Monitoring report form
(Version 04.0)

MONITORING REPORT	
Title of the project activity	Mwenga Hydro Power Project
Reference number of the project activity	9550
Version number of the monitoring report	6
Completion date of the monitoring report	15/03/2015
Registration date of the project activity	30/01/2013
Monitoring period number and duration of this monitoring period	Monitoring Period 1, 30/01/2013 – 29/01/2014 (both days included)
Project participant(s)	Mwenga Hydro Limited, Swedish Energy Agency
Host Party(ies)	United Republic of Tanzania
Sectoral scope and selected methodology(ies), and where applicable, applied standardized baseline(s)	Sectoral Scope 1: Energy industries (renewable - / non-renewable sources) Renewable Electricity Generation for Captive use and Mini Grid (AMS-I.F. ver. 2) Grid connected renewable electricity generation (AMS-I.D. ver. 17)
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	11,354 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	10,209 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period up to 31 December 2012(if applicable)	Not Applicable
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period from 1 January 2013 onwards (if applicable).	Not Applicable

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The purpose of the project activity is to generate electricity via a hydroelectric plant and distribute it to 1) The Mufindi Tea Company (MTC) via a mini-grid (supplementing or replacing current national grid electricity provided to MTC); and 2) the TANESCO national electricity grid. Although these two components of the project use different methodologies (AMS-I.F. and AMS-I.D., respectively), the electricity distributed to the MTC and TANESCO offsets emissions from generating electricity that would otherwise come from the national grid.

Power is also distributed to local villages, but the emissions offset by distribution to villages are not counted toward emissions reductions because of the impracticality of determining valid and verifiable baseline emissions for the villages.

The generation equipment is based on hydro electric technology, and consists of a single vertical axis Francis turbine that generates electricity at 6.6 kV, for subsequent transformation to match that required by the grid. The installed capacity of the project is 3.486MWe. The manufacturer of the Turbine is Serman Energy, it has a maximum nameplate capacity of 3612kW and serial number A100 45T. The manufacturer of the Alternator is Comelmar Italia, it is 5000kVa and has serial number 118957. Approximately 60 meters of head is available at this site through the use of a diversion weir, headrace, sediment tank, penstock, draft tube and tail race. The generated electricity is supplied to the interconnection facility that supplies both the grid and the MTC tea factory via a 33 kV overhead power line.

Construction of the project started on 17th November 2010. The project received its interconnection certificate from the National Utility, TANESCO, on the 17th September 2012, after the successful start up and testing of the plant on 1st September 2012. The hydro plant has operated successfully since this date, and continues to do so. CDM registration was achieved on 30th January 2013.

The total GHG emission reductions achieved over the monitoring period that began at the beginning of the day on 30th January 2013 and completed at the end of the day of the 29th January 2014, is estimated at 10,209 tCO_2e.

A.2. Location of project activity

Iringa Region in southern Tanzania, Mufindi District.

The hydro power plant site is located on the Mwenga River, at approximately 8°37'18.63" S 35°41'30.54" E for the weir and silt collection, and approximately 8°37'27.07" S 35°41'22.82" E for the powerhouse. The site is about 55km by dirt and gravel road from the MTC headquarters, which in turn is located some 30km by dirt and gravel road from the Mafinga Junction, which is the nearest paved road. Access to the site is available only by dirt and gravel roads in isolated mountainous terrain.

There is a small unpaved airstrip approximately 52 km by air from the site, but the site is still only accessible from there by dirt and gravel roads or by foot. The nearest public airport is the Iringa airport, which is approximately 170 km away by road. The nearest train station is at Makambako, about 100 km by air, and 160 km by road. The railway line—without a stop—passes within 20km of the site through the village of Mpanga, but the project site is accessible from there only by foot.

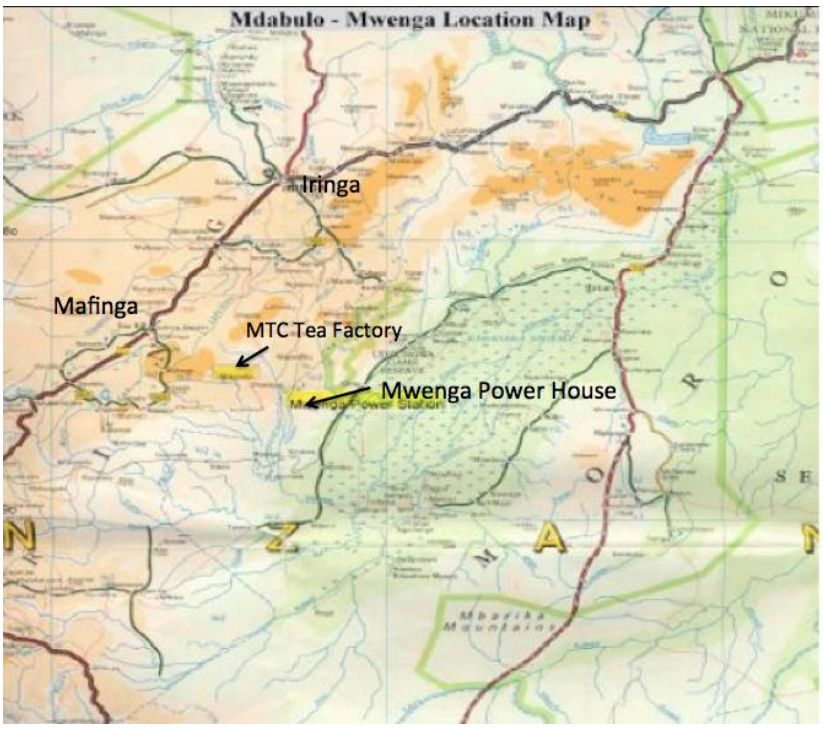

Fig A.1 – Location Map (Iringa Region) for Mwenga Hydro Plant

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
United Republic of Tanzania (Host)	Private entity: Mwenga Hydro Limited	No
Sweden	Public entity: Swedish Energy Agency	No

A.4. Reference of applied methodology and standardized baseline

Renewable Electricity Generation for Captive use and Mini Grid (AMS-I.F. ver. 2), available at http://cdm.unfccc.int/methodologies/DB/9V3T8W0N5PMCJH4YVEA04YYFTVHP3Q.

