MONITORING REPORT FORM (CDM-MR) *
Version 01 - in effect as of: 28/09/2010

CONTENTS

* as contained within the document entitled "Guidelines for completing the monitoring report form (CDM-MR)" (EB 54 meeting report, annex 34).

MONITORING REPORT
Version 01 and date 08/12/2011

Ratchaburi Farms Biogas Project at Veerachai Farm
Reference number 1554
Monitoring period No.1 (28/03/2008 – 31/03/2011)

SECTION A. General description of the project activity

A.1. Brief description of the project activity:

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Ratchaburi Farms Biogas Project at Veerachai Farm has invested in a high-rate continuous flow closed anaerobic treatment reactors to treat 100% of all barn flushing effluents produced from their swine rearing operations. The treatment of swine waste water by way of anaerobic degradation processes leads to the production of a biogas with a CH_4 contents of of 60-70%. The biogas is combusted in gas engines that run generators for producing electricity. Veerachai farm has constructed these facilities to replace a low-rate open anaerobic lagoon barn flushing effluent treatment system, which in the absence of the project would produces methane from the open lagoon system and which would be released directly to the atmosphere. The monitoring period covered by this report runs from 28 March 2008 to 31 March 2011 and the emission reduction achieved during this period is determined to be 122,252 tCO_2e.

Relevant project activities and the dates of these are listed in the table below:

Event	Timing
Management board decides to invest in the project activity and pursue CDM status.	5 October 2003
Veerachai signs first biogas construction contract	15 May 2004
Gas engine#1 commissioning	May 2005
Validation Contract signed with DNV	6 January 2006
1st Expansion of biogas plant, Veerachai signs contract with Biogas Technology Center (BTC)*	4 September 2006
2nd Expansion of the biogas plant, Veerachai signs contract with Biogas Technology Center (BTC)*, Chiang Mai University	28 September 2006
Web hosting at UNFCCC	21 February 2007
Thai DNA issues the LoA for the project activity	5 November 2007
Project registered at UNFCCC	28 March 2008
3rd Expansion of the biogas plant, Veerachai signs contract with Energy Research and Development Institute (ERDI), Chiang Mai University	29 May 2008
Gas engine #2 commissioning	28 December 2008
Monitoring period	28 March 2008 – 31 March 2011

*Biogas Technology Center (BTC) was merged into Energy Research and Development Institute (ERDI) in March 2007.

A.2. Project Participants

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Name of Party involved	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Thailand (Host Party)	• Veerachai Farm Rangwai (VCF Group).	No
Denmark	• Danish Ministry of Climate and Energy/The Danish Energy Agency.	Yes

A.3. Location of the project activity:

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Veerachai Farm is located in Pak Thor District, Ratchaburi Province, Thailand, approximately 100 km west of Bangkok. The specific location of the farm is provided below:

Mailing address Moo 4, Thung Luang Sub-district, Pak Thor District, Ratchaburi
GPS Coordinates: 13°24.558N 99°41.403E

A.4. Technical description of the project

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The high-rate anaerobic wastewater treatment reactors used in the project are based on the *high suspended solids upflow anaerobic sludge blanket* (H-UASB) system, which is a modification of the general UASB concept. A hydrolytic tank or buffer tank is added upstream to the conventional UASB plant. Biogas from the H-UASB is captured and stored under a polyethylene cover placed over the buffer tanks, and from there the biogas is – through PE pipes – pumped to the gas engines that generate electricity that is used in electrical power applications at the farm. This electricity will displace electrical power that was previously imported from the national Thai electricity grid.

Final effluent from the anaerobic treatment plants is percolated across a series of sand filter beds in a batch-fed system, operating on a 4-5 day batch cycle. The removed solids are aerobically dried on the top of the filter bed, and once dry, removed for use as a fertiliser. Percolate is channelled to open lagoons, where further facultative breakdown of the organic load occurs. From there, the final effluent is recycled – usually via a final purification process such as a packaged high-rate sand filter plant – and reused in barn flushing operations (*Figure1*).

