Monitoring report form (Version 03.2)

Monitoring report

Title of the project activity	Small-Scale Hydropower Project Sahanivotry in Madagascar
Reference number of the project activity	3558
Version number of the monitoring report	1.0
Completion date of the monitoring report	26/03/2014
Registration date of the project activity	28/08/2010
Monitoring period number and duration of this monitoring period	1st monitoring period (28/08/2010 – 31/12/2012)
Project participant(s)	HYDELEC Madagascar SA Kommunalkredit Public Consulting (Purchasing Party)
Host Party(ies)	Madagascar
Sectoral scope(s) and applied methodology(ies)	ACM0002 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (version 13.0.0)
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	117,856 tonnes of CO_{2e}
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	84,888 tonnes of CO_{2e}
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period up to 31 December 2012 (if applicable)	84,888 tonnes of CO_{2e}
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period from 1 January 2013 onwards (if applicable).	-

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The purpose of the Sahanivotry Hydro Power Plant (hereafter referred to as "SHPP") is to generate renewable energy using clean hydropower and sell the output electricity into the regional grid of Antananarivo (hereafter referred to as RI TANA) operated by JIRAMA.

SHPP is a run-of-river hydropower plant with a capacity of 16.5 MW with an average electricity generation of 80 GWh (up to 90 GWh in optimal years). The project use three new Pelton turbines and three new generators provided by Hunan Lingling Hengyuan Generating Equipment Co., Ltd (China).

The project construction was commenced in March 2007, and the hydropower plant started commercial operation in October 2008.

The project has been implemented according to the following time schedule:

Table – Time schedule of project implementation

Nr	Milestones	Key Dates
1	**Authorization**	**02/2001-11/2007**
1.1	Concession for the installation and operation of SHPP with an installed capacity of 10 MW Issuing Authority: Ministry of Energy and Mines (MEM)	17/02/2001
1.2	Approbation of the concession contract for the production of energy at HPP with an installed capacity of 10 MW Issuing Authority: MEM	23/03/2001
1.3.	Autorisation for starting construction and increasing capacity from 10 to 15 MW Issuing Authority: MEM	07/03/2007
1.4	Authorization for the increase of capacity by 5 MW at SHPP. Issuing authority: MEM	28/11/2007
2	**Power Purchase Agreement with Jirama**	**02/2001-08/2007**
2.1	Signature of Power Purchase Agreement (PPA)	17/02/2001
2.2	PPA amendment Nr. 1	27/06/2001
2.3	PPA amendment Nr. 2	12/10/2006
2.4	PPA amendment Nr. 3	16/08/2007
3	**Financing**	**07-09/2007**
3.1	Loan Agreement with African Development Bank (AfDB)	05/07/2007
3.2	Loan Agreement with BFV-Société Générale and Mauritius Commercial Bank (Madagascar) S.A.	06/09/2007
4	Construction	03/2007-09/2008
4.1	Start of construction	03/2007
4.2	Procurement and installation of HPP	05-09/2008
5	**Start operation**	**10/2008**

Due to the fact that SHPP was registered under CDM only on 28/08/2010, the CDM crediting period starts with the CDM registration date.

A.2. Location of project activity

The project is located about 30 km from Antsirabé on the river Ampamehana within Sahanivotry village, Antananarivo Province, Madagascar. The Ministry of Energy granted to HYDELEC for a period of 30 years the right to use 70 ha of land that belongs to Sahanivotry village for the construction and operation of the SHPP. The geographical co-ordinates of the project are 47°08' East (longitude) and 20°12' South (latitude).

Figure – The project location

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)
Madagascar (host)	HYDELEC Madagascar SA	No
Austria	Kommunalkredit Public Consulting (Purchasing Party)	No

A.4. Reference of applied methodology

The baseline and monitoring methodology ACM0002 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (version 13.0.0) and "Tool to calculate the emission factor for an electricity system" are applied to the project activity.

A.5. Crediting period of project activity

The CDM crediting period of 10 years is chosen which is from 28/08/2010 (date of CDM registration) to 27/08/2020.

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

The project construction was commenced in March 2007, and the hydropower plant started commercial operation in October 2008. Due to the fact that SHPP was registered under CDM only on 28/08/2010, the crediting period starts with the CDM registration date.

