissions (tCO_2e)	GHG emission reductions or net anthropogenic GHG removals (tCO_2e)		
				Before 01/01/2013	From 01/01/2013	Total amount
9904-P1-0007-CP1	0	0	0	0	0	0
9904-P1-0008-CP1	67	0	0	0	67	67
9904-P1-0009-CP1	707	0	0	0	707	707
Total	**21,227**	**0**	**0**	**0**	**21,227**	**21,227**

F.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the included CPA-DDs

CPA UNFCCC reference number	Amount achieved during this monitoring period (tCO_2e)	Amount estimated ex ante for this monitoring period in the CPA-DD (tCO_2e)
9904-P1-0004-CP1	3,468	7,668
9904-P1-0005-CP1	16,985	23,585
9904-P1-0007-CP1	0	12,019
9904-P1-0008-CP1	67	1,416
9904-P1-0009-CP1	707	799
Total	**21,227**	**45,487**

F.5.1. Explanation of calculation of "amount estimated ex ante for this monitoring period in the CPA-DD"

The ex-ante for this monitoring is calculated from 01/01/2018 to 31/12/2018. Refer monitoring ER sheet for the ex-ante emission reduction values.

F.6. Remarks on increase in achieved emission reductions

The overall CER generated from five CPAs during the reported monitoring period is 53% less than the overall estimated CERs from the respective registered CPA DDs.

F.7. Remarks on scale of small-scale CPAs

All the CPAs covered in this monitoring report are small scale Type I projects, whose installed capacity is less than the renewable energy project activities with a maximum output capacity of 15 MW. Table 27 provides the installed capacity of all the CPAs covered in this monitoring report.

Table 27. Installed capacity of the CPAs covered in this monitoring report

No.	CPA reference no.	Installed capacity (MW)	Remarks
1	9904-P1–0004-CP1	1	It is evident that the installed capacity of the CPAs covered in this monitoring report are less than the small scale threshold limit of 15 MW.
2	9904-P1–0005-CP1	5	
3	9904-P1-0007-CP1	2.5	
4	9904-P1-0008-CP1	0.430	
5	9904-P1-0009-CP1	0.395	

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Document information

Version	*Date*	*Description*
03.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the "CDM project standard for programmes of activities" (CDM-EB93-A07-STAN); • Add a section on remarks on the observance of the scale limit of small-scale CPAs during the crediting periods; • Add "changes specific to afforestation or reforestation activities/CPA" as a possible post-registration changes; • Clarify the reporting of net anthropogenic GHG removals for A/R PoAs between two commitment periods; • Make structural and editorial improvements.
02.0	7 June 2017	Revision to: • Ensure consistency with version 01.0 of the "CDM project standard for programmes of activities (CDM-EB93-A07-STAN); • Make editorial improvements.
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