Grid connected renewable electricity generation (AMS-I.D. ver. 17), available at http://cdm.unfccc.int/methodologies/DB/RSCTZ8SKT4F7N1CFDXCSA7BDQ7FU1X

In addition, the following tool is used:

- Tool to calculate the Emissions Factor for an electricity system (version 2.2.0), available at http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.2.0.pdf.

A.5. Crediting period of project activity

30/01/2013 – 29/01/2020 (Renewable)

A.6. Contact information of responsible persons/ entities

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SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

The project is a 3.486MW (at generator terminals) run-of-river hydro power plant operated by Mwenga Hydro Limited (MHL).

Hydrology: Considerable hydrological data have been recorded since 1957 by various entities, including the Tanzania Ministry of Water and MTC. According to the feasibility study conducted by Ninham Shand in July 2008, a flow rate of 7 m^3/s is exceeded 70% of the time (on an annual basis).[1]

Flow and the power potential: Based on a flow of 7m^3/s, using the design recommended in the feasibility study, the estimated annual power generation of 24,000 MWh can be achieved as given in Table A.1[2], for a plant load factor of 82.8%, which was determined ex-ante, as substantiated in the registered Project Design Document (PDD) and the revised PDD.

The project is a run-of-river scheme diverting water via a diversion weir from the main river course to a small water channel / headrace running 70m to the forebay/desilting tank, where water then flows through a 340m long steel penstock pipe to the power house, and finally discharged back into the river via a draft tube and tail race. A single unit Francis turbine was installed in the powerhouse. The water drops a gross head of 60m from the forebay tank to the turbine.

The river between the extremities of the scheme includes a steep waterfall and a series of small rapids. The headrace canal effectively bypasses this normal watercourse and facilitates a controlled drop of approximately 60m through the penstock.

The location of the diversion weir is on a natural rock outcrop above the waterfall. A ledge in the rock, some 50m upstream of the falls, forms a natural weir with a solid foundation. This was ideal for the construction of a concrete weir. The valley sides at this position are relatively steep, facilitating a narrow and compact structure. A 2.5 m high concrete gravity weir structure was constructed on top of the natural rock to allow for adequate water draw-off facilities. A tongue wall extends into the hillsides at each end of the weir to provide for seepage cut off around the structure. The total crest length is approximately 25m. Draw off facilities take the form of a top entry grated channel feeding the headrace.

A 70m long (2 m x 2 m at a slope of 1V:750H) low-head closed conduit was constructed to convey water from the weir to the top of the penstock. It allows for soil, debris, and storm water flow to pass over the conduit and further provided the benefits of reduced excavation compared to an open canal. The conduit was graded to match the hydraulic losses at the design flow and takes a gently winding route around the hill to the headrace. The conduit was formed of in situ concrete.

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[1] Mwenga River Hydro Project Feasibility Study Report Ninham Shand, July 2008.

[2] This corresponds to net generation output detailed in the financial model submitted to banks to justify financing.

The conduit was shallowly excavated. Where necessary, adequate cross drainage at regular intervals to prevent buoyancy, was provided. Drainage takes the form of a no-fines blinding layer and or wick drains on the up-slope side of the structure. Joints are sealed PVC waterbar at 6m intervals. The closed conduit operates as a low pressure conduit.

A sediment trap was constructed that slows the flow rate of the water down to 0.25 m/s (from 1.5 m/s) to allow settling to occur within the tank. The tank is equipped with flushing facilities to drain accumulated debris. A spillway was built into the side of the sediment tank in order to cater for varying powerhouse operation conditions which are likely to transmit surges through the penstock to the proposed canal. These surges will drain safely over the spillway back to the nearby river.

The 340m-long penstock was constructed from 1.5m diameter steel pipes, buried in places and provided with regular anchor blocks to ensure stability on the steep slope. This layout is suitable in view of the remoteness of the site for ease of construction.

For run-of-river type hydropower projects where stream flow passes through without much modification, specific flow release requirements are generally not required. However, this specific scheme diverts a portion[3] of the water from the Mwenga River which reduces flow over a stretch of some 0.45km of waterfalls and rapids. The length of river, which can potentially be deprived of flow during dry season is of the order of 450m and consists mainly of a high waterfall and some subsequent small rapids. After some testing and environmental monitoring, the final Water Use Permit was issued with a requirement of $1m^3/s$ environmental flow for maintenance of the river during periods of low flow.

A Francis type turbine was chosen for the project. This specific turbine is capable of operating at flow rates below 40% of the rated flow, and is unusually efficient in this regard. The turbine provides significant benefits in terms of space usage, efficiency, ease of installation and operation. Key technical characteristics of the technology applied in this project are given in the Table below:

Table B.1.: Technical characteristics[4]

Hydrology	
Design flow	7 m^3/sec
Design Head	60m
Turbine	
Type	Francis
Number of units	1
Power (turbine axis)@ 100% flow	3.612 MW[5]
Power (at generator Terminals)	3.486 MW[6]
Generator	
Type	Synchronous 3 Phase
Interlinked Voltage	6.6 KV

[3] From the flow data of Mwenga River the flow of $7m^3/s$ will be insufficient only in three months i.e. October, November & December. The volume of water to be diverted to the power channel is 7 m^3 running every second. From the EIA conducted it is recommended that since there is no specific In-stream or Environmental Flow Requirements (EFR) defined for Tanzania, it was proposed that 10% of the observed annual minimum flow be left flowing to the normal river course which is $0.45m^3/s$ as indicated in pg 130 of the Environmental Impact Statement, EIS report

[4] Serman Energy S.RL. Technical Specification for Hydroelectric Turbine and Generator Package .Mufindi, Iringa District, Tanzania.

[5] Maximum instantaneous power estimated at 3.850 MW after operational testing at very high water flow conditions.

[6] Maximum instantaneous power measured at 3.750 MW after operational testing at very high water flow conditions.