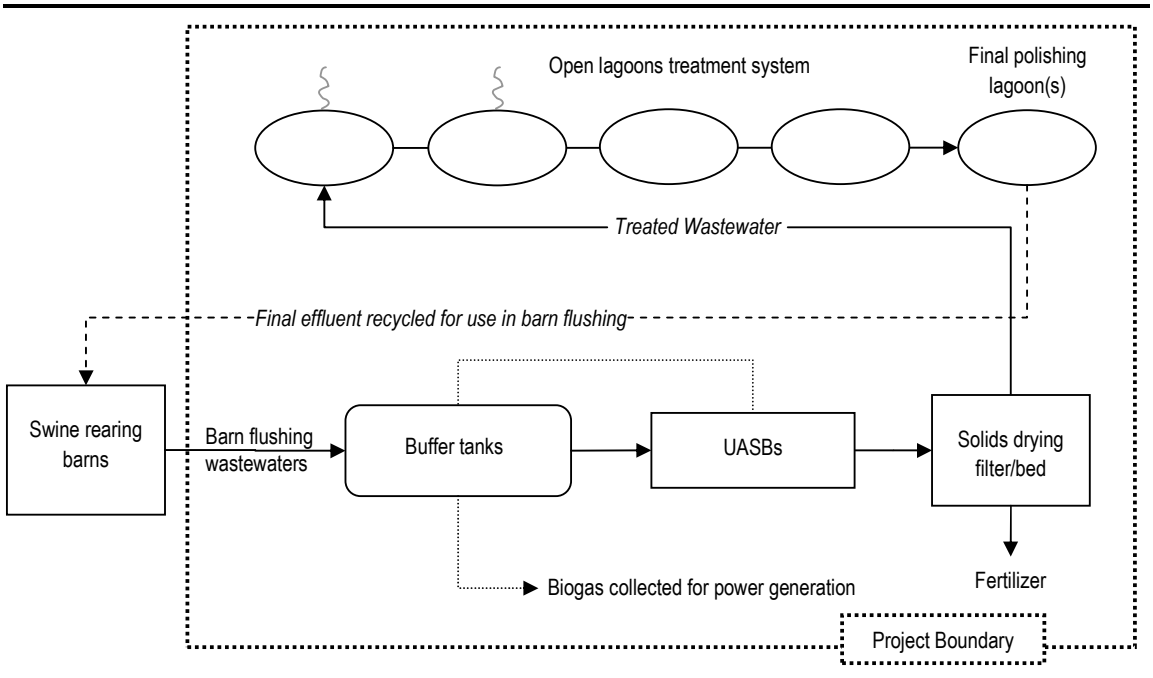

Figure 1 Layout of the system in the project implementation

A.5. Title, reference and version of the baseline and monitoring methodology applied to the project activity:

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AMS-III.D Methane recovery in agricultural and agro industrial activities, version 11 dated 23/12/06.

AMS-I.D Grid connected renewable electricity generation, version 10, dated 23/12/06.

A.6. Registration date of the project activity:

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28 March 2008

A.7. Crediting period of the project activity and related information (start date and choice of crediting period):

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The start date of crediting period is 28 March 2008 with 10 years fixed crediting period.

A.8. Name of responsible person(s)/entity(ies):

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The contact information of the person(s)/entity(ies) responsible for completing the monitoring report form (CDM-MR).

Organization	Danish Energy Management A/S
Contact person	Mr. Karsten M. Holm
Telephone no.	+66 (0) 2305 6606
Email address	kah@dem.dk

SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

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The project started operation in May 2005, which was before the date of project registration with the UNFCCC. From this date the project was implemented as described in the registered PDD, except from the installation of a flare system, which only was installed on 29 July 2008.

During the initial operation the waste water treatment system faced some challenges as the treatment capacity appeared lower than the actual waste water volume. Secondly, the farm increased its swine population and it was evident that an expansion of the treatment system was required. Unaware about the issue of de-bundling, the project owner started construction of a system expansion and pursued a separate CDM status for this part of the project. It was only after the project registration and monitoring had started, that an ERPA signed with a different entity than the project participant listed in the PDD was terminated and the expansion was perceived as a change to the registered project. A notification of project changes has been submitted to the UNFCCC.

The additional wastewater treatment capacity was installed using the same technology as the initial stage. The initial capacity 12,000 m^3 was expanded to 33,000 m^3 totally and in order to fully utilise the increased generation of biogas the proponent has also installed an additional 957 kW gas engine. The total capacity of gas engine is hence 1,909 kW. The expansion unit started operation on 28 December 2008.

There is also submitted a notification of revisions to the Monitoring Plan to the UNFCCC for its approval. These changes include:

- Measurement method of biogas flow to the gas engine
- Accuracy level of methane analyzer
- QA/QC procedure of electricity generated
- Measurement method of flare efficiency

During the operation of the system, the proponent is facing downtimes as detailed in the below table:

Downtime	Gas engine#1		Gas engine#2	
	Hour	%	Hour	%
Forced outage from PEA	24	1	24	1
System modification	552	28	528	24
Breakdown	1,104	55	1,632	75
Repair (waiting for spare)	312	16	0	0
Total	1,992	100	2,184	100

B.2. Revision of the monitoring plan

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Revision of the monitoring plan is being processed by the UNFCCC.

1) Measurement method of biogas flow to the gas engine

The project proponent has installed a difference type of gas flow meter as compared to the type stated in the registered PDD. The installed meter can provide the higher accuracy in the readings than what is stated in the Monitoring Plan of the Registered PDD.

2) The accuracy level of methane analyzer

The accuracy level of methane analyzer applied in the project has a lower level (+/-5) compared with the level stated in the PDD (+/-2.5). This has been notified to the UNFCCC.

3) QA/QC procedure for the parameter "Electricity generated"

Since there is no application of heat in the project activity, the QA/QC description has been revised to maintenance and calibration method of the electricity meter.

4) Measurement method of flare efficiency

The measurement method of the open flare system has been revised to be inline with the “Tool to determine project emissions from flaring gases containing methane” Annex 13 EB 28.

B.3. Request for deviation applied to this monitoring period

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Request for deviation to the monitoring plan is being processed by the UNFCCC.

1) Biogas flow sent to flare

An open flare system was installed on 29 July 2008 and only to serve as an emergency measure. A gas flow meter was installed on 1 January 2010.

2) Flare efficiency

The proponent has not installed measures to enable determination of the flare efficiency. Hence the flare efficiency – when biogas is flared - can only be zero through this monitoring period.

B.4. Notification or request of approval of changes

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Notification of changes is being processed by the UNFCCC.

1) The terminology of waste water treatment system

Through out the registered PDD the term “Channel digester” has been used where a more appropriate term would be a “Buffer tank”. This change is only limited to the terminology change as it has been confirmed with a biogas technology provider that channel digester technology does not require UASB reactors as it is a reactor on its own. Therefore it was an inappropriate terminology used in the registered PDD.

2) Expansion of the wastewater treatment system

Due to insufficient treatment capacity and farm expansion the proponent had to implement an expansion of the wastewater treatment system including 1 buffer tank and 3 H-UASB reactors. This

expansion has started operation in December 2008. Hence, the number of the components of wastewater treatment system has been revised to 3 buffer tanks and 9 H-UASB reactors in the revised PDD.

3) Total installed capacity of the generator

Due to a typographical error the capacity of generator stated in the registered PDD has been edited from 950 kW to 952 kW. Beside, the proponent installed an additional generator of 957 kW in order to utilize the increased biogas production as a result of the expansion of wastewater treatment system. Hence the total electricity generator capacity is revised from 950 kW to 1,909 kW

4) Change of mailing address and contact number of the farm

Mailing address of farm was changed from Moo 1 Ban Nong Bua, Bo Kra Dan Sub-district to Moo 4, Thung Luang Sub-district due to the inaccurate address in the registered PDD. However, the GPS coordinate mentioned in the registered PDD is already correct. Moreover the telephone and fax number have been changed as reflected in the revised PDD.