During this monitoring period, the project had operated well, with the exception of the following event.

- On January 22, 2011, the first energy meter at SHPP failed. Therefore, the second energy meter at the SHPP was used to record the generation data for the period January 22 to February 1, 2011. This generation data was accepted by JIRAMA.

No relevant events and situations have been reported during the monitoring period. The above mentioned failure of the energy meters did not have any effect on the electricity generation. Hence, the amount of emission reductions was not affected by this failure.

B.2. Post registration changes

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

No temporary deviations change occurred in this monitoring period.

B.2.2. Corrections

No corrections occurred in this monitoring period.

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

A post-registration changes has been undertaken and is summarized as follows:

- The PDD was updated from small-scale to large-scale framework, using the latest version of ACM0002 methodology (version 13.0.0) and related tools;

Generators design capacity was slightly upsized to 16.5 MW as compared to the initially registered design of 15 MW, in order to protect the turbines, secure the operation and to fulfil the environmental conditions in dry season. These justifications were addressed by letter to the CDM-EB (attached in PDD Annex 4 p.59-60).

This did not result in any changes to the expected power generation from hydrological studies, which remained constant as the product of a more conservative updated plant load factor and consequent design capacity modification. It is supported by ex-post analysis of monthly power production lower than ex-ante estimate (monthly generation records and supporting invoices provided to the DOE), thus no impact on the revenues accounted for in the IRR calculation.

Moreover the expected investment as per the AfDB financial model did not decrease as a result of the upsizing (cumulated investment spreadsheet provided to the DOE); hence the registered IRR calculation and results are still valid and conservative, including the sensitivity analysis.

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

See B.2.3

B.2.5. Changes to start date of crediting period

The post-registration changes did not impact the start date of crediting period.

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

N/A

SECTION C. Description of monitoring system

The data to be monitored is the net electricity supplied to the regional grid and any diesel consumed by the emergency back-up diesel generator.

The monitoring of the electricity generation is based on real-time transmission of the generation data by means of a fully automatic data acquisition system. The electricity delivered from SHPP to the regional grid is continuously monitored through metering equipments installed in the project sites. The diagram of this Monitoring Plan shows the principles of positioning of metering instruments that are used in the monitoring of the emission reductions in figure below.

Two bi-directional energy meters are used. These have an accuracy of 0.5% and are installed according to the national standards set by JIRAMA. The meters register the following information:

- Active power
- Reactive power
- Apparent power
- Voltage
- Phase's current
- Active energy
- Frequency
- Event record
- Harmonies

To monitor the electricity supplied by the project, the two bi-directional electricity meters M1 and M2 are used, on the project plant site of Sahanivotry. Two additional meters M3 and M4 are used by JIRAMA as a cross-check at Antsirabe's substation and Ibity end-user connection (see Table and Figure below).

Electric meters	**Meters label**	**Serial Number**	**Characteristics**	**Use**
Sahanivotry's substation	M1 ***(main)***	33055428	bi-directional	Monitoring of net electricity supplied by the project
	M 2 ***(back-up)***	36050447	bi-directional	Use in case of failure of M1
JIRAMA : Antsirabe	M3	36050437	bi-directional	Use by JIRAMA to control the electricity supplied by Hydelec
HOLCIM : Ibity	M4	73305393	bi-directional	