$\cos\phi$	0.9
Frequency	50 Hz

The powerhouse has a floor plan of 140m^2, and is a conventional concrete and steel portal type structure, with brick infilling and metal sheet roofing, housing the turbine, generator, transformers and the operational control room.

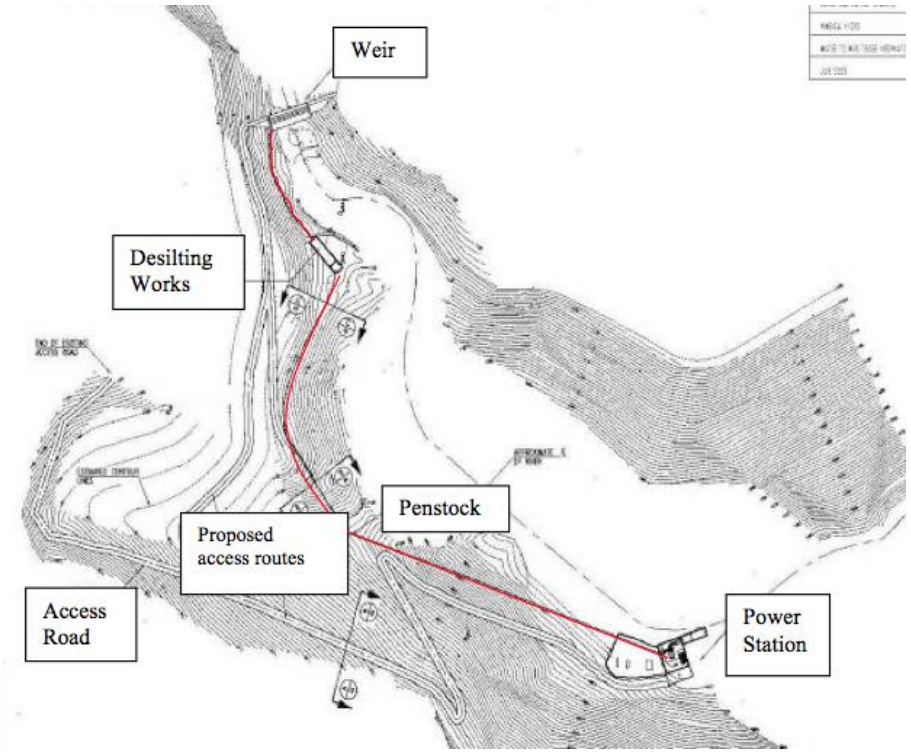

Figure B.1. Mwenga river falls and downstream view of the hydropower plant site[7]

Existing access roads to the power house site consist of dirt and gravel roads that presently provide access to the coffee plantations near the site and that are used for transportation of crops and equipment by 8 ton trucks. The final 10km is a smaller track, generally not provided with gravel wearing course, and has been improved in places to provide more permanent access to the site.

Electricity produced by the Hydropower plant is transported along a 49.7 km 33 kV line to the grid interconnection point located just outside the MTC Processing Factory. A number of villages along the path of this line will be connected and it is estimated that approximately 35 km of minor spur lines have now been installed for this purpose. An estimated 40 km of LV distribution lines have now been installed within the various target villages.

It is estimated that the amount of electricity to be consumed by the end users located in the various villages that will be fed by the Hydropower plant will be approximately 2,500 MWh/yr in the medium term. It is currently only about 300 MWh per year (based on the usage of our current 850 connected customers), but is rising steadily. End users are expected to eventually include approximately 2,600 rural households, 165 Shops, 20 Schools, 13 Clinics/Dispensaries, 1 Hospital and over 100 SME's, amongst other end users.[8]

[7] Mwenga Hydropower Environmental Impact Statement. July 2009. Nyinisaeli K Palangyo

[8] Baseline Study for Mwenga Hydroproject – Final Report Tea Research Institute of Tanzania, Annex 9, pg 87

Interconnection with the TANESCO grid, for export into this grid, takes place at the Mufindi Tea Estate.

This network is presented in a simplified form in Figure B.2.

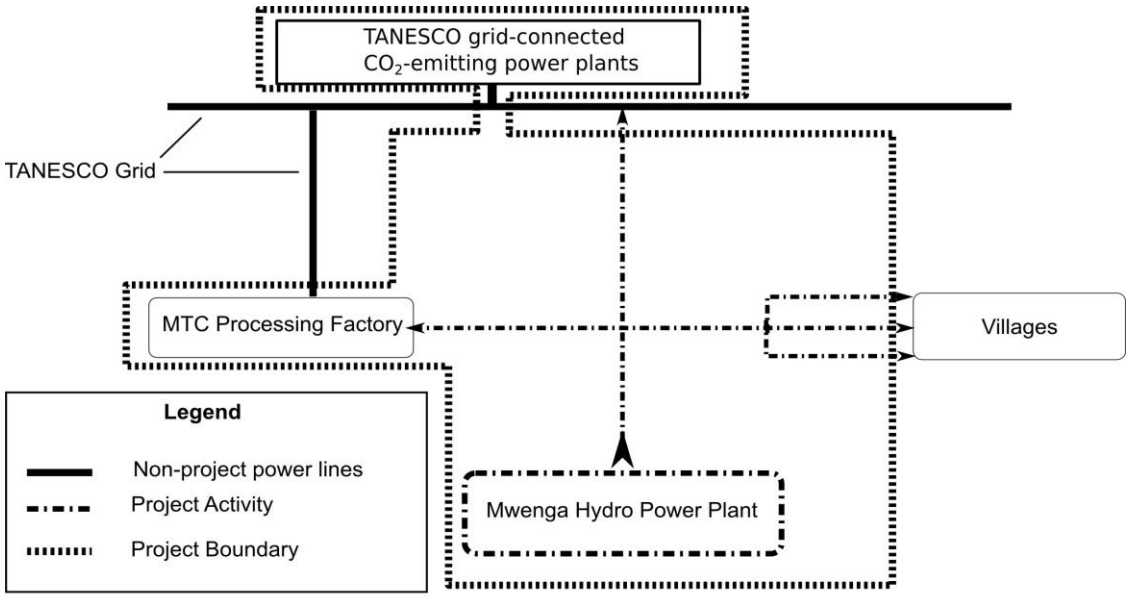

Figure B.2. Simplified schematic diagram illustrating project electricity flow

Using the grid emission factor (GEF) available at the time of PDD submission for registration, the Project was expected to be responsible for reducing approximately 11,354 tCO_2e annually throughout the entire 7-year initial crediting period, thus, generating total reductions of approximately 79,478 tonnes of CO_2e emissions.

