Monitoring report form

(Version 04.0)

Complete this form in accordance with the Attachment "Instructions for filling out the monitoring report form" at the end of this form.

MONITORING REPORT	
Title of the project activity	Improving Kiln Efficiency in the Brick Making Industry in Bangladesh (Bundle-2)
Reference number of the project activity	6085
Version number of the monitoring report	02
Completion date of the monitoring report	07/11/2014
Registration date of the project activity	31/07/2012
Monitoring period number and duration of this monitoring period	First monitoring period : 25/11/2013 to 31/08/2014
Project participant(s)	1. Industrial and Infrastructure Development Finance Company Ltd. (IIDFC) (Private entity), Bangladesh 2. International Bank for Reconstruction and Development (IBRD) as Trustee of the Danish Carbon Fund (DCF) (Public entity) 3. Danish Ministry of Climate and Energy/Danish Energy Agency; (Public entity)
Host Party(ies)	Bangladesh
Sectoral scope and selected methodology(ies), and where applicable, applied standardized baseline(s)	Sectoral Scope: 4: Manufacturing industries; Methodology: AMS-II.D - Energy efficiency and fuel switching measures for industrial facilities, version 12, EB 51
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	28,846 t CO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	3,628 t CO_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	3,628 t CO_2e

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 project was to construct six[1] new energy efficient kilns for reducing CO_2 emissions in Bangladesh. At present, brick making is a highly energy-intensive activity and is one of the largest sources of greenhouse gas (GHG) emission in the country. The existing kiln technology in the country are Fixed Chimney Kiln (FCK), Bulls Trench Kiln (BTK), Zig Zag kiln, etc. which are highly energy inefficient, consuming more fossil fuels and thus contributing to the high GHG emission. By employing the technology embodied in the Hybrid Hoffman Kiln (HHK), the project piloted the introduction of modern and sustainable brick making technology to Bangladesh.

The HHK is a hybrid version of the Hoffman kiln technology that was developed in Germany in the mid-nineteenth century. Since then, it has been redesigned to improve heat retention in the kilns and to capture waste heat for recirculation in the drying tunnel. In addition, the coal consumption is reduced by introducing pulverized coal into the wet clay in each brick, which then bakes the brick from inside.

The production capacity of a HHK varies from a minimum of 50,000 bricks per day to several multiples of 50,000 bricks per day. Though each kiln by itself would qualify as a Clean Development Mechanism (CDM) project, the project bundled the six HHKs, the aggregate maximum daily production capacity of which is 300,000 bricks per day, into one Project Design Document (PDD) for reducing the CDM transaction costs, whilst remaining within the small scale threshold for this type of project activity.

Industrial & Infrastructure Development Finance Company Ltd. (IIDFC), which is a Bangladesh financial institution, acts as the bundling agent for the two kiln owners (four kilns under one brick company and two kilns under another). The construction of first kiln (EETA Kiln 1) under this project was started in 20/02/2010. The construction of Bricks 2010 Limited kilns started in 15/09/2011. More details on implementation and operational timeline of each kiln are provided in section B.1.

The project was registered on 31/07/2012[2]. This report presents the emission reduction achieved for the period from 25/11/2013 to 31/08/2014. The total emission reductions reported for this monitoring period are 3,628 t CO_2e accounting for the 3 operational kilns while the rest 3 kilns are yet to be commissioned.

A.2. Location of project activity

The six HHK units are located in two individual commercial enterprises in Gazipur (4 kilns) and Tangail (2 kilns) districts. Locations of the six HHK facilities are furnished in the table 1 and in Figure 1.

Table 1: Location of kilns

HHK facility	Daily brick production	Host Party	Region / state / province	City / town / community	Latitude ℕ	Longitude 𝔼
Eeta and Tiles Ltd. (EETA Kiln 1)	50,000	Bangladesh	Dhaka Division	Gazipur	+24.03935	+90.36975
Eeta and Tiles Ltd. (EETA Kiln 2)	50,000	Bangladesh	Dhaka Division	Gazipur	+24.03935	+90.36975

[1] Shiekh Brother's Enterprises Ltd. (Kiln 1 and 2) was part of the bundle during registration of PDD. The kilns will not be constructed anymore and they are dropped out of bundle. Hence, these two kilns are removed from PDD through Post Registration Changes (PRC). https://cdm.unfccc.int/PRCContainer/DB/prcp900477827/view

