



**Monitoring report form for CDM programme of activities  
(Version 02.0)**

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

**MONITORING REPORT**

<b>Title of the PoA</b>	Tanzania Renewable Energy Program	
<b>UNFCCC reference number of the PoA</b>	9904	
<b>Version numbers of the PoA-DD applicable to this monitoring report</b>	Version 08 dated 23/04/2014	
<b>Version number of this monitoring report</b>	02	
<b>Completion date of this monitoring report</b>	07/02/2019	
<b>Monitoring period number</b>	First monitoring period	
<b>Duration of this monitoring period</b>	From 08/05/2014 to 31/12/2016 (first and last days included)	
<b>Monitoring report number for this monitoring period</b>	02	
<b>Coordinating/managing entity</b>	Rural Energy Agency (REA)	
<b>Host Parties</b>	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
<b>Sectoral scopes</b>	01 - Energy Industries (renewable/non-renewable sources)	
<b>Applied methodologies and standardized baselines</b>	<ul style="list-style-type: none"> <li>AMS I.D. Grid connected renewable electricity generation, Version 17</li> <li>AMS I.F. Renewable electricity generation for captive use and mini-grid, Version 02</li> </ul> <u>Standardized baseline</u> : Not applicable	
<b>Amount of GHG emission reductions or net anthropogenic GHG removals achieved by all CPAs covered in this monitoring report in this monitoring period</b>	Amount achieved before 1 January 2012	Amount achieved from 1 January 2013
	0 tCO <sub>2</sub> e	1,996 tCO <sub>2</sub> e
<b>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</b>	5,372 tCO <sub>2</sub> e	

## **PART I      Monitoring of programme of activities (PoA)**

### **SECTION A.    Description of PoA**

#### **A.1.    General description of PoA**

Tanzania had, 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 specified the national energy objectives to ensure availability of reliable and affordable energy supplies and to promote efficient energy in order to support national development goals. The policy recognized that, the main thrust should be private initiatives and investments for exploring the local energy sources. The policy gave an entirely new approach to modern energy in rural areas of Tanzania and the government had committed itself to develop and implement the new strategy to address modern energy needs of over 85% of Tanzanians living in 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 the improved access to modern energy services in rural areas through empowering both public and private sector initiatives in 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 the off-grid (isolated mini-grid) and the national grid renewable energy projects within the country using photovoltaic, wind, hydro and biomass technologies for electricity generation. This programme to promote renewable energy projects is fully in line with the Government's strategy for the energy sector.

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 of 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 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 a long-term lending to the small renewable energy projects.

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

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

This is the second monitoring report of the PoA from 08/05/2014 to 31/12/2016 (first and last days included). This monitoring report was prepared for the CPA - Yovi small hydro power project, whose cumulative net electricity exported to grid and mini-grids during the monitoring period was 3,771 MWh. Certified Emission Reductions (CERs) generated during this monitoring period was 1,996 tCO<sub>2</sub>e.

**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 <sup>1</sup> .
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			AMS I.F. Renewable electricity generation for captive use and mini- grid, Version 02 <sup>2</sup> .
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			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	Title and reference number of the corresponding generic CPA	Version of the PoA-DD	Crediting period type and duration	Covered in this monitoring report? (yes/no)
Mapembasi hydro power project, Njombe district (9904-0001)	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	Version 08 dated 23/04/2014	Renewable crediting type, 01/01/2015-31/12/2022	No <sup>3</sup>

<sup>1</sup> <https://cdm.unfccc.int/methodologies/DB/W3TINZ7KKWCK7L8WTXFQQOFQQH4SBK>

<sup>2</sup> <https://cdm.unfccc.int/methodologies/DB/9KJWQ1G0WEG6LKHX21MLPS8BQR7242>

<sup>3</sup> Project is delayed

NextGen solar project, Kigoma region (9904-0002)	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, 04/06/2014-03/16/2021	No <sup>4</sup>
Mbinga hydroelectric Project (9904-0003)	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, 01/12/2015-30/11/2022	No <sup>5</sup>
Yovi small hydro power project (9904-0004)	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 (9904-0005)	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 <sup>6</sup>
Maguta small hydro power project (9904-0006)	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 <sup>7</sup>
Ngombeni biomass power plant project (9904-0007)	Renewable energy technology (hydro, wind, biomass or PV connected to existing or new isolated mini-grids replacing existing dedicated diesel based power generation		Renewable crediting type, 01/09/2016-31/08/2023	No <sup>8</sup>

---

<sup>4</sup> Project is delayed

<sup>5</sup> This CPA is covered in monitoring report number 01

<sup>6</sup> This CPA is covered in monitoring report number 01

<sup>7</sup> Project is not yet commissioned

<sup>8</sup> This CPA is covered in monitoring report number 01

	Ref no: CPA category 02			
Ikondo micro hydro power plant (9904-0008)	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	No <sup>9</sup>