The project was first interconnected with the TANESCO grid, commencing regular generation output, on the 1st September 2012. The registration date of the CDM activity and start of the crediting period is given as the 30th January 2013, so for the purposes of this monitoring report we will be deeming the production done prior to the 30th January 2013 as not relevant.

Currently the project has not yet connected the Mufindi Tea Company (MTC) to the network, and does not yet supply electricity directly to the MTC factory. This connection is still planned to be implemented, though is still awaiting approval from TANESCO to implement changes to the TANESCO power lines that supply the factory. This is now expected to be implemented during the course of 2014.

We encountered significant difficulties in meeting production targets in both January and February of 2013 owing to repeated problems with the turbine cooling circuit and draft tube – where both the draft tube itself, and the cooling pipes that were mounted in the tail race kept on cracking due to excessive water hammer related vibrations. Significant downtime was incurred over this period whilst repairs and modifications were made to this area to permanently solve the problem.

In both March and April 2013 significant stoppages resulted from the failure of the overseas based aftersales service provider to remotely reset a PLC fault. This delayed service was a result of the turbine provider declaring bankruptcy, and the contracted aftersales service provider discontinuing service provision. We eventually negotiated a dedicated service provision directly with the service provider.

We also lost a significant amount of production time in both June and July 2013 due to extended grid outages – both within our own network, and in the TANESCO network. We eventually

procured a service vehicle to speed up fault reaction times, and engaged some additional reaction staff, as we were unable to obtain acceptable reaction times from our contractor.

November 2013 saw the introduction of load shedding from TANESCO, which resulted in abnormally high plant down time for this month.

December 2013 production was significantly affected by a planned visit by the aftersales service provider to make final performance adjustments to the turbine, and additionally conduct a thorough inspection of the plant at the same time. Retraining of staff was also undertaken. The visit resulted in an additional 100 kW of peak instantaneous power being made available from the turbine. TANESCO outages were also significant over this period, and continued on into January 2014.

Data relating to the exact periods of downtime and shutdowns is given in the excel sheet “Mwenga downtime figures”. On average we lost approximately 5% of available production time to TANESCO related issues, and 7% of available production time to Mwenga Hydro related issues (both grid and plant related) over the period end January 2013 to end January 2014. It is estimated that 5% of Mwenga Hydro related downtime should be considered as unusual, and non recurrent.

During the initial months of the plant’s operation, the process for recording daily production logs was still in development. For the first three months of the project activity, only monthly figures are available. Because daily figures were not available for the month of January, 2013, to be conservative, production figures from January 2013 have been excluded from power production figures to calculate emissions reductions. It is anticipated that daily production logs will be available for the entirety of future monitoring periods.

There were no events that occurred during the course of the monitoring period which could impact on the applicability of the methodology applied. The project owner confirms that there were no changes to equipment or project design made during any major or minor shutdown within the period in question. Only routine machine adjustments were performed during the course of the year.

B.2. Post registration changes

B.2.1. Temporary deviations from registered monitoring plan, applied methodology or applied standardized baseline

The planned connection of the MTC tea factory to Mwenga Hydro supply has not yet occurred, but is still planned to be done as soon as the appropriate interconnection equipment is procured and installed.
.

Additionally the individual village transformer meters that are planned to be installed at each village transformer as a means of measuring electricity losses within each village (and additionally as a fail safe means of measuring power supplied to TANESCO in the event of TANESCO billing and check meter failure) have not yet been installed. The materials for this have however been procured, and these are currently in the process of being installed. These meters are not necessary for the measurement of the CERs claimed by the project, as these only become relevant in the event of failure of both the main TANESCO billing and check meters – which did not occur. Therefore, there has been no substantive deviation from the registered monitoring plan or applied methodology.

B.2.2. Corrections

There are some changes to the implemented project design to that given in the registered PDD, as outlined below:

1. Small water channel and low head closed conduit runs 70m rather than 50m, as in registered PDD
2. Water permit issued @1 m3/s rather than at 2.5m3/s as estimated in registered PDD
3. The type of turbine and the name plate data of the turbine and alternator have not altered in any way. During routine operational tests conducted over the course of wet seasons of 2013 and 2014, the PO was able to determine the maximum instantaneous capacity available out of the turbine, and subsequently the generator terminals. This information has been added as footnotes 5 and 6 in this monitoring report.
4. Distribution Network: Additional rural distribution infrastructure is larger than that described in the registered PDD. 35 km of minor spur lines have now been installed rather than 34km as estimated in the registered PDD. An estimated 40 km of LV distribution lines have now been installed within the various target villages rather than 30km as estimated in the registered PDD. These are however outside the boundary of the registered CDM project and no CERs are claimed for this element of the project.

These changes do not adversely impact on

- The applicability and application of the applied methodology. The project activity applies the approved small-scale methodologies
    - AMS-I.F Renewable Electricity Generation for Captive use and Mini Grid (version 2),
    - AMS-I.D Grid connected renewable electricity generation (version 17)

  The revised PDD includes the post-registration changes outlined above. Section B.2 of the revised PDD considers the impact of these on the applicability of the methodologies listed above. This analysis found that there was no impact on the applicability and application of the applied methodologies as a result of the post-registration changes listed above.

- The additionality of the project activity. As outlined in the registered PDD for the project, additionality of the project is assessed according to "Guidelines for Demonstrating Additionality of Microscale Project Activities" (version 4)[9]. According to Section II. Paragraph 2 of the Guidelines, project activities of up to 5 megawatts that employ renewable energy as their primary technology (i.e., technologies described in Type I small-scale methodologies including those used by this project) are automatically deemed "additional" if "any one of the conditions below is satisfied" (emphasis appears in the original document):

  (a) The geographic location of the project activity is in one of the least developed countries or the small island developing states (LDCs/SIDs) or in a special underdeveloped zone (SUZ) of the host country.