5) The data for IPCC tier 2 approach calculation

The calculation of methane emissions from the baseline scenario in the registered PDD were calculated *ex-ante* using IPCC tier 2 approach. Though there is no change to this approach, the 'average energy of feed intake per head per day' was by mistake based on farm data of metabolized energy. This is changed to 'average gross energy of feed intake per head per day'. The Registered PDD's 'daily intake per head' of 26.02 MJ/day is recalculated to 'average gross energy of feed intake per head per day' 35.30 MJ/day.

SECTION C. Description of the monitoring system

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According to the requirement of the CDM Executive Board, all CDM data are required to be stored for a minimum period of 2 years after the end of crediting period or the date that verify the last CER depending on which occurs later. Since the crediting period of this project activity is 10 years, all data would be kept at least until March 2020. Data from all meters such as flow meters, methane analyzer, and power meters will be read daily and recorded in log book and in monthly monitoring record table. For other parameters such as the sludge application, this will be noted by the responsible personnel whenever sludge is removed from the treatment plant or the sludge that are regularly collected from the drying beds subsequent to the water treatment. The information flow system of the project and point of meter installation are illustrated in *Figure 2*.

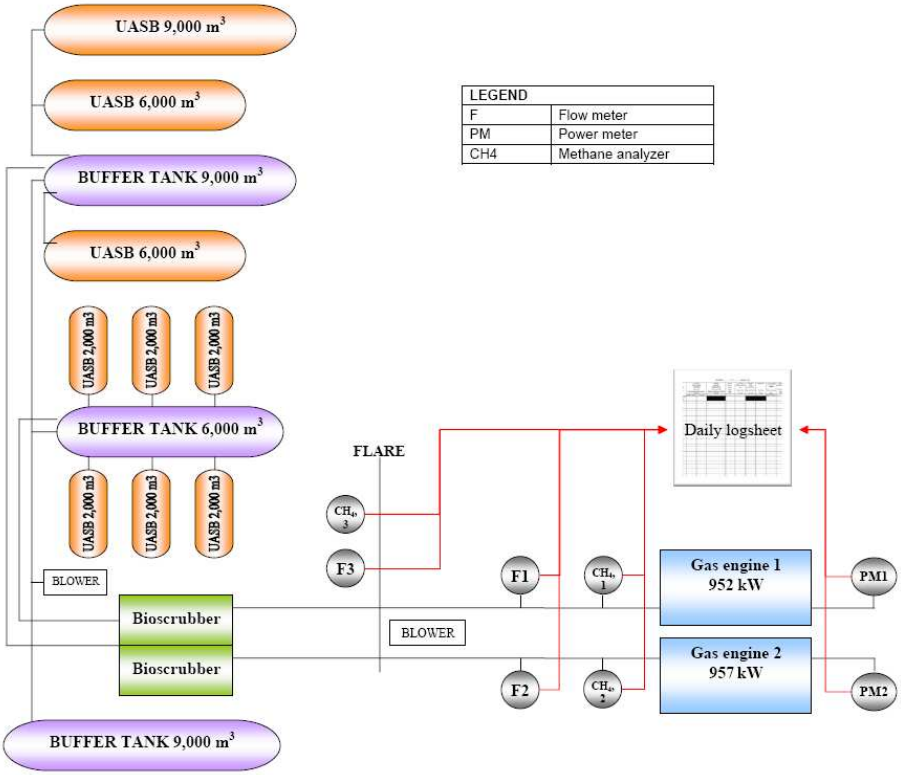

Figure 2 The information flow system of project and point of meter installation

Code	Type	Parameters Monitored	Unit
F1	Flow meter	Biogas flow to gas engine1	m^3
F2	Flow meter	Biogas flow to gas engine2	m^3
F3	Flow meter	Biogas flow to flare	m^3
PM1	Power meter	Electrical output from gas engine1	kWh
PM2	Power meter	Electrical output from gas engine2	kWh
CH_4,1	Methane analyzer	Methane content in biogas to engine1	%
CH_4,2	Methane analyzer	Methane content in biogas to engine2	%
CH_4,3	Methane analyzer	Methane content in biogas to flare	%

The organisation of staff involved in the CDM activity and their responsibilities are shown in *Figure 3* below. The CDM manager is responsible for checking the data in log books of the operational managers and for transfer of data to the monthly monitoring record table, electronic files, and for submitting these to the CDM consultant within one week after the end of each month.

Any deviations or abnormal trends observed by the CDM office is reported to the CDM Manager, who is responsible for initiating corrective actions.