## A.2. Coordinating/managing entity

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

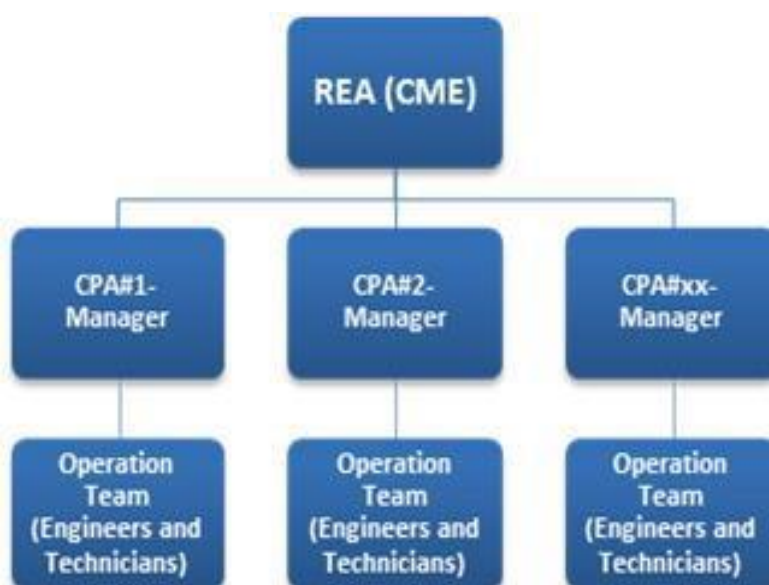
## SECTION B. Implementation of PoA

### B.1. Description of implemented PoA

The management system was developed in accordance with the “CDM project standard for programmes of activities” Version 01.0, EB93<sup>10</sup>.

REA is the PoA CME. The operational and management arrangements established by the REA for the implementation of the PoA is 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. The implementation structure is given in figure 1.



**Figure 1: Implementation structure**

<sup>9</sup> This CPA is covered in monitoring report number 01

<sup>10</sup> [https://cdm.unfccc.int/filestorage/e/x/t/extfile-20170307130828328-reg\\_stan03.pdf/reg\\_stan03.pdf?t=elp8b3hlZmphfDBfqrOCr9Vab35yLKRtq5w](https://cdm.unfccc.int/filestorage/e/x/t/extfile-20170307130828328-reg_stan03.pdf/reg_stan03.pdf?t=elp8b3hlZmphfDBfqrOCr9Vab35yLKRtq5w)

**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 were 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 the 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 individual CPA.

At the PoA level, REA maintained a record of complete database on all CPAs and the entire PoA. REA cross-checked the data from all the CPAs to ensure their 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, 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 applied standards or tools**

Not applicable

**B.2.4. Changes to programme design**

Not applicable

## **PART II Monitoring of CPAs**

### **SECTION C. Implementation of CPAs**

Of the 8 CPAs included into PoA, only one CPA (ref no: 9904-0004) as mentioned in section A.1.2 was covered in this monitoring report.

**C.1. Description of implemented CPAs**

Only one CPA - Yovi small hydro power project (ref no: 9904-0004) was covered in this monitoring report. The details of the Yovi CPA are provided in the Table 1.

**Table 1: Details of Yovi CPA**

<b>CPA reference no.</b>	<b>CPA name<sup>11</sup></b>	<b>Registered / Included<sup>12</sup></b>	<b>Capacity</b>	<b>Project implementer</b>
9904-0004	Yovi small hydro power project	06/11/2015	2.3 MW	Yovi Hydro Power Company Limited

This report was prepared as a monitoring report number 02 for Yovi CPA for the first monitoring period from - 08/05/2014 to 31/12/2016 (first and last days included) under the registered PoA. The timeline for the project implementation of these CPAs are furnished in the table 2.

<sup>11</sup> For simplicity, in this monitoring report the CPA is shortly referred to as Yovi.

<sup>12</sup> [https://cdm.unfccc.int/ProgrammeOfActivities/poa\\_db/DEI4JOVUTN7A0936CP1WLMMSGYB58ZF/viewCPAS](https://cdm.unfccc.int/ProgrammeOfActivities/poa_db/DEI4JOVUTN7A0936CP1WLMMSGYB58ZF/viewCPAS)

**Table 2: Timeline of the CPA implementation**

Description	Date
CPA start date	19/07/2012
CPA inclusion date	06/11/2015
Start date of the first crediting period	01/12/2015
Commissioning date of phase I (1 MW)	06/11/2015 <sup>13</sup>

The implementation of phase II (1.3 MW) of the power plant is delayed and is expected to be commissioned by 2019. The delay is mainly due to the challenges faced in the mobilization of funds.

#### **Technical description of Yovi CPA:**

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

Yovi CPA was 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 first phase, a 1 MW Pelton turbine and 33 kV transmission line was constructed to supply electricity to the national grid. In the next phase, an additional 1.3 MW Pelton turbine will be installed. Also, an isolated mini-grid network will be developed.