[2] http://cdm.unfccc.int/Projects/DB/DNV-CUK1334835346.18/view

HHK facility	Daily brick production	Host Party	Region / state / province	City / town / community	Latitude °N	Longitude °E
Eeta and Tiles Ltd. (EETA Kiln 3)	50,000	Bangladesh	Dhaka Division	Gazipur	+24.03935	+90.36975
Eeta and Tiles Ltd. (EETA Kiln 4)	50,000	Bangladesh	Dhaka Division	Gazipur	+24.03935	+90.36975
Bricks 2010 Ltd. (Bricks 2010 Kiln 1)	50,000	Bangladesh	Dhaka Division	Tangail	+24.10278	+90.19620
Bricks 2010 Ltd. (Bricks 2010 Kiln 2)	50,000	Bangladesh	Dhaka Division	Tangail	+24.10278	+90.19620

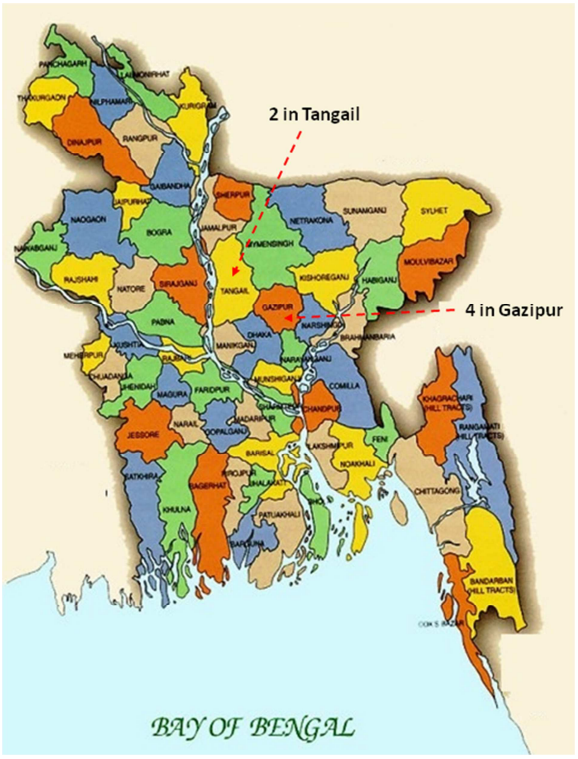

Figure 1: Map showing location of project kilns and the distribution of brick making activities

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)
Bangladesh (host)	Industrial and Infrastructure Development Finance Company Ltd (IIDFC) (Private entity)	No
Denmark	International Bank for Reconstruction and Development (IBRD) as Trustee of the Danish Carbon Fund (DCF) (Public entity)	Yes

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)
Denmark	Danish Ministry of Climate and Energy/Danish Energy Agency; (Public entity)	Yes

A.4. Reference of applied methodology and standardized baseline

Title : Type II – Energy Efficiency Improvement Projects
Reference : AMS-II.D - Energy Efficiency and Fuel Switching Measures for Industrial Facilities[3]
Version : 12, EB 51, December 2009
Sectoral Scope: 4, Manufacturing industries

The following CDM Executive Board guidelines and tools are also considered and applied:

- *Tool to calculate the emission factor for an electricity system, Version 2, EB 50, Annex 14*[4]
- *Guidelines for Objective Demonstration and Assessment of Barriers, version 01.0, EB 50*[5]
- *General Guidelines for Sampling and Surveys for Small-Scale CDM Project Activities, version 01, EB 50, Annex 30*[6] *(as followed in registered PDD)*
- *Guidelines for sampling and surveys for CDM project activities and programme of activities, version 03.0, EB 75*[7] *(as followed in PRC PDD)*

A.5. Crediting period of project activity

Fixed crediting period of 10 years starting from 25/11/2013 to 24/11/2023 is chosen.

Monitoring period reported in this monitoring report starts from 25/11/2013 to 31/08/2014.

A.6. Contact information of responsible persons/ entities

Mr. Matiul Islam
Chairman
Industrial and Infrastructure Development Finance Company Ltd (IIDFC)
122-124, Motijheel C/A
Dhaka – 1000
Bangladesh
chairman@iidfc.com

The above mentioned responsible person/entity is also a project participant as listed in Appendix 1 of this MR.