Table: Electricity meters characteristics

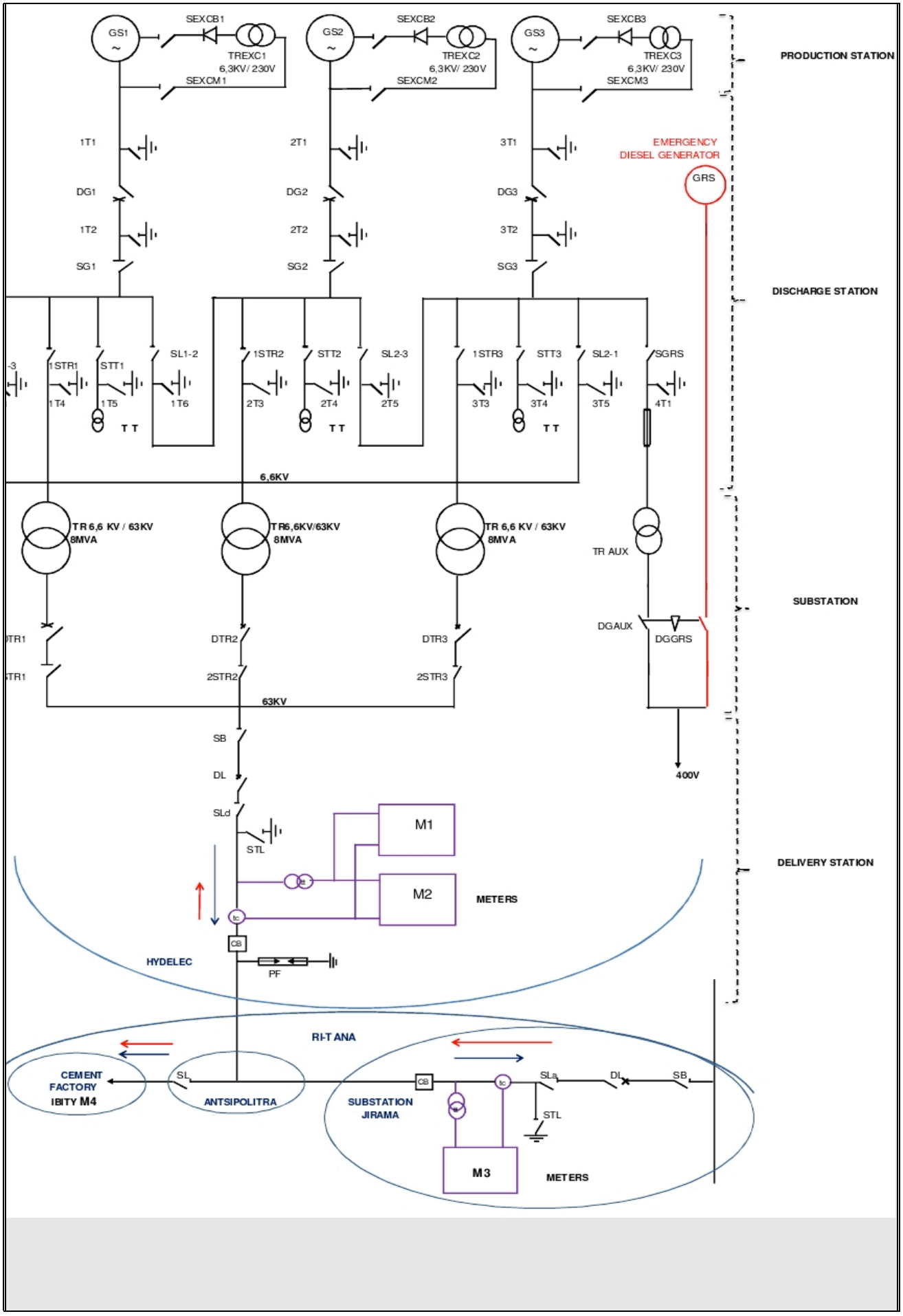
M1 (and M2 backup) readings are net measurements, deducting SHPP's eventual power import from the grid for its auxiliary consumption when not operational (and alternatively to its emergency diesel generator).

Table below provides with indicative information along monitoring period regarding activities/observation/measures taken for monitoring energy generated by the project mentioning with which meters information has been collected.

Period	*Activities*	*Observations/Measures taken*
04.10.2008	Commissioning of hydropower plant	-
04.10.08 to 12.11.2009	M1 is working	Normal energy production information collected by M1
13.11.2009 to 17.11.2009	Failure M1	Data collection by M3 and M4
17.11.2009	Fixing M1 Installation of M2	Contact LABORATORY COUNTER JIRAMA Intervention JIRAMA
18.11.09 to 21.01.2011	M1 and M2 in function	No failure
22.01.2011	M1 failure	Contact LABORATORY COUNTER JIRAMA Intervention JIRAMA
22.01.2011 to 01.02.2011	M1 failure	Data collection thanks to M2
01.02.2011	Fixing M1	Intervention JIRAMA
02.02.2011 to 23.04.2011	M1 and M2 in function	Data collection with M2
24.04.2011	M2 stopped	Contact LABORATORY COUNTER JIRAMA Intervention JIRAMA
24.04.2011 to 26.12.2012	M1 in function	Data collection from M1
26.12.2011	Fixing M2	Intervention JIRAMA
27.12.2011 to 31.08.2012	M1 and M2 in function	Data collection from M1
01.09.2012 to 31.12.2012	M1 and M2 in function	Data collection from M1

The following grid connection diagram indicates the principles of positioning of metering instruments M1, M2 M3 and M4 that have been used in the monitoring of the emission reductions.
Staff watched the operation status of metering equipments daily on site and production recorded daily is provided to DOE. Furthermore, designated staff collected the measured electricity monthly and completed the corresponding record. These records have been checked by the company administrator or supervisor regularly.