The hydropower plant utilized the natural head in the Yovi River. The powerhouse was 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 was a one floor building with a pitched roof, that lodged the Pelton turbines and all the related electrical and mechanical equipment. The main features of the 2.3 MW hydro power plant were given in table 3.

**Table 3: Specification of 2.3 MW hydro power plant**

Water level at the diversion weir (minimum)	1,225.01 m 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
Mean flow	360 l/s - 520 l/s
Installed Capacity	2.3 MW
Penstock diameter	600 mm
Penstock length	1,725 m
Expected generation	15.1 GWh per year

<sup>13</sup> Yovi-TANESCO interconnection report dated 26/11/2015



The technical specification of installed 1 MW hydro power plant is given in table 4.

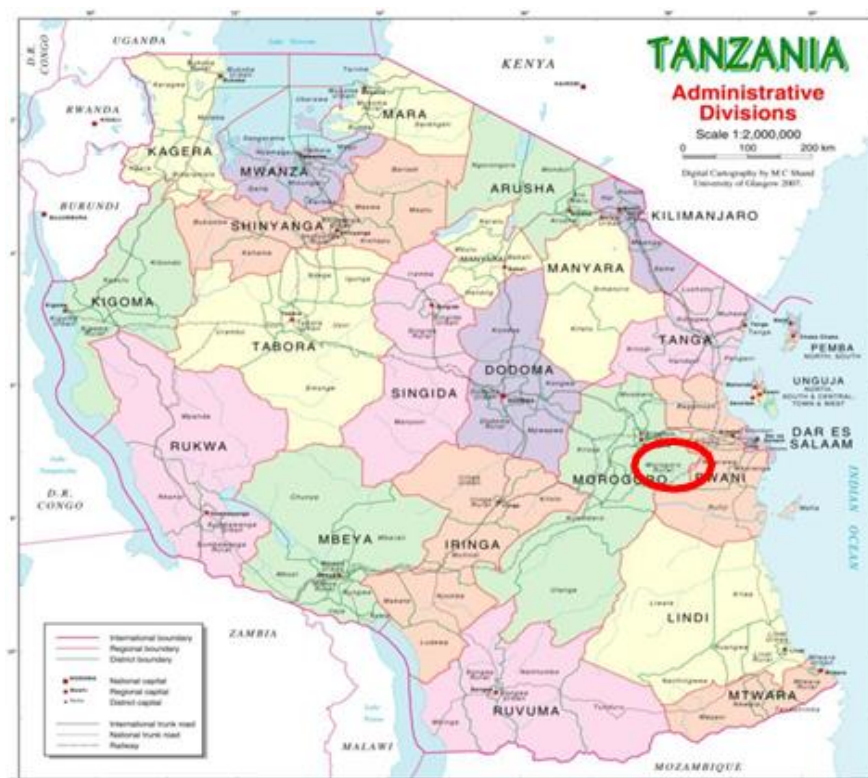
**Table 4: Specification of installed power plant for phase 1**

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

The net emission reduction achieved in Yovi CPA during this monitoring period was 1,996 tCO<sub>2</sub>e.

## C.2. Location of CPAs

Yovi small hydro power project was located along the Yovi River at Mululu area, Msowelo hamlet/kitongoji, Msolwa Village, Kisanga Ward, Kilosa District, Morogoro Region. Yovi River was a tributary of Great Ruaha River, in the Morogoro region. The location of the CPA is given in the figure 2. The specific location of the intake is at 36.7081° E; 7.1829° N, elevation 1224.30 m AMSL. The powerhouse is to be located at 36.7141° E; 7.1934° N, elevation 867 m AMSL.



**Figure 2: Location map of Yovi small hydro power project<sup>14</sup>**

<sup>14</sup> [http://www.foreign.go.tz/index.php/tanzania/category/country\\_profile/](http://www.foreign.go.tz/index.php/tanzania/category/country_profile/)

**C.3. Post-registration changes to CPAs****C.3.1. Temporary deviations from the monitoring plans in the included CPA-DDs, applied methodologies or standardized baselines**

Not applicable

**C.3.2. Corrections**

Not applicable

**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 applied standards or tools**

Not applicable

**C.3.6. Changes to project design**

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 and it was approved by the Board on 31/01/2019 (Ref. No. 9904-PRC-003) .

**SECTION D. Description of monitoring system of CPAs**

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

The management system was developed in accordance with the “CDM project standard for programmes of activities” Version 01.0, EB93.

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

To ensure that the data was 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 3 - Power projects connected to both grid and mini-grid

**Monitoring data**

The following were the parameters to be monitored by the CPA:

- Net electricity generation supplied to the national grid
- Net electricity supplied to the mini-grid

During this monitoring period, the CPA supplied power only to the TANESCO national grid. No power was supplied to the TANESCO mini-grid. The power supply to national grid was monitored by the plant operators at their project site and were entered in data sheets.