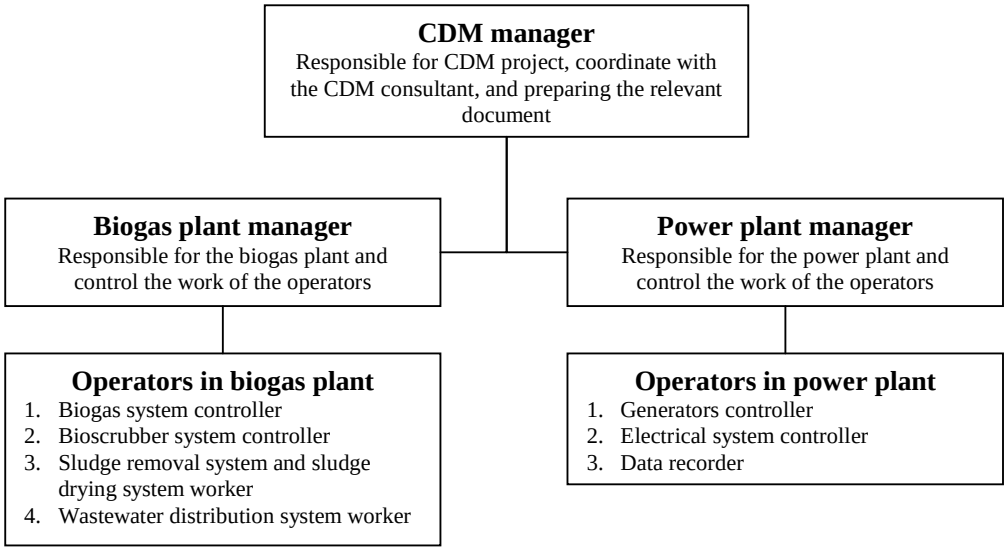

Figure 3 Organizational structure and responsibilities of the personnel

SECTION D. Data and parameters

D.1. Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors

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Data / Parameter:	**GE**
Data unit:	MJ/day
Description:	The average gross energy of feed intake per head per day
Source of data used:	PDD
Value(s) :	35.30
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Additional comment:	This parameter depends on the feed formula used in farm. If there is any change of swine feed, the value should be recalculated from time to time.

Data / Parameter:	**DE**
Data unit:	%
Description:	Digestibility of the feed in percent
Source of data used:	IPCC 2006 as per the PDD
Value(s) :	80
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Additional comment:	n/a

Data / Parameter:	**UE**
Data unit:	Dimensionless
Description:	Urinary energy expressed as fraction of GE

Source of data used:	IPCC 2006 as per the PDD
Value(s) :	0.02
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Additional comment:	n/a

Data / Parameter:	**ASH**
Data unit:	%
Description:	The ash content of manure
Source of data used:	IPCC 1996 as per the PDD
Value(s) :	4
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Additional comment:	n/a

Data / Parameter:	**VS**
Data unit:	kg VS/day
Description:	Daily volatile Solid Excretion
Source of data used:	PDD
Value(s) :	0.40
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Additional comment:	n/a

Data / Parameter:	**Pop**
Data unit:	Heads
Description:	Animal population in Farm
Source of data used:	Data provided by the farm (A conservative swine population is used which is lower than data provided by the farm)
Value(s) :	115,000
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Additional comment:	n/a

Data / Parameter:	**B_o**
Data unit:	m^3 CH_4/kg VS
Description:	Maximum methane producing capacity for manure
Source of data used:	IPCC 2006 as per the PDD
Value(s) :	0.29
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Additional comment:	n/a

Data / Parameter:	**MCF**

Data unit:	%
Description:	Methane Conversion Factor
Source of data used:	IPCC 2006 as per the PDD
Value(s) :	80
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Additional comment:	n/a

Data / Parameter:	**EF**
Data unit:	kg CH_4/head/year
Description:	Annual methane emission factor
Source of data used:	PDD
Value(s) :	24.50
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Additional comment:	n/a

Data / Parameter:	**Methane density**
Data unit:	kg/m^3
Description:	Methane density
Source of data used:	Tool to determine project emissions from flaring containing methane. EB 28, Annex 13.
Value(s) :	0.716
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Additional comment:	n/a

Data / Parameter:	**$GWP_{Methane}$**
Data unit:	tCO_2/tCH_4
Description:	Global Warming Potential of methane
Source of data used:	IPCC 2006
Value(s) :	21
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Additional comment:	n/a

Data / Parameter:	**Manure management system usage**
Data unit:	%
Description:	Fraction of manure being treated by the system
Source of data used:	PDD
Value(s) :	100%
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Additional comment:	n/a

D.2. Data and parameters monitored

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Data / Parameter:	Q_G			
Data unit:	m^3			
Description:	Biogas flow to gas engines			
Measured /Calculated /Default:	Measured by two flow meters with the codes F1 and F2			
Source of data:	Log sheet			
Value(s) of monitored parameter:	Month	$F1_{Retire}$	$F1_{Operate}$	F2
	28 – 31 March 2008	26,300	-	-
	April 2008	181,460	-	-
	May 2008	158,900	-	-
	June 2008	135,510	-	-
	July 2008	145,430	-	-
	August 2008	155,570	-	-
	September 2008	187,910	-	-
	October 2008	230,880	-	-
	November 2008	190,800	-	-
	December 2008	174,000	-	20,480
	January 2009	154,690	-	135,100
	February 2009	155,350	-	151,040
	March 2009	104,040	-	214,820
	April 2009	170,950	-	142,810
	May 2009	160,400	-	177,870
	June 2009	155,440	-	199,900
	July 2009	159,830	-	199,190
	August 2009	176,340	-	193,840
	September 2009	169,660	-	175,870
	October 2009	150,810	-	181,960
	November 2009	163,400	-	169,770
	December 2009	185,530	-	186,030
	January 2010	151,230	-	182,040
	February 2010	208,270	-	0
	March 2010	227,410	-	27,410
	April 2010	181,410	-	193,380
	May 2010	96,190	-	237,580
	June 2010	145,060	-	213,960
	July 2010	50,080	-	246,480
	August 2010	-	73,210	268,820
	September 2010	-	117,114	252,620
	October 2010	-	92,695	230,170
	November 2010	-	88,629	241,450
	December 2010	-	123,938	256,220
	January 2011	-	170,243	246,820
	February 2011	-	144,798	216,200
	March 2011	-	151,197	253,330
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation			
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)		$F1_{Retire}$	$F1_{Operate}$	F2
	Status	Retired on 15/07/10	Operate	Operate
	Manufacturer	Kobold	FCI	Kobold
	Model/Type	DOG-1326LF1FNVDY	ST51	DOG-1325LF1FNNDY
	Accuracy	±1.5% of reading	±2% of reading +	±1.5% of reading

			0.5% of full scale	
	Serial number	4830	311614	5591
	Measurement range	0 – 600 m^3/hr	0 – 600 m^3/hr	0 – 600 m^3/hr
	Recommended calibration frequency	36 months	18 months	36 months
	Date of calibration	07/02/08 21/02/09 19/02/10	14/12/09	13/07/08 21/02/09 19/02/10
	Validity	18/02/13	13/06/11	18/02/13
Measuring/ Reading/ Recording frequency:	Measured continuously Read daily Recorded daily			
Calculation method (if applicable):	Monthly summary of biogas flow rate from two meters is calculated for emission calculation.			
QA/QC procedures applied:	Biogas flow meters are be subjected to recalibration by accredited laboratory in accordance with calibration schedule. Where erroneous meter readings are encountered, specialist contractors will be employed to recalibrate meters.			