  [the Guidelines then list multiple other conditions that do not apply to the project activity]

  Considering the changes listed above, the project has an installed capacity <5MW, is a Type 1 project and is located in an LDC. Therefore, the changes above do not adversely impact on the additionality of the project activity.

- The scale of the project activity. Considering the changes listed above, the project capacity is 3.486MWe, well within the small scale project limits. Therefore, the changes above do not adversely impact on the scale of the project activity.

Prior approval by the Board is not therefore required, according to Appendix 1 of the Project Standard (version 7.0)[10]

[9] EB68, Annex 26, available from http://cdm.unfccc.int/EB/index.html

[10] https://cdm.unfccc.int/Reference/Standards/index.html

In the revised PDD, further changes relate to

- Clarification that the Simple Adjusted OM is calculated based on the Ex ante data vintages Option for the estimates appearing in the registered PDD. However, as stated in the Monitoring Plan, Ex Post monitoring shall be used for this parameter.
- Editorial changes due to adoption of new PDD template, listed below:
    - Cover page: completion of additional fields, namely Project participant(s), Host Party, Sectoral scope and selected methodology(ies), and Estimated amount of annual average GHG emission reductions, in line with new PDD template
    - Section A.1 and section A.3: additional text to clarify that the project is a greenfield project and to describe the scenario existing prior to implementation of the project and the baseline scenario
    - Section B.6.2: completion of additional fields, namely purpose of data
    - Section B.7.1: completion of additional fields, namely purpose of data and monitoring frequency
    - Section B.7.2: clarification that this section is not applicable to this project
    - Section F: additional text to confirm that Letters of Approval have been received from the Tanzanian DNA and the Swedish DNA for this project
    - Appendix 1: addition of Camco contact details as responsible entity for application of selected methodologies
    - Appendix 3: Transfer of text from Appendix 3 to Appendix 4
    - Revised Appendix references in the entire PDD text

B.2.3. Permanent changes from registered monitoring plan, applied methodology or applied standardized baseline

Not applicable

B.2.4. Changes to project design of registered project activity

Not applicable

B.2.5. Changes to start date of crediting period

Not applicable

B.2.6. Types of changes specific to afforestation or reforestation project activity

Not applicable

SECTION C. Description of monitoring system

The monitoring plan requires that the parameters indicated in the revised PDD section B.7.1 be monitored for the purposes of CER calculations. However, for operations as a whole, and to provide a backup in case of meter failure at either relevant off-take point, MHL measures, with appropriate meters:

1) Total electricity produced from the power plant
2) Electricity delivered to Mufindi Tea Company (EGBL,y,1)

3) Electricity delivered to TANESCO (EGBL,y,2)

4) Electricity delivered to the villages at the transformer for each village. These village supply transformer meters, in conjunction with the total output meter, will be used for internal auditing purposes to monitor residential meter accuracy and transmission or other losses, and additionally allow reconciliation of power produced and distributed, particularly in the case of meter failure at a given off-take point. These meters are not necessary to track output related to CERs provided that all other meters are in working order. As noted above, these meters have not yet been installed, and both the main and check meters are in working order, thus there is no effect on CER calculations for this monitoring period

As noted in the revised PDD , for $EFCO_2$,y, MHL attempts to obtain from TANESCO on an annual basis $EFCO_2$,y data as calculated based on the most recent three years of available data. Failing this, MHL will attempt to obtain from TANESCO or other reputable sources the weighted average emissions in tCO_2e/MWh in the applicable crediting year. In the event such data are not available, the most recently available figure will be used. This is a conservative approach because the vast majority of grid power added by Tanzania since 2010 has been fossil fuel-based, and the majority of firmly-planned future plants will be fossil fuel-based. Thus, in the absence of more current data, it is likely that a given GEF will likely cause an understatement of emissions reductions.

The following diagram indicates the metering points described in the Monitoring Plan.

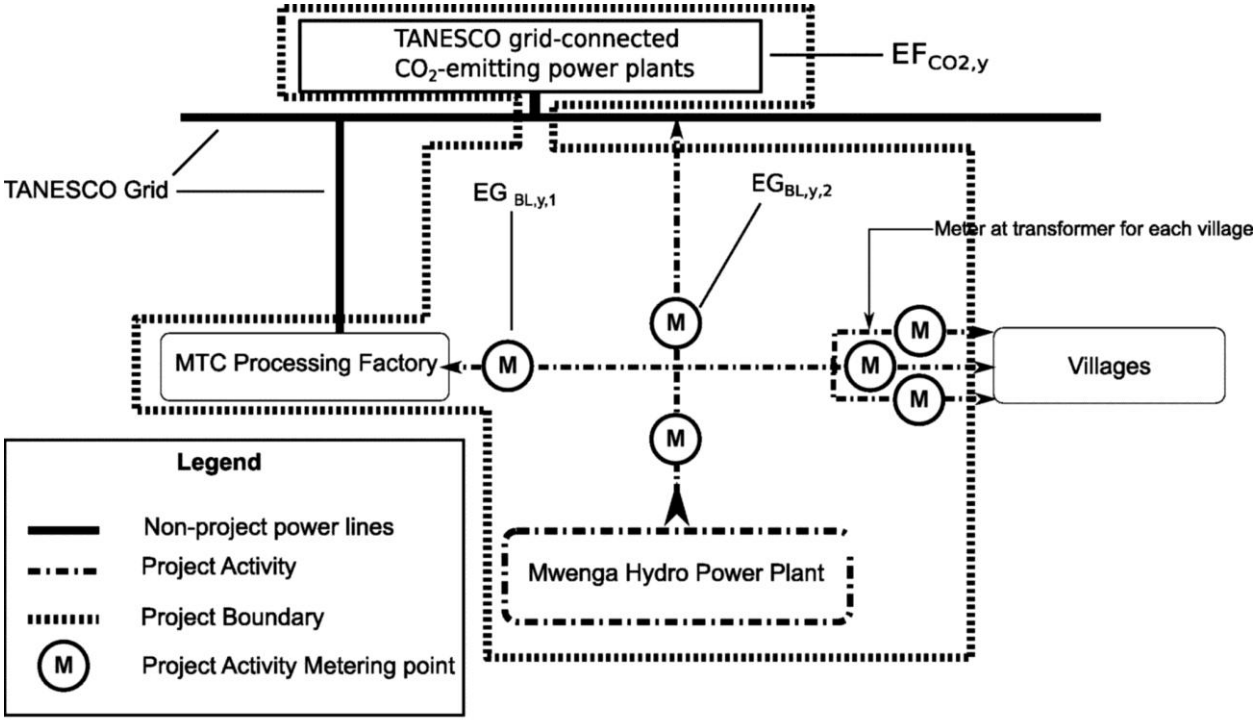

Figure C.1. Simplified Monitoring Diagram indicating location of metering points covered by the monitoring plan