### Monitoring procedure

The gross electricity generation, if possible, 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 occurring with the monitoring equipment were also captured. 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 were designed and manufactured to the accepted standards (Regulatory standards were followed for each electricity meter). CPA provided all information regarding the metering devices including accuracy class and calibration frequency required, at least annually.
- All monitoring equipment were located in secure locations free from the possibility of accidental damage
- Routine maintenance and calibration of all monitoring equipment were performed in accordance with the utility standards, regular standards or the manufacturer's specification, whenever applicable, to ensure that the data remained accurate.

When all the generated electricity was delivered to the national grid, then the emission reduction (ER) was 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 were the main base for ER calculation.

The technical specifications of power meters installed at the power plant is provided in the table 5.

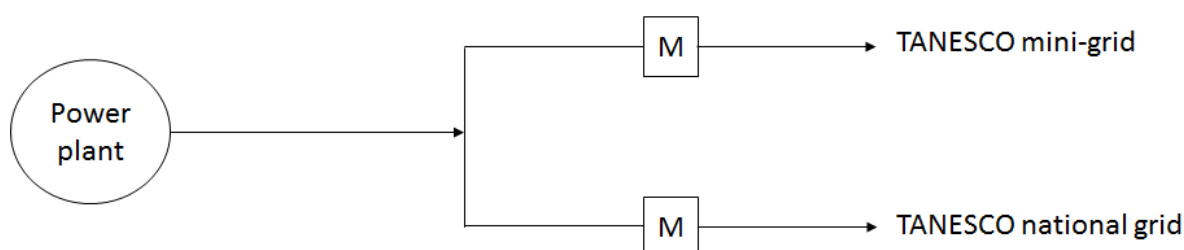
**Table 5: Technical details of the power meters installed at the grid export point in Yovi**

Parameter	Main meter	Check meter
Model	EDMI	EDMI
Type	Bi-directional	Bi-directional
Accuracy	0.5 S	0.5 S
Serial number	208304008	208302546
First calibration date	06/11/2015	06/11/2015

Parameter	Main meter	Check meter
Second calibration date <sup>15</sup>	03/03/2017	03/03/2017

The validity of first calibration ended on 05/11/2016. The second calibration has been carried out by the TANESCO only on 03/03/2017. As per the second calibration testings, the error identified for the Yovi CPA is still less than the permissible limit of 0.5%. Therefore, for the delay period of November and December 2016 (within the reported monitoring period of this CPA), the maximum error of 0.5% is discounted in the readings before the CER estimations as per the guideline (paragraph 352) of CDM validation and verification standard, version 02

The metering points for the CPA is given in figure 3.



**Figure 3: Metering points of Yovi CPA**

During this monitoring period, the CPA was connected only to the national grid.

### Quality assurance and quality control

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 project site has prepared a report consisting of the above parameters in electronic format. Both, the hard copy of data as well as the electronic report, were forwarded to the CPA manager, who manages the database for CPA in line with the CDM requirements under the supervision of REA.