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

Initially at the time of the registration, a total of eight brick kilns based on the HHK technology were planned to be constructed at different locations in Bangladesh.

[3] https://cdm.unfccc.int/filestorage/7/P/F/7PFK2TOWNXUI035ZRSHBQLA9V1MD8E/EB51_repan16_AMS-II.D_ver12.pdf?t=Rml8bmJxZnVxfDBzc1fPlITPgKdj5235bGAU
[4] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.pdf
[5] https://cdm.unfccc.int/EB/050/eb50_repan13.pdf
[6] http://cdm.unfccc.int/EB/050/eb50_repan30.pdf
[7] http://cdm.unfccc.int/filestorage/I/J/9/IJ9FVMQKZ2BU4YSE1RH370WXCG6P8A/eb75_repan08.pdf?t=OGR8bmJxZzRofDCzQETd8qfpQYGrCH9YRZKS

Shiekh Brother's Enterprises Ltd. (Kiln 1 and 2) was earlier part of the bundle during the registration of PDD. These kilns will not be constructed anymore and they are dropped out of bundle. Hence, these two kilns are removed from the PDD during the Post Registration Changes (PRC).

Out of the six kilns planned, only three kilns (EETA Kiln 1 & 2 and Bricks 2010 Kiln 1) were constructed and commissioned. These three kilns also started their commercial operation after November 2013 (refer table 2).

As per PDD version 08, dated 18/04/2014, the crediting period starts from 01/09/2012. However, the kilns did not start commercial operation before 25/11/2013 (EETA Kiln 1). The PE has hence requested to change the start date of the crediting period to 25/11/2013 in place of 01/09/2012. The change has been implemented by the EB as of 07/11/2014.

All the CER generation calculation provided in this report is only for the period of 25/11/2013 to 31/08/2014 only. The remaining three kilns are under construction and will be in operation soon. As the technology is new to Bangladesh, technology services were largely imported from China by the brick kiln owners.

The brick kilns were designed and constructed to operate throughout the year in all seasons. However, to undertake corrective and preventive maintenance, the kilns may be shut down for 1-2 months a year. The details of operational and shutdown duration of each kiln during this monitoring period (25/11/2013 to 31/08/2014) is provided in appendix 2.

The details of the implementation timeline and operation status of the kilns are presented in table 2:

Table 2: Project implementation details

No.	Kiln name	Construction start date	Commissioning date	Commercial operation start date	Is the kiln in continuous operation other than the maintenance period?	Operational days in the monitoring period
1.	EETA Kiln 1	20/02/2010	20/10/2013	25/11/2013	Yes	241
2.	EETA Kiln 2	15/01/2010	18/01/2014	02/02/2014	Yes	198
3.	EETA Kiln 3	Not yet started	-Not applicable-	-Not applicable-	-Not applicable-	-Not applicable-
4.	EETA Kiln 4	Not yet started	-Not applicable-	-Not applicable-	-Not applicable-	-Not applicable-
5.	Bricks 2010 Kiln 1	15/09/2011	17/06/2013	05/05/2014[8]	Yes	114
6.	Bricks 2010 Kiln 2	Not yet started	-Not applicable-	-Not applicable-	-Not applicable-	-Not applicable-

Technology description

[8] The commercial operation of kiln 1 was delayed due to the presence of leakages in the kiln. Initial operation of the kiln was extremely inefficient which lead to excessive consumption of coal and inferior quality of burned bricks. Therefore the kiln was shut down and repair works were carried out until 05/05/2014.

A kiln consisting of 18-22 doors has a production capacity of 50,000 bricks per day and is considered as single sized HHK. All the 6 kilns constructed under this bundle are single sized kilns.

The brick production process involves the following processes:

Clay extraction, transportation and preparation - The clay is excavated by hydraulic excavator or by hand from a nearby area and transported to the kiln clay stocking yard by trucks. The clay is then crushed by means of roller mills, followed by a double-shaft mixer, where water is added to ensure 15% moisture content.

Pulverized coal introduction and shaping the brick - Pulverized coal is mixed with the clay and is fed into a vacuum extruder. A column of clay is pushed out / extruded. This is then cut into the green bricks, which are then manually loaded onto a drying car for drying.

Brick Drying - The drying car is then moved into the drying tunnel. The drying cycle lasts for about 26 hours. The hot air in the drying tunnel is sucked in from the annular kiln.