Figure– Grid connection and meters diagram


GS1
GS2
GS3
SEXCB1
SEXCB2
SEXCB3
TREXC1
6,3KV/ 230V
TREXC2
6,3KV/ 230V
TREXC3
6,3KV/ 230V
SEXCM1
SEXCM2
SEXCM3
PRODUCTION STATION
1T1
2T1
3T1
EMERGENCY
DIESEL GENERATOR
GRS
DG1
DG2
DG3
1T2
2T2
3T2
SG1
SG2
SG3
DISCHARGE STATION
1STR1
STT1
SL1-2
1STR2
STT2
SL2-3
1STR3
STT3
SL2-1
SGRS
1T4
1T5
1T6
2T3
2T4
2T5
3T3
3T4
3T5
4T1
T T
T T
T T
6,6KV
TR 6,6 KV / 63KV
8MVA
TR6,6KV/63KV
8MVA
TR 6,6 KV / 63KV
8MVA
TR AUX
SUBSTATION
DTR2
DTR3
DGAUX
DGGRS
2STR2
2STR3
63KV
400V
SB
DL
SLd
STL
M1
M2
METERS
HYDELEC
PF
RI-T ANA
CEMENT
FACTORY
IBITY M4
SL
ANTSIPOLITRA
SUBSTATION
JIRAMA
SLa
DL
SB
STL
M3
METERS
DELIVERY STATION

Caption:

SEXCB :low voltage excitation disconnector
SEXCM :Medium voltage excitation disconnector
TREXC :excitation transformer
DG :generator's circuit breaker
SG :generator's disconnector
CB :tank circuit
STR: transformer's disconnector
DTR:transformer's circuit breaker
STT:voltage transformer's disconnector
SL: link disconnector
ST: earthing switch
TRAUX : auxiliary transformer
DGAUX:auxiliary circuit breaker
DGGRS: emergency generator circuit breaker
TT:voltage transformer

SB: bus bar disconnector
DL: line's circuit breaker
GS: generator
SGRS: emergency diesel generator's disconnector
STL: line's earthing switch
Sla: line's disconnector
SLd: line's disconnector
M1,M2,M3, M4: kilowatt-hour meters
tc: current transformer
tt: voltage transformer
PF: surge arrester

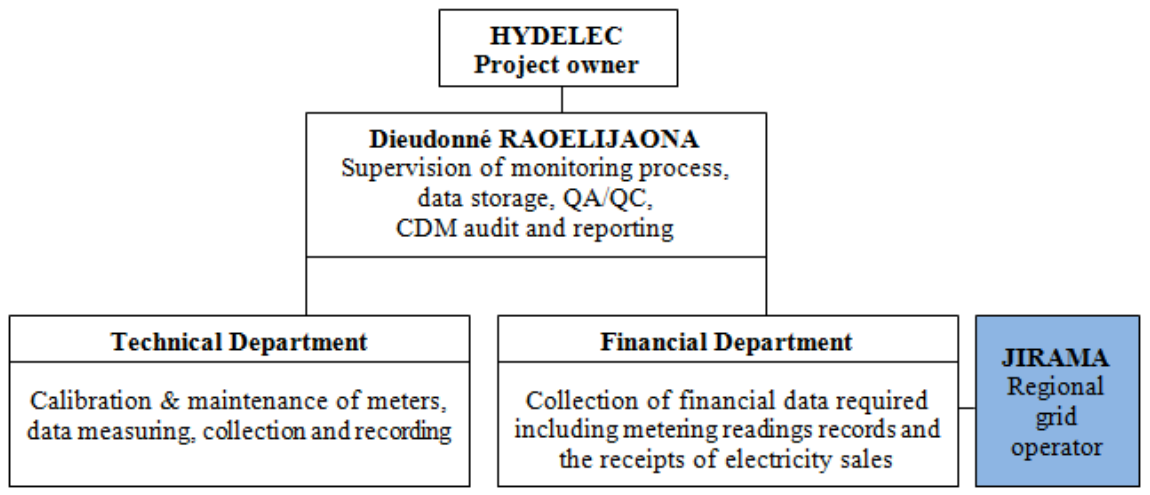
current direction when the plant is operational
current direction when the plant is shutdown

During any emergency situation, the quantity of diesel fuel consumed by the diesel generator is measured and recorded in a log book during the emergency period.