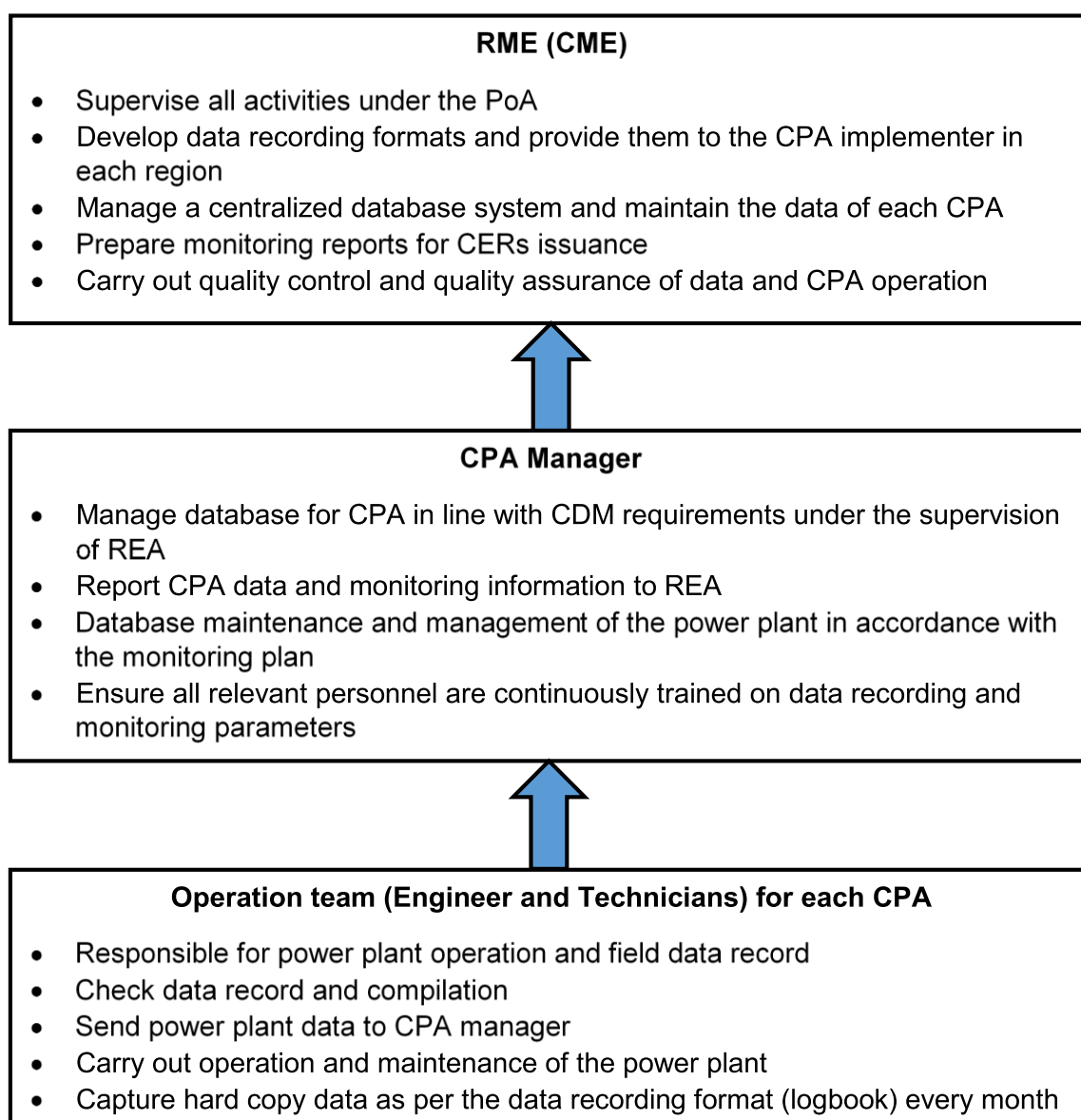
After the quality control, the CPA manager sent the consolidated data collected to REA. Being the CME, REA was responsible for the management of records and data associated with each SSC-CPA. REA maintained the overall programme database for these records. The project manager of the PoA was responsible for the overall programme database and maintained the records of all the CPAs under this programme. The operation and management structure for the monitoring was shown in the figure 4.

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 the grid was cross checked as gross energy generation in the project activity power plant minus the auxiliary/station electricity consumption, technical losses

<sup>15</sup> As per TANESCO letter dated 03/03/2017

and electricity import from the grid to the project power plant measured at the grid interface/connection used for billing purposes.



**Figure 4: Operational and management structure for monitoring**

## **SECTION E. Data and parameters**

### **E.1. Data and parameters fixed ex ante**

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

*(Copy this table for each data or parameter.)*

<b>Data/Parameter</b>	<b>EF<sub>CO2,grid,y</sub></b>
Unit	tCO <sub>2</sub> e/MWh
Description	CO <sub>2</sub> emission factor of the grid in year y
Source of data	Calculated as described in part II 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 was 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 was used. Details of calculation were provided in part II of section B.6.3 in PoA DD.
Purpose of data/parameter	Calculation of baseline emissions
Additional comments	The value is fixed ex-ante for the first crediting period.

<b>Data/parameter</b>	<b>EF<sub>CO<sub>2</sub>,m,i,y</sub></b>
Unit	tCO <sub>2</sub> /GJ
Description	CO <sub>2</sub> emissions factor of fossil fuel type i used in power unit m in year y
Source of data	IPCC 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 <sub>2</sub> /GJ Natural Gas - 0.0543 tCO <sub>2</sub> /GJ
Choice of data or measurement methods and procedures	No data for the fuels used in Tanzania was available. Hence IPCC defaults were used. For the calculation of the Simple Adjusted OM these figures were updated once, at the start of each crediting period in accordance with the applicable IPCC data at that time. For the BM, these figures were updated once, at the start of each crediting period with the applicable IPCC data at the time.
Purpose of data	Calculation of baseline emissions
Additional comments	Not applicable

<b>Data/parameter</b>	<b>EF<sub>EL,m,y</sub></b>																														
Unit	tCO <sub>2</sub> /MWh																														
Description	CO <sub>2</sub> emissions factor of power unit m considered in grid emission factor calculation in year																														
Source of data	TANESCO																														
Value(s) applied	<table border="1"> <thead> <tr> <th>Plants</th><th>Emission Factor EF<sub>EL,m,y</sub> (tCO<sub>2</sub>/MWh)</th></tr> </thead> <tbody> <tr><td>Zuzu</td><td>0.69</td></tr> <tr><td>Tegeta Gas Plant (TGP)</td><td>0.46</td></tr> <tr><td>Ubungo Gas Plant (UGP)</td><td>0.45</td></tr> <tr><td>SONGAS UGT1&amp;2</td><td>0.57</td></tr> <tr><td>SONGAS UGT3,4,5&amp;6</td><td>0.54</td></tr> <tr><td>IPTL</td><td>0.70</td></tr> <tr><td>NYAKATO</td><td>0.69</td></tr> <tr><td>AGR(TG)</td><td>0.66</td></tr> <tr><td>AGR(UB)</td><td>0.66</td></tr> <tr><td>UGP 2</td><td>0.53</td></tr> <tr><td>SYMB UB GP</td><td>0.49</td></tr> <tr><td>SYMB UB JET A</td><td>0.66</td></tr> <tr><td>SYMB (AR)</td><td>0.66</td></tr> <tr><td>SYMB (DD)</td><td>0.66</td></tr> </tbody> </table>	Plants	Emission Factor EF <sub>EL,m,y</sub> (tCO <sub>2</sub> /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
Plants	Emission Factor EF <sub>EL,m,y</sub> (tCO <sub>2</sub> /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 for each power unit, m.																														
Purpose of data	Calculation of baseline emissions.																														
Additional comments	Not applicable																														