Data / Parameter:	**CEF**	
Data unit:	tCO_2/MWh	
Description:	Grid Carbon Emission Factor	
Measured /Calculated /Default:	Default value	
Source of data:	EPPO and EGAT	
Value(s) of monitored parameter:	Month	Values
	March – December 2008	0.559
	January – December 2009	0.550
	January – December 2010	0.556
	January – March 2011	0.546
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline/Project emission calculation	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	n/a	
Measuring/ Reading/ Recording frequency:	Calculated every year according to the most updated data from EPPO and EGAT. The data in year 2011 are not publicly available therefore the emission factor is calculated using data from the year before (y-1) and the same data vintage (y-1) is applied throughout this monitoring period.	
Calculation method (if applicable):	The CEF of grid is calculated based on the weighted average of the emissions of the current generation mix in tCO_2/MWh.	
QA/QC procedures applied:	n/a	

Data / Parameter:	$\mathbf{f_{G,CH4}}$			
Data unit:	%			
Description:	Methane content in biogas			
Measured /Calculated /Default:	Measured by methane analyzer meter coded CH_4			
Source of data:	Log sheet			
Value(s) of monitored parameter:	Month	$\%CH_4$ to G1	$\%CH_4$ to G2	$\%CH_4$ to flare
	28 – 31 March 2008	68.0	-	-
	April 2008	69.2	-	-
	May 2008	69.0	-	-
	June 2008	71.0	-	-
	July 2008	69.0	-	-
	August 2008	68.5	-	-
	September 2008	69.3	-	-
	October 2008	68.0	-	-
	November 2008	65.0	-	-
	December 2008	65.4	67.0	-
	January 2009	67.3	69.7	-
	February 2009	65.0	69.3	-
	March 2009	68.0	69.0	-
	April 2009	64.5	68.7	-
	May 2009	65.5	68.3	-
	June 2009	68.5	67.7	-
	July 2009	68.0	68.0	-
	August 2009	67.0	68.0	-
	September 2009	66.7	68.7	-
	October 2009	66.0	67.7	-
	November 2009	67.0	68.7	-
	December 2009	66.0	67.7	-
	January 2010	66.7	68.3	67.0
	February 2010	66.7	-	67.4
	March 2010	66.7	67.0	67.1
	April 2010	66.3	67.3	-
	May 2010	66.7	67.0	-
	June 2010	66.3	68.0	-
	July 2010	67.0	67.3	-
	August 2010	67.5	69.0	68.0
	September 2010	66.7	68.3	-
	October 2010	66.7	68.3	-
	November 2010	66.3	68.3	-
	December 2010	66.5	68.3	-
	January 2011	68.0	68.7	-
	February 2011	68.3	69.3	-
	March 2011	69.7	69.3	-
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation			
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last		CH_4		
	Status	Operate		
	Manufacturer	Riken Keiki		
	Model/Type	RX-415 (type CH_4)		

calibration, validity)	Accuracy	±5% full scale
	Serial number	772020050RN
	Measurement range	0 – 100%
	Recommended calibration frequency	12 months
	Date of calibration	15/01/08 12/07/08 23/01/09 20/07/09 18/01/10 09/07/10 06/02/11
	Validity	05/02/12
Measuring/ Reading/ Recording frequency:	Measured at least monthly Read at least monthly Recorded at least monthly	
Calculation method (if applicable):	Monthly average of methane content is calculated for emission calculation.	
QA/QC procedures applied:	Methane analyzer meter should be subjected to recalibrate by accredited laboratory. Where erroneous meter readings are encountered, specialist contractors will be employed to recalibrate meters.	

Data / Parameter:	**$KW_{E,GENERATED}$**			
Data unit:	MWh			
Description:	Electricity generated by gas engines			
Measured /Calculated /Default:	Measured by two power meters coded PM1 and PM2			
Source of data:	Log sheet			
Value(s) of monitored parameter:	Month	PM1	PM2	Total
	28 – 31 March 2008	73.059	-	73.059
	April 2008	511.279	-	511.279
	May 2008	438.126	-	438.126
	June 2008	357.092	-	357.092
	July 2008	376.700	-	376.700
	August 2008	391.183	-	391.183
	September 2008	489.677	-	489.677
	October 2008	612.968	-	612.968
	November 2008	511.267	-	511.267
	December 2008	434.502	41.777	476.279
	January 2009	366.941	273.781	640.722
	February 2009	370.688	305.769	676.457
	March 2009	246.983	450.329	697.312
	April 2009	388.940	281.452	670.392
	May 2009	371.264	369.031	740.295
	June 2009	350.476	420.730	771.206
	July 2009	377.375	413.577	790.952
	August 2009	413.030	391.951	804.981
	September 2009	403.555*	364.962	768.517
	October 2009	344.280*	386.840	731.120
	November 2009	375.187	370.580	745.767
	December 2009	422.386	413.887	836.273
	January 2010	336.448	413.448	749.896
	February 2010	510.351	0.000	510.351
	March 2010	570.975	57.808	628.783