The project owner HYDELEC took the responsibility of the monitoring plan implementation; HYDELEC appointed a CDM manager, who was responsible for the supervision of the monitoring process, the data measuring, collection and recording, QA/QC, audit and reporting.

The staff from technical and financial departments undertook the monitoring tasks including watching metering equipments periodically, collecting electricity data and completing records, checking and analyzing the data, archiving relevant records, reporting to the CDM manager Mr Dieudonné RAOELIJAONA.

Figure– Monitoring and management structure



Energy meters

Two bi-directional energy meters (ACTARIS SL 7000; Type: SL 761 B 060; Serial number: 33055428 and 36050447; Manufacturer: ACTARIS France with a respective accuracy of 0.5% and 1%) have been installed for monitoring the generated power, according to the national standard set by JIRAMA.

The meters registered the following information:

1. Active power
2. Reactive power
3. Apparent power
4. Voltage
5. Phase's current
6. Active energy
7. Frequency

8. Event record
9. Harmonies

Quality assurance and quality control

The electricity delivered by SHPP to RI TANA has been monitored trough metering equipment at the project site. The data has been cross-checked against electricity sales receipt from JIRAMA and/or records from the grid for quality control. Since the electricity meters was the revenue meters which measure the quantity of electricity that the project was paid for thanks to the power meter M3 located at the substation of Antsirabe; the Power Purchase Agreement between JIRAMA and HYDELEC can be used as reference.

Calibration of meters occurred annually according to the national standards set by JIRAMA.
All relevant data records obtained from the monitoring will be kept by the project owner during the crediting period and for at least two years after for DOE's verification.

SECTION D. Data and parameters

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

Data / Parameter:	**$FC_{i,m,y}$**
Unit:	g/kWh
Description:	Amount of fossil fuel type i consumed by power plant / unit *m* in year *y* within RI TANA
Source of data:	JIRAMA (2007) Ministry of Energy and Mines, Least Cost Generation Master plan (2005)
Value(s) applied):	See Annex 3 of registered PDD
Purpose of data:	Calculation of baseline emissions
Additional comment:	The data is from the national utility JIRAMA resp. Ministry of Energy and Mines. The uncertainty of the data is low.

Data / Parameter:	**$EG_{m,y}$** and **$EG_{k,y}$**
Unit:	MWh
Description:	Net electricity generated and delivered to the RI TANA by power plant / unit *m* resp. *k* in year *y*
Source of data:	JIRAMA (2004, 2005, 2006)
Value(s) applied):	See Annex 3 of registered PDD
Purpose of data:	Calculation of baseline emissions
Additional comment:	The data is from the national utility JIRAMA resp. Ministry of Energy and Mines. The uncertainty of the data is low.

Data / Parameter:	**$NCV_{i,y}$**
Unit:	GJ/ton
Description:	Net calorific value (energy content) of fossil fuel type *i* in year *y*
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied):	Fuel oil: 44.44 Diesel: 40.19
Purpose of data:	Calculation of baseline emissions

Additional comment:	2006 IPCC Guidelines for National Greenhouse Gas Inventories are considered to be authoritative.

Data / Parameter:	**$EF_{CO2,i,j,y}$**
Unit:	tCO_2/GJ
Description:	CO_2 emission factor of fossil fuel type *i* in year *y*
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Workbook Vol.2.
Value(s) applied):	Fuel oil: 77.37 Diesel: 74.06
Purpose of data:	Calculation of baseline emissions
Additional comment:	IPCC Guidelines for National Greenhouse Gas Inventories are considered to be authoritative.