Notes: Diagram is not to scale. There will be a meter at the transformer from the project grid to each village. To keep this figure legible, only three village transformer meters are shown here. As noted throughout this document and the revised PDD, emissions reductions are not being claimed for villages because of the impracticality of establishing a valid baseline, thus, the villages fall outside the project boundary. As noted in parameters EGBL,y,1 and EGBL,y,2, the main plant meter and village transformer meters are monitored only as secondary checks against the MTC and TANESCO meters, and are therefore included within the project boundary, but the village transformer meters are not required by the applicable methodologies: They are only necessary in case of failure of the main and check meters that are required by the applicable methodologies.

During this monitoring period neither the main nor check meters failed, therefore, the village meters were not necessary to accurately monitor production. Per AMS-I.D and associated guidance[11], grid-connected power plants with CO_2 emissions are included within the project boundary because they are used as the basis for calculating $EFCO_2,y$. Note that the project boundary does not include non-project power lines, because MHL is not responsible for building or maintaining them.

Metering devices enable the continuous measurement of the electricity supplied to meet the requirements of the MTC factory, the TANESCO grid, and the villages. During this monitoring period, there was no output to the MTC factory, and village transformer meters were not yet installed. As noted above, because all main and check meters for output directed to customers within the project boundary were fully operational throughout the monitoring period, the lack of village transformer meters has no effect on CER calculations.

MHL is responsible for the installation, ownership and maintenance of the metering at the Delivery Point and Off-take Points for the villages and MTC. TANESCO is responsible for the seals on the billing and check meter at the grid interconnection point.

The metering systems are designed such that the overall error of the metering installation, (including instrument transformers, wiring, and metering instruments) are in accordance with manufacturer specifications and national or IEC standards when available and applicable.

MHL shall have its main meter and the MTC and village transformer meters tested and, if necessary, re-calibrated by an independent testing facility at least once every twenty-four months, or whenever MHL or one of its customers has reason to believe that the equipment is no longer performing within the applicable standards of accuracy given in the preceding paragraph. The calibration shall be performed by an individual or entity that is authorized to certify or otherwise attest that the meters have been calibrated in accordance with manufacturer specifications and national or IEC standards when available and applicable.

TANESCO shall have the main and check meters at the grid interconnection point tested and, if necessary, re-calibrated at least once every twelve months or whenever a Party has reason to believe that the equipment is no longer performing to applicable IEC, manufacturer, or national standards.

After completion of any such testing, MHL shall prepare a statement which shall constitute a record of the results of the testing carried out, and the extent to which the meters were performing outside the required limits of accuracy.

If, at any time, it is determined by the MHL or one of its customers as a consequence of a test or as is otherwise manifestly necessary that the meters should be replaced, then MHL shall arrange for a new meter to be furnished. Such action shall be recorded and the relevant documentation held.

The Operations Manager of MHL is responsible for the reading and recording of the respective kWh meter readings on the respective electricity meter(s) on the last day of each calendar month, along with the time of the reading, and the date of reading.

This data have been entered into a hard copy book set aside for this purpose, and kept at the Operations Manager's office. Additionally this data is used to generate invoicing to the respective customers, and is also entered into a computer spreadsheet by the Operations Manager that mirrors this information. This file forms part of the monthly operations report of MHL. These physical and electronic records will be stored for at least two years after the later of the end of the crediting period or the last issuance of CERs for the project activity.

[11] Tool to calculate the Emissions Factor for an electricity system (version 2.2.0), available at http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.2.0.pdf

The Operations Manager is responsible for maintaining records of meter testing and any replacement, as well as any other information relating to the meters' operations.

Internal Audits are conducted annually under the supervision of the Director, Internal Audit of MHL's parent company. Two internal audits were undertaken over the period in question, one in early March 2013, and one at the end of November 2013, and covered all aspects of the business operation. These audits did not note any exceptions in the Carbon Credit compliance procedures.

Staff involved in monitoring and reporting are trained to ensure that the relevant monitoring and reporting procedures that need to be followed as part of the above monitoring plan.

Management is responsible for ensuring that staff responsible for monitoring and reporting have received adequate training.

MHL provides the necessary management structure and allocate responsibilities to staff to ensure that the above procedures are adhered to.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

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	Refer to data series from TANESCO files hourly data in GEF spreadsheet. For current monitoring period, refer to sheet "HOURLY_GEN2013"
Choice of data or Measurement methods and procedures	Data from TANESCO can be considered reliable
Purpose of data	To calculate Grid Emission Factor
Additional comment	The Simple Adjusted OM is calculated based on the Ex ante data vintages Option for the estimates appearing in the registered PDD and the revised PDD. However, as stated in the Monitoring Plan, Ex Post monitoring shall be used

Data / Parameter	**$EF_{EL,m,y}$**
Unit	tCO_2e/MWh
Description	CO_2 emissions factor of power unit m in year *y*
Source of data	TANESCO
Value(s) applied	Refer to GEF calculation spreadsheet
Choice of data or Measurement methods and procedures	Calculated based on approach provided under Option A2 of the Simple OM method, using annual electricity generation, fuel type and efficiency for each power unit, *m*
Purpose of data	To calculate Grid Emission Factor
Additional comment	The Simple Adjusted OM is calculated based on the Ex ante data vintages Option for the estimates appearing in the registered PDD and the revised PDD. However, as stated in the Monitoring Plan, Ex Post monitoring shall be used