	April 2010	386.544	417.198	803.742
	May 2010	202.622	521.828	724.450
	June 2010	310.632	469.682	780.314
	July 2010	244.402	559.271	803.673
	August 2010	203.432	606.272	809.704
	September 2010	216.157	565.122	781.279
	October 2010	171.760*	523.678*	695.438
	November 2010	162.686*	553.901*	716.587
	December 2010	228.140*	585.289*	813.428
	January 2011	315.628	554.832	870.460
	February 2011	270.771	486.246	757.017
	March 2011	279.246	567.404	846.650
	* *The data is already adjusted due to the gap of calibration*			
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation			
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)		PM1	PM2	
	Status	Operate	Operate	
	Manufacturer	Merlin Gerin	Carlo Gavazzi	
	Model/Type	PM500	WM3-96	
	Accuracy class	1.0	1.0	
	Serial number	10100	BH2820039101	
	Measurement range	0 – 99999999 kWh	0 – 999999999 kWh	
	Recommended calibration frequency	12 months	12 months	
	Date of calibration	19/11/07 16/09/08 27/10/09 15/12/10	27/10/09 15/12/10	
	Validity	14/12/11	14/12/11	
Measuring/ Reading/ Recording frequency:	Measured continuously Read daily Recorded daily			
Calculation method (if applicable):	Monthly summary of electricity output from two meters is calculated for emission calculation.			
QA/QC procedures applied:	A technician from the Provincial Electricity Authority (PEA) will be employed to recalibrate the electricity meters in line with the supplier's recommendation. Where erroneous meter readings are encountered, specialist contractors will be employed to recalibrate meters.			

Data / Parameter:	**E_{power}**	
Data unit:	MWh	
Description:	Auxiliary electricity consumption for biogas system	
Measured /Calculated /Default:	Calculated value	
Source of data:	Project proponent	
Value(s) of monitored parameter:	Month	Values
	28 – 31 March 2008	3.66
	April 2008	27.42
	May 2008	28.33
	June 2008	27.42
	July 2008	28.33
	August 2008	28.33

	September 2008	27.42
	October 2008	28.33
	November 2008	27.42
	December 2008	28.33
	January 2009	28.33
	February 2009	25.59
	March 2009	28.33
	April 2009	27.42
	May 2009	28.33
	June 2009	27.42
	July 2009	28.33
	August 2009	28.33
	September 2009	27.42
	October 2009	28.33
	November 2009	27.42
	December 2009	28.33
	January 2010	28.33
	February 2010	25.59
	March 2010	28.33
	April 2010	27.42
	May 2010	28.33
	June 2010	27.42
	July 2010	28.33
	August 2010	28.33
	September 2010	27.42
	October 2010	28.33
	November 2010	27.42
	December 2010	28.33
	January 2011	28.33
	February 2011	25.59
	March 2011	28.33

Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	n/a
Measuring/ Reading/ Recording frequency:	Recalculated whenever the auxiliary equipments installed in the project activity is added/removed.
Calculation method (if applicable):	***Initial wastewater treatment system***

Place of Motor	no. of Motor	kW	Operating hour (hr/d)	Energy Consumption (Mwh/yr)
Equalization tank	6	2.3	18	90.67
CT	1	15	6	32.85
H-UASB	12	2.3	0.067	0.67
Bioscrubber	4	0.75	24	26.28
				150.47

Additional wastewater treatment system

	Place of Motor	no. of Motor	kW	Operating hour (hr/d)	Energy Consumption (Mwh/yr)
	CT	4	11	6	96.36
	H-UASB	6	2.2	0.067	0.32
	Distribution system	8	3.7	8	86.43
					183.11
				Total	333.58
QA/QC procedures applied:	n/a				

Data / Parameter:	**Biogas Flared**	
Data unit:	m^3	
Description:	Amount of the biogas sent to the flare	
Measured /Calculated /Default:	Measured by flow meter coded F3	
Source of data:	Log sheet	
Value(s) of monitored parameter:	Month	F3
	28 – 31 March 2008	-
	April 2008	-
	May 2008	-
	June 2008	-
	July 2008	-
	August 2008	-
	September 2008	-
	October 2008	-
	November 2008	-
	December 2008	-
	January 2009	-
	February 2009	-
	March 2009	-
	April 2009	-
	May 2009	-
	June 2009	-
	July 2009	-
	August 2009	-
	September 2009	-
	October 2009	-
	November 2009	-
	December 2009	-
	January 2010	8,334*
	February 2010	61,648*
	March 2010	66,183*
	April 2010	0
	May 2010	0
	June 2010	0
	July 2010	0
	August 2010	1,873*
	September 2010	0
	October 2010	0
	November 2010	0
	December 2010	0
	January 2011	0

	February 2011	0
	March 2011	0
	* *The data is already adjusted due to the gap of calibration*	
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculation	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)		F3
	Status	Operate
	Manufacturer	FCI
	Model/Type	ST98-23CT01CAACA
	Accuracy	±1% of reading + 0.5% full scale
	Serial number	285369
	Measurement range	0 – 800 m^3/hr
	Recommended calibration frequency	18 months
	Date of calibration	26/11/07
	Validity	25/05/09
Measuring/ Reading/ Recording frequency:	Measured continuously Read daily Recorded daily	
Calculation method (if applicable):	Monthly summary of biogas flow rate from the meter is calculated for emission calculation.	
QA/QC procedures applied:	This parameter will only be monitored when there is surplus gas from the project and a flare is installed.	