Brick Firing - The dried green bricks are then removed from the drying tunnel and loaded manually into the annular HHK kiln. The speed of the firing is 1.25 m/h at a sintering temperature of about 950° C – 1050° C. The fired bricks are unloaded and conveyed manually in carts to the stacking yard.

These kilns were operating at around 40% of their design brick production capacity during the monitoring period. The main reason for reduced brick production was that HHK being a new technology, little or no skilled labor was available for efficient kiln operations like raw material preparation for green bricks, proper coal feeding in kilns, effective equipment operation and maintenance. However, these are being addressed and capacity building activities are carried so that the kilns can achieve a stabilized/improved production capacity in the forthcoming years.

B.2. Post registration changes

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

Not applicable.

B.2.2. Corrections

Not applicable.

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

After the registration of the project, there were few changes in the registered monitoring plan. The changes were carried out in the revised PDD version 08, dated 18/04/2014 and was approved by UNFCCC through a Post Registration Change (PRC) request [9] (ref no: PRC-6085-001) on 19/08/2014. The main changes to the registered project were as follows:

- Measuring equipment of coal consumption revised from weighbridge to digital weighing scale. The coal consumption will be measured by counting the number of buckets/sacks of coal consumed per day. Each of the bucket/sack of coal is weighed to determine the weight of a bucket of coal using a digital weighing scale.
- QA/QC procedures for ensuring the accuracy of digital weighing scales are added to the purchase new weighing scale every year
- Measuring equipment of diesel consumption revised from flow meter to measuring cans

[9] https://cdm.unfccc.int/PRCContainer/DB/prcp900477827/view

- QA/QC procedures for ensuring the accuracy of measuring cans are added to purchase new measuring cans every year
- Removal of calibration requirement for energy meters. There is no calibration procedure existing for the energy meters in Bangladesh. A letter from Bangladesh DNA is provided as a proof of evidence for the same.
- Brick sampling procedures is revised to multi-stage cluster sampling as per the latest "Guidelines for sampling and surveys for CDM project activities and programme of activities, version 03.0, EB 75"

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

At the time of the registration, a total of eight brick kilns based on the HHK technology were planned to be constructed at different locations in Bangladesh. Sheikh Brother's Enterprises Ltd. (Kiln 1 and 2) was earlier part of the bundle during registration of PDD. These kilns will not be constructed anymore and they are dropped out of bundle. Hence, these two kilns are removed from the PDD through Post Registration Changes (PRC).

The above corrections reflected in revised PDD version 08, dated 18/04/2014 and was approved by UNFCCC through a Post Registration Change (PRC) request[10] (ref no: PRC-6085-001) on 19/08/2014.

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 details of monitored parameters and their method of collection are described in Section D.2. The monitored data were recorded manually by the kiln operators during the kiln operation on daily basis. Data monitoring points are indicated below in the figure 2. All kilns of EETA and Tiles (4 kilns) are located within a single plant. Similarly, all kilns of Bricks 2010 (2 kilns) are located within a single plant. Therefore, energy consumptions such as coal, diesel and electricity are consolidated from all kilns and presented as single consumption for each of EETA kilns and Bricks 2010 kilns. In the same way, daily brick production and sampling of brick weights are monitored for individual the kilns but consolidated as single production and brick weight values. Based on these fuel consumption and brick production data, one single value of specific energy consumption is calculated for CER estimation for each of EETA and Tiles and Bricks 2010 Limited.

Each kiln owner has employed a competent person in his kiln / office as the CDM monitoring and compliance officer, whose responsibility is to collect the monitoring data as described in Section D.2. As mentioned in figure 2, the CDM monitoring and compliance officer collects the monitoring data from different departments / sections of the kiln and compiles the data in the excel format provided by IIDFC, the bundling agent. He is also responsible for monthly delivery of electronic version of the monitored data to IIDFC. Monitoring officer of IIDFC collects the data from each kiln on a monthly basis, creates the monitoring sheets (consolidated details of all the kilns) and submits these reports to IIDFC senior officer.

IIDFC had conducted various training sessions to the kiln CDM monitoring and compliance officers, kiln operators and the training materials were provided to them. Standard data collection formats

[10] https://cdm.unfccc.int/PRCContainer/DB/prcp900477827/view

were prepared by IIDFC and were provided to the kilns. The brick kilns were also guided through the CDM monitoring mechanisms in terms of record keeping, overall maintenance and procedures for the corrective action to be taken.