Data / Parameter:	**λ_y**
Unit:	%
Description:	Fraction of time when the low-cost must-run resources are on the margin in year *y*
Source of data:	JIRAMA (2007)
Value(s) applied):	74
Purpose of data:	Calculation of baseline emissions
Additional comment:	The data is from the national utility JIRAMA. The uncertainty of the data is low.

Data / Parameter:	**EF_{CO2}** for the diesel consumed by the emergency back-up diesel generator
Unit:	tCO2/kg of diesel
Description:	CO_2 emission factor of diesel used for the emergency back-up diesel generator at SHPP
Source of data:	Footnote of Table I.D.1 in AMS I.D. ver.13 mentions this conversion factor following revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.
Value(s) applied):	3.2 tCO_2/kg of diesel
Purpose of data:	Calculation of baseline emissions
Additional comment:	-

Data / Parameter:	**CAP_{BL}**
Unit:	W
Description:	Installed capacity of the hydro power plant before the implementation of the project activity.
Source of data:	Project site
Value(s) applied):	For new hydro power plants, this value is zero.
Purpose of data:	Calculation of baseline emissions

Additional comment:	This parameter is used to calculate the power density. However calculation of power density is not required for this proposed project activity (no reservoir).

Data / Parameter:	**A_{BL}**
Unit:	m^2
Description:	Area of the reservoir measured in the surface of the water before the implementation of the project activity, when the reservoir is full
Source of data:	Project site
Value(s) applied):	For new reservoirs, this value is zero
Purpose of data:	Calculation of baseline emissions
Additional comment:	This parameter is used to calculate the power density. However calculation of power density is not required for this proposed project activity (no reservoir).

D.2. Data and parameters monitored

Data / Parameter:	**$EG_{facility,y}$**
Unit:	MWh/yr
Description:	Quantity of net electricity generation supplied by the project plant to the grid in year *y*
Measured/ Calculated / Default:	Electricity meter(s)
Source of data:	Energy production records
Value(s) of monitored parameter:	y: 2010 | 2011 | 2012 $EG_{facility,y}$: 13,854 | 80,312 | 60,743
Monitoring equipment:	Two bi-directional energy meters M1 and M2 are used to monitor the net electricity generated (ACTARIS SL 7000; Type: SL 761 B 060; Serial number: 33055428 and, 36050447; Manufacturer: ACTARIS France with a respective accuracy of 0.5% and 1%) M1 and M2 are installed on the 63 kV substation of the hydro power plant to measure directly and continuously the electricity generation and the net electricity supply to the grid. The metering instruments will be calibrated annually in accordance with the national standard set by JIRAMA.
Measuring/ Reading/ Recording frequency:	Measured monthly
Calculation method (if applicable):	N/A

QA/QC procedures:	The data is cross-checked against electricity sales receipt from JIRAMA and/or records from the grid for quality control. Since the electricity generated will be the revenue meters which measure the quantity of electricity that the project will be paid for, the Power Purchase Agreement between JIRAMA and HYDELEC can be used as reference. Moreover a third power meter M3 (Serial number: 36050437) is used by JIRAMA at the substation of Antsirabe, together with a fourth end-user power meter M4 (Serial number: 73305393) at HOLCIM cement factory of Ibity, to cross checked the net electricity generated by the project.
Purpose of data:	Calculation of baseline emissions
Additional comment:	The information have been provided monthly by HYDELEC to JIRAMA.

Data / Parameter:	**FC_{diesel}**
Unit:	kg
Description:	The quantity of diesel fuel consumed by the diesel generator during any emergency situation
Measured/ Calculated / Default:	Measured
Source of data:	The emergency records and log book
Value(s) of monitored parameter:	605
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	-
Calculation method (if applicable):	N/A
QA/QC procedures:	This will be cross checked with the purchase receipts of diesel fuel and measurement conducted in the diesel storage tank
Purpose of data:	Calculation of project emissions
Additional comment:	The diesel generator will only operate in unplanned emergency situations. The hydropower plant has three turbines; therefore the maintenance is done during the dry season; where only one or two turbines are running. That means the maintenance of SHPP is done without any need of the diesel generator.