Data / Parameter:	**Flare efficiency**	
Data unit:	%	
Description:	The fraction of methane destroyed. The flare efficiency is defined as the fraction of time in which the gas is combusted in the flare, multiplied by the efficiency of the flaring process.	
Measured /Calculated /Default:	Default value	
Source of data:	EB28 Annex13	
Value(s) of monitored parameter:	Month	Value
	28 – 31 March 2008	-
	April 2008	-
	May 2008	-
	June 2008	-
	July 2008	-
	August 2008	-
	September 2008	-
	October 2008	-
	November 2008	-
	December 2008	-
	January 2009	-
	February 2009	-
	March 2009	-
	April 2009	-
	May 2009	-
	June 2009	-
	July 2009	-
	August 2009	-
	September 2009	-
	October 2009	-

	November 2009	-
	December 2009	-
	January 2010	0
	February 2010	0
	March 2010	0
	April 2010	0
	May 2010	0
	June 2010	0
	July 2010	0
	August 2010	0
	September 2010	0
	October 2010	0
	November 2010	0
	December 2010	0
	January 2011	0
	February 2011	0
	March 2011	0
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculation	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	n/a	
Measuring/ Reading/ Recording frequency:	Whenever the surplus biogas is sent to flare	
Calculation method (if applicable):	n/a	
QA/QC procedures applied:	n/a	

Data / Parameter:	**Sludge application**		
Data unit:	Tonnes		
Description:	Quantity of sludge removed from the treatment system and its application.		
Measured /Calculated /Default:	Measured by farm		
Source of data:	Log sheet		
Value(s) of monitored parameter:	Month	Value	Application
	28 – 31 March 2008	116.96	Fertilizer
	April 2008	34.01	Fertilizer
	May 2008	134.39	Fertilizer
	June 2008	14.98	Fertilizer
	July 2008	0.00	Fertilizer
	August 2008	12.41	Fertilizer
	September 2008	4.43	Fertilizer
	October 2008	0.00	Fertilizer
	November 2008	0.00	Fertilizer
	December 2008	15.88	Fertilizer
	January 2009	0.87	Fertilizer
	February 2009	56.15	Fertilizer
	March 2009	332.04	Fertilizer
	April 2009	132.13	Fertilizer
	May 2009	72.05	Fertilizer

	June 2009	161.75	Fertilizer
	July 2009	48.71	Fertilizer
	August 2009	0.00	Fertilizer
	September 2009	69.87	Fertilizer
	October 2009	0.00	Fertilizer
	November 2009	66.91	Fertilizer
	December 2009	79.96	Fertilizer
	January 2010	311.18	Fertilizer
	February 2010	95.95	Fertilizer
	March 2010	176.48	Fertilizer
	April 2010	224.19	Fertilizer
	May 2010	480.95	Fertilizer
	June 2010	938.06	Fertilizer
	July 2010	275.28	Fertilizer
	August 2010	149.71	Fertilizer
	September 2010	78.62	Fertilizer
	October 2010	116.07	Fertilizer
	November 2010	197.44	Fertilizer
	December 2010	129.76	Fertilizer
	January 2011	179.33	Fertilizer
	February 2011	431.05	Fertilizer
	March 2011	715.42	Fertilizer
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculation		
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)		Truck scale	
	Manufacturer	Mettler Toledo	
	Model/Type	8530 Couger	
	Maximum permissible error	20 kg	
	Serial number	5078670 – 5FA	
	Measurement range	10-80,000 kg	
	Recommended calibration frequency	24 months	
	Date of calibration	28/03/08 20/10/13	
	Validity	19/10/13	
Measuring/ Reading/ Recording frequency:	Measured and recorded whenever the sludge is removed from the biogas system		
Calculation method (if applicable):	n/a		
QA/QC procedures applied:	Measurement will be carried out adhering to internationally recognized procedures		

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

>>

AMS-I.D.

The baseline emission from electricity generation is calculated as:

$$BE_{electricity} = KW_{E,GENERATED} \times CEF$$

Where:

$BE_{electricity}$: Baseline electricity generation emissions (tCO_2e)

$KW_{E,GENERATED}$: Electricity produced by the biogas generator unit for grid electricity replacement (MWh)

CEF: Emission coefficient for electricity grid (tCO_2e/MWh)

Month	$BE_{electricity}$ (tCO_2e)
28 – 31 March 2008	41
April 2008	286
May 2008	245
June 2008	200
July 2008	211
August 2008	219
September 2008	274
October 2008	343
November 2008	286
December 2008	266
January 2009	352
February 2009	372
March 2009	384
April 2009	369
May 2009	407
June 2009	424
July 2009	435
August 2009	443
September 2009	423
October 2009	402
November 2009	410
December 2009	460
January 2010	417
February 2010	284
March 2010	350
April 2010	447
May 2010	403
June 2010	434
July 2010	447
August 2010	450
September 2010	434
October 2010	387
November 2010	398
December 2010	452
January 2011	475
February 2011	413
March 2011	462
Total baseline emission from AMS-I.D.	**13,503**

AMS-III.D.

Methane emissions are calculated as specified in paragraph (a) direct measurement and (b) calculation ex ante with IPCC tier2 approach and the lower of these two values is used.

a) Actual monitored amount of methane captured and destroyed by the project activity is estimated from:

$$BE_{CH4,\ measurement} = Q_G \times f_{G,CH4} \times 0.716\ kg/m^3 \times GWP / 1000$$

Where:

$BE_{CH4,\ measurement}$: Methane emission by direct measurement (tCO_2e)

Q_G: Flow rate of biogas produced to gas engines (m^3)

$f_{G,CH4}$: Methane content in biogas (%)

GWP: Global warming potential for methane (21 tCO_2e/tCH_4)

b) The methane emissions calculated ex ante with the most recent IPCC tier 2 approach as per the PDD.