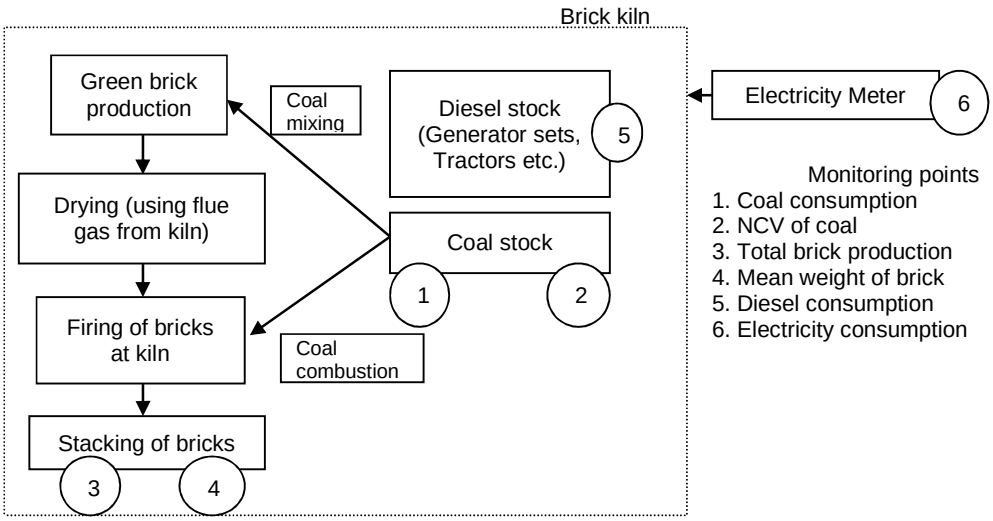

Figure 2: Location points of data monitoring

An annual audit was also carried out for three consecutive days, at the plant premises of EETA & Tiles (14-16 July, 2014) and Bricks 2010 Limited (22-24 August, 2014) by IIDFC to review the CDM compliance practices. The results were presented as a report to kilns.

The monitoring operations were carried out according to the following table:

Table 3: CDM monitoring and responsibilities

Task and area of responsibility	Method used	Frequency	Responsible person	Responsible Entity
Measurement of monitored data	Manual measurement, data recording	Daily	Operator in-charge	Respective kiln
Electronic recording	Data transfer to electronic workbook format provided by IIDFC	Daily	CDM compliance and monitoring officer	Respective kiln
Collection and storage of data (measured, calculated, estimated data)	Collection of monitoring data from each kiln	Monthly	Monitoring Officer	IIDFC
Calculation of the emission reductions and any deviations from projections	As per PDD/ monitoring plan with excel spreadsheets	Yearly	Monitoring Officer	IIDFC
QA/QC	As per the Operation and Monitoring Plan (OMP)	Yearly	Monitoring Officer	IIDFC
Kiln staff training	Training program as and when	As and when	IIDFC or their	IIDFC

Task and area of responsibility	Method used	Frequency	Responsible person	Responsible Entity
(CDM monitoring)	required	required	Consultants	
Approval of monitoring reports and achieved ERs	Not applicable	Yearly	Project in-charge	IIDFC

SECTION D. Data and parameters

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

(Copy this table for each piece of data and parameter.)

Data / Parameter:	**$CV_{coal, FCK}$**
Unit:	TJ/kg
Description:	Net calorific value (energy content) per mass unit of a fuel (*calorific value of the coal used in the baseline)*
Source of data:	Coal specifications reported by Barapukuria Coal Mining Company Limited (BCMCL) (http://www.bcmcl.org.bd/)
Value(s) applied):	6,135 kCal/kg or 6,135× 4.186 × 10^{-9} TJ/kg
Purpose of data:	To calculate baseline emissions
Additional comment:	Not applicable

Data / Parameter:	**CEF_{coal}**
Unit:	t C/TJ
Description:	Carbon emission factor per energy unit of coal
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories: Chapter 1: Introduction, Table 1-3; Default values of carbon content, pg.21
Value(s) applied):	25.80
Purpose of data:	To calculate baseline emissions
Additional comment:	Default data from IPCC has been used as country specific data is not available