Data / Parameter	**$EF_{CO2m,i,y}$**

Unit	tCO_2/GJ
Description	CO_2 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 0.0543 HFO 0.0755 DIESEL 0.0726 G.O 0.0726 JET A1 0.0697
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 OM these figures shall be updated once, at the start of each crediting period in accordance with the applicable IPPC data at the time. For the BM these figures shall be updated once, at the start of each crediting period with the applicable IPPC data at the time.
Purpose of data	To calculate Grid Emission Factor
Additional comment	The Simple Adjusted OM is calculated based on the Ex ante data vintages Option for the estimates appearing in the registered PDD and the revised PDD. However, as stated in the Monitoring Plan, Ex Post monitoring shall be used

Data / Parameter	η_y
Unit	Ratio
Description	Average net energy conversion efficiency of power unit m in year y
Source of data	TANESCO
Value(s) applied	Refer to GEF calculation spreadsheet
Choice of data or Measurement methods and procedures	Data from TANESCO can be considered reliable
Purpose of data	To calculate Grid Emission Factor
Additional comment	Weighted average was calculated based on weighted average of annual weighted average net conversion efficiency, i.e., (sum of each annual plant production * plant efficiency factor) / sum of total annual production. Each annual weighted average was then re-weighted as (sum of production in each year * annual applicable weighted average efficiency factor) / total production over three years. The Simple Adjusted OM is calculated based on the Ex ante data vintages Option for the estimates appearing in the registered PDD and the revised PDD. However, as stated in the Monitoring Plan, Ex Post monitoring shall be used

Note in the revised PDD, parameters used to calculated the Grid Emission Factor (i.e. $EG_{m,y,}$ $EF_{EL,m,y,}$ $EF_{CO2m,i,y}$ and ηy) are listed in section B.6.2. The Simple Adjusted OM is calculated based on the Ex ante data vintages Option for the estimates appearing in the revisedPDD. However, as stated in the Monitoring Plan, Ex Post monitoring shall be used.

D.2. Data and parameters monitored

Data / Parameter:	**$EG_{BL,y,1}$**
Unit:	MWh

Description:	Net electricity generated by the Hydropower plant which is to be delivered to meet the requirements of the MTC Processing Factory, but not including offset emissions from diesel backup generators
Measured/ Calculated / Default:	Measured
Source of data:	Joint monthly meter reading sheet showing monthly metering equipment readings
Value(s) of monitored parameter:	0
Monitoring equipment:	Class 2 or better billing meter installed at the MTC tea processing factory and installed, tested, and calibrated in accordance with manufacturer specifications and IEC and/or national standards when available and applicable.
Measuring/ Reading/ Recording frequency:	Measured continuously, recorded monthly.
Calculation method (if applicable):	Not applicable
QA/QC procedures:	Not yet implemented
Purpose of data:	Calculation of baseline emissions
Additional comment:	Component 1 was not implemented during this monitoring period.

Data / Parameter:	**$EG_{BL,y,2}$**
Unit:	MWh
Description:	Net electricity generated by the Hydropower plant which is delivered to the TANESCO national grid
Measured/ Calculated / Default:	Measured[12].
Source of data:	Joint monthly meter reading sheet of monthly billing and check meters installed at the TANESCO meter interconnection point
Value(s) of monitored parameter:	17,801.36 MWh (adjusted pro rata for partial month of January 2014 and excluding data from January of 2013, to be conservative. Also adjusted to take account of period where meters were not calibrated according to the method outlined in the VVS v7 para 283)
Monitoring equipment:	EDMI Mk10E Class 0.5, serial numbers 211309937 (main meter) and 211105245 (check meter), installed on 12th August 2012, tested annually, and successfully next calibrated on 9th July 2014 by TANESCO, in accordance with manufacturer specifications and IEC and/or national standards. The calibration undertaken in July 2014 found that errors were within maximum accuracy limits..
Measuring/ Reading/ Recording frequency:	Monthly
Calculation method (if applicable):	Not applicable

[12] the import and export are measured separately, and the net is calculated from the measured parameters

QA/QC procedures:	• Data from MHL's main power station meter compared with sales receipts and consumption figures obtained from meter readings by TANESCO, and cross-checked against a check meter on the MHL side of the grid interconnection • Data archived electronically • Meters tested and re-calibrated at least once every twelve months or whenever a Party has reason to believe that the equipment is no longer performing to applicable IEC or national standards. TANESCO is responsible for testing and calibration of these meters as per Article 4 h) of the SPPA agreement. All testing and calibration performed in accordance with the manufacturers' specifications and instructions. • Data for the partial month of January 2014 has been adjusted pro rata (i.e., 29/31 of invoice amount) to exclude sales attributable to 30 and 31 January, 2014, which fall outside the monitoring period. • Due to non-calibration of meters from July 2013 to July 2014, CER calculation has been revised accordingly to comply with the guidance under paragraph 283(a) of the CDM Validation and Verification Standard version 07.0. According to the calibration certificate, the maximum error of the meters is +/-2%. This error has been applied to meter readings used to calculate emission reductions for the period 01/07/2013 – 29/01/2014.
Purpose of data:	Calculation of baseline emissions
Additional comment:	

Data / Parameter:	**$EF_{CO2,y}$**
Unit:	**tCO_2e/MWh** (the methodology tables specify tCO_2e/kWh, but MWh will be used as the denominator for compatibility with other parameters)
Description:	Grid emissions factor calculated in accordance with applicable UNFCCC methodologies, guidance, and requirements.
Measured/ Calculated / Default:	Calculated
Source of data:	TANESCO hourly generation data for past three available years, IPCC default values
Value(s) of monitored parameter:	0.5735
Monitoring equipment:	
Measuring/ Reading/ Recording frequency:	Hourly by TANESCO, however yearly data has been considered for calculations
Calculation method (if applicable):	See GEF spreadsheet and worksheet; partial or leap years were extrapolated to years of 8760 hours.
QA/QC procedures:	Data from TANESCO are considered to be reliable.
Purpose of data:	Calculation of baseline emissions
Additional comment:	Calculated in accordance with methodology outlined in the Tool to calculate the Emissions Factor for an electricity system (version 2.2.0). Refer also to revised PDD section B.6.1. Parameter is calculated using 2013 data i.e. for the year in which the project activity displaces grid electricity, as per p5 of the Tool to calculate the Emissions Factor for an electricity system (version 2.2.0). As 2014 data is not available 2013 data is used for the period 01/01/2014 - 29/01/14, as per p6 of the Tool.