Month	**$BE_{CH4,\ measurement}$ (tCO_2e)**	**$BE_{CH4,Tier2}$ (tCO_2e)**	**Lower BE_{CH4} (tCO_2e)**
28 – 31 March 2008	269	648	269
April 2008	1,887	4,863	1,887
May 2008	1,649	5,026	1,649
June 2008	1,447	4,863	1,447
July 2008	1,509	5,026	1,509
August 2008	1,602	5,026	1,602
September 2008	1,957	4,863	1,957
October 2008	2,361	5,026	2,361
November 2008	1,865	4,863	1,865
December 2008	1,917	5,026	1,917
January 2009	2,981	5,026	2,981
February 2009	3,093	4,539	3,093
March 2009	3,292	5,026	3,292
April 2009	3,132	4,863	3,132
May 2009	3,407	5,026	3,407
June 2009	3,635	4,863	3,635
July 2009	3,671	5,026	3,671
August 2009	3,758	5,026	3,758
September 2009	3,516	4,863	3,516
October 2009	3,348	5,026	3,348
November 2009	3,399	4,863	3,399
December 2009	3,734	5,026	3,734
January 2010	3,470	5,026	3,470
February 2010	2,712	4,539	2,712
March 2010	3,224	5,026	3,224
April 2010	3,767	4,863	3,767
May 2010	3,358	5,026	3,358
June 2010	3,634	4,863	3,634
July 2010	3,000	5,026	3,000
August 2010	3,551	5,026	3,551
September 2010	3,770	4,863	3,770
October 2010	3,294	5,026	3,294
November 2010	3,365	4,863	3,365
December 2010	3,872	5,026	3,872
January 2011	4,289	5,026	4,289
February 2011	3,742	4,539	3,742
March 2011	4,225	5,026	4,225
Total baseline emission from AMS-III.D.			**110,701**

The total baseline emission can be summed up to 124,204 tCO_2e.

E.2. Project emissions calculation

>>

AMS-I.D:

As the project is utilizing biogas with biogenic origins to produce renewable energy, and the design of the system include only smaller electrical appliances, the anthropogenic emissions from this component are considered to be zero.

AMS-III.D:

Project emission during monitoring period can be calculated as:

$$PE_{project} = E_{flare} + E_{power} + E_{sludge}$$

Where:

$PE_{project}$: Project emissions (tCO_2e)
E_{flare}: Methane captured and not flared (tCO_2e)
E_{power}: CO_2 emissions from use of fossil fuel or electricity for the operation (tCO_2e)
E_{sludge}: CH_4 emission from anaerobic treatment of removed sludge (tCO_2e)

$$E_{flare} = Q_{flare} \times f_{G,CH4} \times 0.716\ kg/m^3 \times GWP / 1000 \times (1- flare\ efficiency)$$

Where:

E_{flare}: Methane captured and not flared (tCO_2e)
Q_{flare}: Flow rate of biogas sent to the flare (m^3)
$f_{G,CH4}$: Methane content in biogas (%)
GWP: Global warming potential for methane (21 tCO_2e/tCH_4)

$$E_{power} = EC_{Aux} \times CEF$$

Where:

E_{power}: CO_2 emissions from use of electricity for the operation (tCO_2e)
EC_{Aux}: Power consumption by the auxiliary equipments in the biogas plant (MWh)
CEF: Emission coefficient for electricity grid (tCO_2e/MWh)

E_{sludge}, the sludge is dried aerobically on the sand bed therefore the emission is considered to be zero.

Month	E_{flare} (tCO_2e)	E_{power} (tCO_2e)	E_{sludge} (tCO_2e)	$PE_{project}$ (tCO_2e)
28 – 31 March 2008	0	2	0	2
April 2008	0	15	0	15
May 2008	0	16	0	16
June 2008	0	15	0	15
July 2008	0	16	0	16
August 2008	0	16	0	16
September 2008	0	15	0	15
October 2008	0	16	0	16
November 2008	0	15	0	15
December 2008	0	16	0	16
January 2009	0	16	0	16
February 2009	0	14	0	14
March 2009	0	16	0	16
April 2009	0	15	0	15
May 2009	0	16	0	16
June 2009	0	15	0	15
July 2009	0	16	0	16
August 2009	0	16	0	16
September 2009	0	15	0	15

Month	E_{flare} (tCO_2e)	E_{power} (tCO_2e)	E_{sludge} (tCO_2e)	$PE_{project}$ (tCO_2e)
October 2009	0	16	0	16
November 2009	0	15	0	15
December 2009	0	16	0	16
January 2010	84	16	0	100
February 2010	624	14	0	639
March 2010	668	16	0	684
April 2010	0	15	0	15
May 2010	0	16	0	16
June 2010	0	15	0	15
July 2010	0	16	0	16
August 2010	19	16	0	16
September 2010	0	15	0	15
October 2010	0	16	0	16
November 2010	0	15	0	15
December 2010	0	16	0	16
January 2011	0	15	0	15
February 2011	0	14	0	14
March 2011	0	15	0	15
Total project emissions from AMS-I.D. and AMS-III.D.				**1,952**

The total emission reduction can be summed up to 1,952 tCO_2e.

E.3. Leakage calculation

>>

AMS-I.D:

No leakage calculation is required since the equipment is not being transferred to or from another activity.

AMS-III.D:

No leakage calculation is required.

E.4. Emission reductions calculation

>>

According to the applied methodology, the emission reductions (ER) should be calculated as:

ER = BE – PE – L

Total baseline emissions	124,204 tCO_2e
Total project emissions	1,952 tCO_2e
Total leakage	0 tCO_2e
Total emission reductions	122,252 tCO_2e

E.5. Comparison of actual emission reductions with estimates in the CDM-PDD

>>

Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission Reductions (tCO_2e)	**177,897**[1]	**122,252**

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

>>

The emission reductions reached during this 36 months of the monitoring period (from 28 March 2008 to 31 March 2011) is 122,252 tCO_2e while the value mentioned in the revised PDD equals 177,897 tCO_2e. That means the actual emission reduction is 31% lower than the value applied in the PDD.

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[1] The value applied in ex-ante calculation of the revised CDM-PDD.

History of the document

Version	Date	Nature of revision
01	EB 54, Annex 34 28 May 2010	Initial adoption.
Decision Class: Regulatory **Document Type**: Guideline, Form **Business Function**: Issuance		