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	<table><tr><th>Plants</th><th>Type of fuel</th><th>Technology used</th><th>Efficiency (%)</th></tr><tr><td>Zuzu</td><td>Diesel &amp; Industrial oil</td><td>Open cycle</td><td>37.8%</td></tr><tr><td>Tegeta Gas Plant (TGP)</td><td>Natural Gas</td><td>Open cycle</td><td>42.4%</td></tr><tr><td>Ubungo Gas Plant (UGP)</td><td>Natural Gas</td><td>Open cycle</td><td>43.0%</td></tr><tr><td>SONGAS UGT1&amp;2</td><td>Natural Gas</td><td>Open cycle</td><td>34.1%</td></tr><tr><td>SONGAS UGT3,4,5&amp;6</td><td>Natural Gas</td><td>Open cycle</td><td>36.4%</td></tr><tr><td>IPTL</td><td>HFO</td><td>Open cycle</td><td>39.0%</td></tr><tr><td>NYAKATO</td><td>Diesel &amp; Industrial oil</td><td>Open cycle</td><td>38.0%</td></tr><tr><td>AGR(TG)</td><td>Diesel &amp; Industrial oil</td><td>Open cycle</td><td>39.5%</td></tr><tr><td>AGR(UB)</td><td>Diesel &amp; Industrial oil</td><td>Open cycle</td><td>39.5%</td></tr><tr><td>UGP 2</td><td>Natural Gas</td><td>Open cycle</td><td>37.0%</td></tr><tr><td>SYMB UB GP</td><td>Natural Gas</td><td>Open cycle</td><td>39.5%</td></tr><tr><td>SYMB UB JET A</td><td>Diesel &amp; Industrial oil</td><td>Open cycle</td><td>39.5%</td></tr><tr><td>SYMB (AR)</td><td>Diesel &amp; Industrial oil</td><td>Open cycle</td><td>39.5%</td></tr><tr><td>SYMB (DD)</td><td>Diesel &amp; Industrial oil</td><td>Open cycle</td><td>39.5%</td></tr></table> <p>Efficiency factor of AGR and SYMB plants were taken from Appendix 1 of the “Tool to calculate the emission factor for an electricity system” for plant built after 2000.</p>	Plants	Type of fuel	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	38.0%	AGR(TG)	Diesel & Industrial oil	Open cycle	39.5%	AGR(UB)	Diesel & Industrial oil	Open cycle	39.5%	UGP 2	Natural Gas	Open cycle	37.0%	SYMB UB GP	Natural Gas	Open cycle	39.5%	SYMB UB JET A	Diesel & Industrial oil	Open cycle	39.5%	SYMB (AR)	Diesel & Industrial oil	Open cycle	39.5%	SYMB (DD)	Diesel & Industrial oil	Open cycle	39.5%
Plants	Type of fuel	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	38.0%																																																										
AGR(TG)	Diesel & Industrial oil	Open cycle	39.5%																																																										
AGR(UB)	Diesel & Industrial oil	Open cycle	39.5%																																																										
UGP 2	Natural Gas	Open cycle	37.0%																																																										
SYMB UB GP	Natural Gas	Open cycle	39.5%																																																										
SYMB UB JET A	Diesel & Industrial oil	Open cycle	39.5%																																																										
SYMB (AR)	Diesel & Industrial oil	Open cycle	39.5%																																																										
SYMB (DD)	Diesel & Industrial oil	Open cycle	39.5%																																																										
Choice of data or measurement methods and procedures	Data from the Tanzania grid company were used as available. Default values were used for plants where data were not available.																																																												
Purpose of data	Calculation of baseline emissions																																																												
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 spread sheet
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	Calculation of baseline emissions
Additional comments	Not applicable

Data/parameter	EG <sub>k,y</sub>
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 spread sheet
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	Calculation of grid emission factor
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 <sub>CO<sub>2</sub>,y</sub>
Unit	tCO <sub>2</sub> e/MWh
Description	CO <sub>2</sub> emission factor for displacement of electricity in the mini-grid and/or the captive power plant.
Source of data	Table I.F.1. of AMS-I.F.
Value(s) applied	0.8
Choice of data or measurement methods and procedures	<p>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.</p> <p>The installed capacity was larger than 200 kW. Thus, the value of 0.8 tCO<sub>2</sub>e/MWh was used. This is the emission factor for a modern diesel generating unit of capacity larger than 200 kW.</p>
Purpose of data	Calculation of baseline emissions
Additional comments	Not applicable

**E.2. Data and parameters monitored**

(Copy this table for each data or parameter.)