Data / Parameter:	**$NCV_{diesel,y}$**
Unit:	GJ per mass or volume unit (e.g. GJ/m³, GJ/ton)
Description:	Weighted average net calorific value of diesel fuel in year *y*
Measured/ Calculated / Default:	Default

Source of data:	IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG inventories, as neither local nor national values available.
Value(s) of monitored parameter:	43.3
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	-
Calculation method (if applicable):	-
QA/QC procedures:	-
Purpose of data:	Calculation of baseline emissions
Additional comment:	No revision of the IPCC Guidelines have been done thus not taken into account.

Data / Parameter:	$EF_{CO2,\ diesel,y}$
Unit:	tCO_2/GJ
Description:	Weighted average CO_2 emission factor of diesel fuel in year *y*
Measured/ Calculated / Default:	Default
Source of data:	IPCC default values at the upper limit of the 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, as neither local nor national values available.
Value(s) of monitored parameter:	0.0748
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	-
Calculation method (if applicable):	-
QA/QC procedures:	-
Purpose of data:	Calculation of baseline emissions
Additional comment:	Applicable since Option B of the Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion is used. Any future revision of the IPCC Guidelines should be taken into account however no revision have been done at the time of project verification.

Data / Parameter:	CAP_{PJ}
Unit:	W
Description:	Installed capacity of the hydro power plant after the implementation of the project activity
Measured/ Calculated / Default:	-
Source of data:	Project site
Value(s) of monitored parameter:	16,500,000
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	Monitored yearly
Calculation method (if applicable):	Determined based on recognized standards.
QA/QC procedures:	-
Purpose of data:	Applicability condition of methodology ACM0002
Additional comment:	This parameter is used to calculate the power density. However calculation of power density is not required for this proposed project activity. As mentioned in Applicability conditions of the methodology ACM0002, the project is the installation of a new run-off-river hydro power plant and does not involve any reservoir.

Data / Parameter:	A_{PJ}
Unit:	m_2
Description:	Surface area of the reservoir measured at full supply level after the implementation of the project activity.
Measured/ Calculated / Default:	-
Source of data:	-
Value(s) of monitored parameter:	-
Monitoring equipment:	-
Measuring/ Reading/ Recording frequency:	-
Calculation method (if applicable):	-
QA/QC procedures:	-
Purpose of data:	Applicability condition of methodology ACM0002

Additional comment:	This parameter is used to calculate the power density. However calculation of power density is not required for this proposed project activity. As mentioned in Table 4 (Applicability conditions of the methodology ACM0002), the project is the installation of a new run-off-river hydro power plant and does not involve any reservoir.

D.3. Implementation of sampling plan

No sampling plan is used thus section is 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

In this CDM monitoring period (28/08/2010 to 31/12/2012), the GHG baseline emissions was **84,890 tCO_2e** such as demonstrated in table below.

Date	EG_y (MWh)	EF_y (tCO_2e/MWh)	BE_y (tCO_2e)
	A	B	C=A*B
28/08/2010 – 31/08/2010	390	0,548	214
01/09/2010 – 30/09/2010	1982	0,548	1086
01/10/2010 – 31/10/2010	1224	0,548	671
01/11/2010 – 30/11/2010	2911	0,548	1595
01/12/2010 – 31/12/2010	7346	0,548	4026
01/01/2011 – 31/01/2011	7935	0,548	4348
01/02/2011 – 28/02/2011	10731	0,548	5881
01/03/2011 – 31/03/2011	11690	0,548	6406
01/04/2011 – 30/04/2011	10971	0,548	6012
01/05/2011 – 31/05/2011	8906	0,548	4880
01/06/2011 – 30/06/2011	6318	0,548	3462
01/07/2011 – 31/07/2011	5580	0,548	3058
01/08/2011 – 30/08/2011	4205	0,548	2304
01/09/2011 – 31/09/2011	2722	0,548	1492
01/10/2011 – 30/10/2011	2515	0,548	1378
01/11/2011 – 31/11/2011	3626	0,548	1987
01/12/2011 – 30/12/2011	5114	0,548	2803
01/01/2012 – 31/01/2012	6988	0,548	3829
01/02/2012 – 28/02/2012	5929	0,548	3249
01/03/2012 – 31/03/2012	6758	0,548	3704
01/04/2012 – 30/04/2012	6547	0,548	3588
01/05/2012 – 31/05/2012	6500	0,548	3562
01/06/2012 – 30/06/2012	5497	0,548	3012
01/07/2012 – 31/07/2012	4516	0,548	2475