Data / Parameter:	**CF**
Unit:	t CO_2e/t C
Description:	Carbon to CO_2 conversion factor
Source of data:	Not applicable
Value(s) applied):	3.66
Purpose of data:	To calculate baseline emissions
Additional comment:	Not applicable

Data / Parameter:	**$EF_{CO2, Elec}$**
Unit:	t CO_2e/MWh
Description:	Grid emissions factor per MWh of power produced
Source of data:	Bangladesh Designated National Authority, letter dated 09/02/2011
Value(s) applied):	0.62
Purpose of data:	To calculate baseline emissions
Additional comment:	The value has been fixed ex-ante

Data / Parameter:	**$SEC_{FCK, Bricks}$**
Unit:	TJ/kg-brick

Description:	Specific energy consumption per kg-brick in conventional FCK kilns Key value in determining the current energy consumption of the existing Fixed Chimney Kilns (FCK) in Bangladesh
Source of data:	Calculation result using equation
Value(s) applied):	2.125×10^{-6}
Purpose of data:	To calculate the baseline emissions
Additional comment:	It has been fixed ex-ante. In the absence of published data, calorific value of Barapukuria coal 6,135 kCal/kg (as measured for this project) and coal use of 24 tons per 100,000 bricks were utilized to calculate the Specific Fuel Consumption per kg-bricks in the baseline (FCK) technology.

Data / Parameter:	**$SFC_{FCK, Bricks}$**
Unit:	kg of coal/brick
Description:	Specific fuel (coal) consumption (SFC) per unit FCK brick
Source of data:	1. Clean Development Mechanism Project Opportunities in Bangladesh, Pre-Feasibility Report on a Brick Manufacturing Fuel Substitution CDM Project, Bangladesh University of Engineering, December 2002, Table A, pg 3: http://pubs.pembina.org/reports/cdm_bangladesh_brickkilns.pdf 2. Emissions Baseline Report for the IKEBMI Project (PDF-B Phase BGD/04/014) by The Louis Berger Group, Washington DC, June 2006, Table 2, pg 3
Value(s) applied):	0.24
Purpose of data:	To calculate the baseline emissions
Additional comment:	Country specific SFC data for FCK is available and therefore used. This value is used only to calculate the specific energy consumption per kg-brick ($SEC_{FCK, Bricks}$) in conventional FCK kilns.

Data / Parameter:	**$M_{FCK ,brick}$**
Unit:	kg/brick
Description:	Weight of a single FCK brick
Source of data:	As per IIDFC study titled " Weight of Bricks in Bangladesh, 2009"
Value(s) applied):	2.9
Purpose of data:	To calculate total mass of brick produced per year
Additional comment:	Average specific weight per unit brick was determined through direct measurement of a substantial number of FCK bricks. This value is used to only to calculate the specific energy consumption per kg-brick ($SEC_{FCK, Bricks}$) in conventional FCK kilns.

Data / Parameter:	**$NCV_{Diesel,y}$**
Unit:	TJ/kl
Description:	Weighted average net calorific value of diesel (fuel type) in year y
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
Value(s) applied):	0.036509
Purpose of data:	To calculate project emissions
Additional comment:	In mass unit, the value is 43.3 TJ/Gg or 43.3 MJ/kg. The density used for the conversion is 0.8432 kg/litre.

Data / Parameter:	$Density_{Diesel,y}$
Unit:	kg/litre
Description:	Density value of diesel (fuel type) in year y
Source of data:	IPCC default values as provided in Table 11 (pg. 81) of Chapter Energy of the 2002 IPCC Background Papers on Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories
Value(s) applied):	0.8432
Purpose of data:	To calculate project emissions
Additional comment:	Density = 1/Specific volume. The specific volume published by IPCC is 1,186 kilolitre/Gg or 1.186 litre/kg.

Data / Parameter:	$EF_{CO2, Diesel,y}$
Unit:	t CO_2/TJ
Description:	Weighted average CO_2 emission factor of diesel fuel type) i in year y
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
Value(s) applied):	74.8
Purpose of data:	To calculate project emissions
Additional comment:	Default data from IPCC is used, in the absence of values provided by the fuel supplier in invoices, measurements by the project participants and regional or national default values.

D.2. Data and parameters monitored

(Copy this table for each piece of data and parameter.)