For CPA category 3, the parameters of both CPA category 1 and CPA category 2 are applicable.

**CPA Category1: CPAs supplying the national grid (AMS-I.D. Grid connected renewable electricity generation)**

Data/parameter	EG <sub>actual,y</sub> /EG <sub>BL,y</sub> (Category1)			
Unit	MWh/year			
Description	Quantity of net electricity supplied to the national grid in year y.			
Measured/calculated/default	Measured			
Source of data	Measured by energy meters.			
Value(s) of monitored parameter				
	CPA	Power supplied to the grid (MWh/year)		
		2014	2015	2016
		Yovi	NA	123.452



Monitoring equipment	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)	<p>Measurements were taken using energy meters. Bidirectional energy meters were installed so that any eventual electricity supplied by the grid to the project or to the communities was not included in the ER calculation.</p> <p>Measurement results were cross checked with records for sold/purchased electricity (e.g., invoices/receipts).</p> <p>The net electricity exported/supplied to a grid was the difference between the measured quantities of the grid electricity export and the import. The net electricity supplied to a grid were 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.</p>
QA/QC procedures	<p>The device was calibrated and/or tested as per the instructions (schedules, procedures) for QA of the technology provider and/or EWURA's standard.</p> <p>There was compliance with the maintenance schedule recommended by the technology provider and/or EWURA. The quality control was ensured by EWURA's SSPA that mandates monthly readings, with rated error no greater than 0.5%.</p> <p>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 were correct.</p>
Purpose of data	Calculation of baseline emissions
Additional comments	Not applicable.

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

Data/parameter	EG <sub>BL,y</sub>														
Unit	MWh/year														
Description	Quantity of net electricity supplied to the mini-grid in year y.														
Measured/calculated/default	Measured														
Source of data	Measured by bi-directional energy meters.														
Value(s) of monitored parameter	<b><u>To mini-grid (plant is not connected to mini-grid yet)</u></b> <table><tr><td rowspan="2">CPA</td><td colspan="3">Power supplied to the mini grid (MWh/year)</td></tr><tr><td>2014</td><td>2015</td><td>2016</td></tr><tr><td>Yovi</td><td>NA</td><td>0</td><td>0</td></tr></table>				CPA	Power supplied to the mini grid (MWh/year)			2014	2015	2016	Yovi	NA	0	0
CPA	Power supplied to the mini grid (MWh/year)														
	2014	2015	2016												
Yovi	NA	0	0												
Monitoring equipment	Bi-directional energy meters														
Measuring/reading/recording frequency	Continuous monitoring, hourly measurement and at least monthly recording.														
Calculation method (if applicable)	Measurements were taken using energy meters. In the case of electricity sold to a third party, measurement results were cross-checked with records of sold/purchased electricity (e.g., invoices/receipts). The net electricity displaced was the gross energy generation by the project activity power plant minus the auxiliary/station electricity consumption.														

QA/QC procedures	<p>The device was calibrated and tested by the CPA implementer as per the instructions (schedules, procedures) for QA of the technology provider and EWURA's standard.</p> <p>There were 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%.</p> <p>Quality control and assurance were achieved through a monthly check of the monitoring log sheet, which was signed by plant staff to acknowledge that the parameters were correct.</p>
Purpose of data	Calculation of baseline emissions
Additional comments	The data will be archived for two years after the crediting period.

### 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

Yovi small power plant was a green field project, which supplies power to TANESCO national grid and mini grid. Currently Yovi power plant was supplying power only to the national grid.

#### Baseline emissions

As the Yovi CPA was 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 were calculated as follows:

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

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

Where:

$BE_{y, (Category 1)}$  = Baseline emissions in year y (tCO<sub>2</sub>) for electricity supplied to the national grid

$EG_{BL,y, (Category 1)}$  = 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<sub>2</sub> emission factor of the grid in year y (tCO<sub>2</sub>/MWh)

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

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

Where:

$BE_{y, (Category 2)}$  = Baseline emissions in year y (tCO<sub>2</sub>) for electricity supplied to the mini-grid

$EG_{BL,y, (Category 2)}$  = Quantity of net electricity supplied to the mini-grid as a result of the implementation of the CDM project activity in year y (MWh)

$EF_{CO2, grid, y}$  = CO<sub>2</sub> emission factor of the grid in year y (tCO<sub>2</sub>/MWh)

The details of net electricity exported to the national grid are given in table 6. The mini-grid is not yet established and there was no power supply to the mini-grid during this monitoring period.