01/08/2012 – 31/08/2012	3343	0,548	1832
01/09/2012 – 30/09/2012	2329	0,548	1276
01/10/2012 – 31/10/2012	1958	0,548	1073
01/11/2012 – 30/11/2012	3840	0,548	2104
01/12/2012 – 31/12/2012	6538	0,548	3583
Total	**154,909**		**84,890**

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

The project is a run-of-river hydro project. The only fossil CO_2 emissions from the project activity come from the 275 kW diesel emergency unit installed at the plant. This unit has been operated along monitored period and was for back up in unplanned emergency situations. The hydropower plant has three turbines; therefore the maintenance was done during the dry season; where only one or two turbines were running. That means the maintenance was done easily without any need of the diesel generator. However, emergency system has been used to serve the plant when the power in the plant was not available during following period presented in table below.

In case this diesel emergency unit is used, the following formula is applied to calculate the project emission for the year y:

$$PE_y = FC_{diesel,y} \times NCV_{diesel,y} \times EF_{CO2,\ diesel,y}$$

Where
$FC_{diesel,y}$ = diesel consumed by the emergency back-up diesel generator in year y;
$NCV_{diesel,y}$= Weighted average net calorific value of diesel fuel in year y;
$EF_{CO2,\ diesel,y}$ = Weighted average CO2 emission factor of diesel fuel in year ;

The diesel generator was only used in the following cases listed in table below:

Table - Monitoring data and project emissions calculation for the CDM monitoring period

Date	$FC_{diesel,y}$ (kg)	EF_{CO2} (tCO_2e/kg)	PE_y (tCO_2e)	Reason for diesel generator usage
	D	E	F=D*E	
08/10/2010	5	0.0032	0,016	Preventive maintenance work
09/10/2010	88	0.0032	0,282	TX HYD : construction new sand trap JIRAMA: maintenance work on line 7602
09/10/2010	48	0.0032	0,154	TX HYD : construction new sand trap JIRAMA: maintenance work on line 7602
10/10/2010	10	0.0032	0,032	TX HYD : construction new sand trap JIRAMA: network problem
17/10/2010	102	0.0032	0,326	TX HYD :maintenance poste 63kv JIRAMA: maintenance work on line 7602
25/01/2011	11	0.0032	0,035	Work rescue group because trigger (lack of voltage 63kV)
07/04/2011	3	0.0032	0,010	Preventive maintenance work
18/09/2011	6	0.0032	0.019	Preventive maintenance work
23/10/2011	68	0.0032	0.218	Removing line 7602 A/be Saha TX JIRAMA(NA°203/11): Replacing broken insulator 15 E; Replacing rotten support beam n°22 TX HYD : Maintenance of cells 6,3Kv
20/11/2011	88	0.0032	0.282	Removing line 7602 A/be Saha TX JIRAMA(NA°218E/11): Installation of guarding cable to support n°124; Replacing of support beam n°12 & 67 TX HYD(NA°219E/11): Grit upstream dam; Interior visit GE°1,2
26/02/2012	87	0.0032	0.278	Removing line 7602 A/be Saha TX JIRAMA(NA°60E/12): Visit with bringing the supports n°76 au 124 TX HYD(NA°61E/12): Desilting of the canal led; interior visit GE°1,2

17/06/2012	89	0.0032	0.285	Replacing valve HP cooling system; Note of stop N°204E/12 and maintenance L7602 N A N°199E/12
Total	**605**		**1.9**	

E.3. Calculation of leakage

As newly built hydropower plant, there is no energy generating equipment transferred from another activity and no existing equipment transferred to another activity. There is no need to consider leakage (L_y) for the proposed project, thus $L_y = 0$.

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	84,890	1.9	0	84,888

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)	117,856	84,888

The annual emission reductions were estimated in the PDD at 117,856 t CO_2e for the years 2010, 2011 and 2012 of project operation. This is compared with the actual values of the CDM monitoring period covers from 28/08/2010 to 31/12/2012 which is 84,890 t CO_2e.

As the grid emission factor is fixed ex-ante, only the projected and the actual generation figures have to be assessed. Hence, a monthly comparison of the projected and the actual generation values has been conducted.

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

The actual emission reduction figures have been lower than projected in the PDD.

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)	84,888 t CO_2e	-

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Document information

Version	*Date*	*Description*
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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