D.3. Implementation of sampling plan

Not applicable

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

Baseline emissions reductions are given by the formula

($EG_{BL,y,1}$ [0 MWh]* $EF_{CO2,y}$ [0.5735 tCO_2e/MWh])+ ($EG_{BL,y,2}$ [17,801.36. MWh]* $EF_{CO2,y}$ [0.5735 tCO_2e/MWh]**)** = 10,209 tCO_2e

Where
$EG_{BL,y,2}$ = Power exported to TANESCO- power imported from TANESCO
= 17,822.89-21.53MWh
= 17,801.36 MWh

Note also that this value for $EG_{BL,y,2}$ is an adjusted value to take account of delayed calibration.

Total baseline emissions: 10,209tCO_2e

E.2. Calculation of project emissions or actual net GHG removals by sinks

Given that the project activity is a small scale hydro project and doesn't result in a new reservoir, no project emissions occur on account of the decomposition of vegetative biomass.

Therefore, as outlined in the revised PDD section B.6.1 based on the methodologies AMS-I.F. and AMS-I.D.,

Total project emissions: 0

E.3. Calculation of leakage

No leakage takes place because the generating equipment is not transferred from another activity. Therefore, as outlined in the revised PDD section B.6.1 based on the methodologies AMS-I.F. and AMS-I.D.,

Total leakage: 0

E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

Item	Baseline emissions or baseline net GHG removals by sinks ($t CO_2e$)	Project emissions or actual net GHG removals by sinks ($t CO_2e$)	Leakage ($t CO_2e$)	Emission reductions or net anthropogenic GHG removals by sinks ($t CO_2e$)
Total	10,209	0	0	10,209

E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO_2e) in monitoring period 1, 30/01/2013 – 29/01/2014 (both days included)	11,354 tCO_2e (As per the revised PDD)	10,209 tCO_2e

E.6. Remarks on difference from estimated value in registered PDD

The actual output during the portion of the monitoring period used for emissions calculations was 19,134.564MWh, of which 17,822.89 MWh was sold to TANESCO.
To be conservative, because of the evolving state of production record keeping at the beginning of 2013, figures from 30 and 31 January, 2013 are omitted. Additionally, this figure has been adjusted pro rata for the partial month of January 2014 (1-29 January). It has been further adjusted to account for delayed calibration of the meters.

A total of 21.53MWh was imported from TANESCO during the monitoring period, making the net power generation 17,801.36MWh. At a GEF of 0.5735, as calculated above and in the attached spreadsheets, this has resulted in emissions reductions of 17,801.36*0.5735 = 10,209 tCO_2e. Although the GEF has increased due to Tanzania's addition of multiple new fossil fuel plants, there was significantly less water available than projected, leading to lower project output during this monitoring period than was originally anticipated.

There was no increase in the actual emissions reductions achieved. However, had there been enough water available for the plant to produce its projected output, there would likely have been an increase in actual emissions reductions achieved. This is because Tanzania has consistently been adding only thermal electricity generation capacity over the past few years, thus raising the GEF from 0.529 as calculated at the time of the original PDD submission to 0.5735 during this first monitoring period.

E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards
Emission reductions or GHG removals by sinks (t CO_2e)	N/A	N/A

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Appendix 1. Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	☒ Project participant ☒ Responsible person/ entity for completing the CDM-MR-FORM
Organization name	Mwenga Hydro Limited
Street/P.O. Box	Schwindgasse 19/18
Building	-
City	Vienna
State/Region	-
Postcode	1080
Country	Austria
Telephone	+43 69 91 920 9597
Fax	-
E-mail	itona@intafrica.com
Website	-
Contact person	Franz Kottulinsky
Title	-
Salutation	Mr
Last name	Kottulinsky
Middle name	-
First name	Franz
Department	-
Mobile	-
Direct fax	-
Direct tel.	+43 69 91 920 9597
Personal e-mail	franzkottulinsky@gmail.com

Project participant and/or responsible person/ entity	☒ Project participant ☒ Responsible person/ entity for completing the CDM-MR-FORM
Organization name	Mwenga Hydro Ltd.
Street/P.O. Box	P.O. Box 70192, Dar es Salaam
Building	1st Floor, Haidery Plaza
City	Dar es Salaam
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Postcode	-
Country	Tanzania
Telephone	+255 26 2772342
Fax	-
E-mail	itona@intafrica.com
Website	-
Contact person	Michael Gratwicke
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Salutation	Mr
Last name	Gratwicke

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First name	Michael
Department	Project Manager
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Direct fax	+255 26 2772807
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Personal e-mail	mike.gratwicke@gmail.com

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for completing the CDM-MR-FORM
Organization name	Swedish Energy Agency
Street/P.O. Box	PO Box 310
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City	Eskilstuna
State/Region	-
Postcode	SE-631 04
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Fax	+46 (0)16 544 2099
E-mail	backoffice@swedishenergyagency.se
Website	http://www.energimyndigheten.se/
Contact person	Ola Hansén
Title	-
Salutation	Mr.
Last name	Hansén
Middle name	-
First name	Ola
Department	Climate Change Unit
Mobile	-
Direct fax	+46 (0)16 544 2099
Direct tel.	+46 (0)16 544 2212
Personal e-mail	ola.hansen@swedishenergyagency.se

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for completing the CDM-MR-FORM
Organization name	Swedish Energy Agency
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Contact person	Kenneth Möllersten

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Document information

Version	*Date*	*Description*
04.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from *F-CDM-MR* to *CDM-MR-FORM*; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.

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