Table 6: Net electricity exported to grid from Yovi

Time period		Electricity exported to grid	Electricity imported from grid	Net electricity exported $EG_{\text{actual},y}$	Net electricity after calibration error
From	To	(MWh)	(MWh)	(MWh)	MWh
		A	B	C=A-B	
01/12/2015	31/12/2015	123.453	0.001	123.452	123.452
01/01/2016	31/01/2016	238.767	0.001	238.766	238.766
01/02/2016	29/02/2016	429.335	0.000	429.335	429.335
01/03/2016	31/03/2016	148.079	0.000	148.079	148.079
01/04/2016	30/04/2016	435.862	0.000	435.862	435.862
01/05/2016	31/05/2016	551.941	0.000	551.941	551.941
01/06/2016	30/06/2016	107.414	0.001	107.413	107.413
01/07/2016	31/07/2016	0.000	0.000	0.000	0.000
01/08/2016	31/08/2016	123.991	0.000	123.991	123.991
01/09/2016	30/09/2016	556.200	0.000	556.200	556.200
01/10/2016	31/10/2016	200.954	0.000	200.954	200.954
01/11/2016	30/11/2016	446.108	0.005	446.103	443.872
01/12/2016	31/12/2016	408.986	0.000	408.986	406.941
<b>Total</b>		<b>3,771.090</b>	<b>0.008</b>	<b>3,771.000</b>	<b>3,766.000</b>

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

a) For power supplied to TANESCO grid:

$$\begin{aligned}
 BE_{y(\text{Category1})} &= EG_{BL,y,(\text{Category1})} \times EF_{CO_2,grid,y} \\
 &= 3,766 \text{ MWh} \times 0.530 \text{ tCO}_2/\text{MWh} \\
 &= 1,996 \text{ tCO}_2
 \end{aligned}$$

b) For power supplied to mini grid:

$$\begin{aligned}
 BE_{y(\text{Category2})} &= EG_{BL,y,(\text{Category2})} \times EF_{CO_2,grid,y} \\
 &= 0 \text{ (since the mini grid is not yet established under Yovi CPA)}
 \end{aligned}$$

The baseline emissions for the CPA based on the power supply to the grid and mini-grid is summarized as in table 7.

Table 7. Summary of baseline emissions of the CPA

Time period		Net electricity generation EG <sub>actual,y</sub>	Grid emission factor	Baseline emission BE <sub>y</sub>
From	To	(MWh)	(tCO <sub>2</sub> /MWh)	(tCO <sub>2</sub> )
		A	B	C = A*B
Baseline emissions for electricity supplied to grid				
01/12/2015	31/12/2016	3,766	0.53	1,996
Baseline emissions for electricity supplied to grid				
01/12/2015	31/12/2016	0	0.80	0

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

The CPA was generating power from the run-of-the-river type hydro power projects. Hence, the project emission was considered as zero.

$$PE_{y(\text{Category}1)} = 0$$

**F.3. Calculation of leakage emissions**

As per AMS-I.D. and AMS-I.F., leakage had to be considered, if there was any energy generating equipment transfer from another activity. The CPA under the PoA did not involve any transfer of equipment from another activity. All systems comprised only newly procured equipment. Hence, the leakage emission due to equipment transfer was not considered for the CPA under this PoA.

$$LE_{y(\text{Category}3)} = 0$$

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

CPA UNFCCC reference number	Baseline GHG emissions or baseline net GHG removals (t CO <sub>2</sub> e)	Project GHG emissions or actual net GHG removals (t CO <sub>2</sub> e)	Leakage GHG emissions (t CO <sub>2</sub> e)	GHG emission reductions or net anthropogenic GHG removals (t CO <sub>2</sub> e)		
				Before 01/01/2013	From 01/01/2013	Total amount
9904-0004	1,996	0	0	0	1,996	1,996
<b>Total</b>	<b>1,996</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1,996</b>	<b>1,996</b>

**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 (t CO <sub>2</sub> e)	Amount estimated ex ante (t CO <sub>2</sub> e)
9904-0004	1,996	5,372
<b>Total</b>	1,996	5,372

**F.6. Remarks on increase in achieved emission reductions**

The overall CER generated during the reported monitoring period is 63% less than the estimated CERs from the registered CPA. During the monitoring period, the power plant faced synchronisation issues when exporting power to the national grid. The project developer and the TANESCO were working together to resolve this issue. This is the reason for the decreased power generation and export from the CPA.

- - - - -

## Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
02.0	7 June 2017	Revision to: <ul style="list-style-type: none"><li>• Ensure consistency with version 01.0 of the “CDM project standard for programmes of activities (CDM-EB93-A07-STAN);</li><li>• Make editorial improvements.</li></ul>
01.0	1 April 2015	Initial publication.
Decision Class: Regulatory Document Type: Form Business Function: Issuance Keywords: monitoring report, programme of activities		