Data / Parameter:	$TC_{Coal,i,y}$
Unit:	Tonnes/year
Description:	Total consumption of coal for brick making in brick kiln i in year y
Measured/ Calculated / Default:	Measured using digital weighing scale
Source of data:	Invoices from the coal suppliers and coal consumption registers
Value(s) of monitored parameter:	<table><tr><th>No.</th><th>Kiln name</th><th>tonnes/year</th></tr><tr><td>1</td><td>EETA and Tiles Ltd</td><td>1,074</td></tr><tr><td>2</td><td>Bricks 2010 Ltd</td><td>304</td></tr></table>
Monitoring equipment:	Digital weighing scale (used for both coal and brick weight measurement): <table><tr><th>No.</th><th>Kiln name</th><th>Make</th><th>Accuracy (± g)</th><th>Purchase date</th></tr><tr><td>1.</td><td>EETA and Tiles Ltd.</td><td>Excel</td><td>2</td><td>11/09/2013</td></tr><tr><td>2.</td><td>Bricks 2010 Ltd</td><td>Mega king</td><td>1</td><td>03/05/2014</td></tr></table>
Measuring/ Reading/ Recording frequency:	Every brick production day
Calculation method (if applicable):	The coal consumption at the kiln is measured through counting the number of buckets/sacks of coal consumed per day. A bucket/sack of coal is weighed to determine the weight of a bucket of coal using a digital weighing scale. The coal purchased is also cross verified by the supplier invoice provided with each coal consignment. The records are maintained at the kiln office for the amount of coal consumed, which can be cross checked against the invoices taking into account the balance of coal not consumed for the monitoring period concerned.

QA/QC procedures:	Coal stock at the end of each verification period is estimated and noted down. The coal stock register is used to cross check the brick production. The kilns may purchase a new weighing scale every year or calibrate the existing weighing scale in case the calibration services/facilities become more affordable, during that monitoring period. In case of any delay in procuring new weighing scales or calibration of existing equipment after one year, then the maximum permissible error as per the respective manufacturer specifications shall be applied on the measured readings for the period until next calibration or procurement of new equipment.
Purpose of data:	To calculate the project emissions
Additional comment:	Both EETA Kiln 1 and Kiln 2 make use of a single bulk coal purchases. Therefore, both the kilns are treated as one for coal consumption purposes. Coal registers are kept and used to record monthly coal consumption. The data will be archived for two years after the crediting period

Data / Parameter:	**$NCV_{Coal,i,y}$**
Unit:	TJ/kg
Description:	Net calorific value of coal used in y^{th} year in brick kiln i
Measured/ Calculated / Default:	Measured
Source of data:	As per the data provided by the supplier and independently verified by a credible Bangladesh laboratory.
Value(s) of monitored parameter:	**No** | **Kiln name** | **x 10^5 TJ/kg** 1 | EETA and Tiles Ltd | 2.31 2 | Bricks 2010 Ltd | 2.74
Monitoring equipment:	Lab analysis
Measuring/ Reading/ Recording frequency:	Quarterly
Calculation method (if applicable):	A composite sample of 1 kg is taken from each new consignment of coal at each kiln. At the end of each quarter, all the samples taken in that quarter are crushed and mixed to produce a representative sample for that quarter. The sample is laboratory tested to determine the net calorific value of coal used for that particular quarter. The entire data is monitored and archived on paper and in electronic format. Average of the net calorific values of different quarters is calculated at the end of each monitoring period and is considered as the net calorific value of coal used by related brick kiln in that crediting period.
QA/QC procedures:	IIDFC checks the coal consumption data by inspecting the coal stock register and reports of calorific value tests at the end of monitoring period.
Purpose of data:	To calculate project emissions
Additional comment:	The data will be archived for two years after the crediting period

Data / Parameter:	**$DP_{Bricks,i}$**
Unit:	Bricks
Description:	Daily production of bricks in brick kiln i
Measured/ Calculated / Default:	Measured
Source of data:	Daily brick production registers through manual count of bricks.
Value(s) of monitored parameter:	Cumulative daily production for the monitoring period in each kiln are given below: **No.** | **Kiln name** | **No. of bricks**

	<table><tr><td>1</td><td>EETA and Tiles Ltd</td><td>8,614,499</td></tr><tr><td></td><td>EETA Kiln 1</td><td>4,626,600</td></tr><tr><td></td><td>EETA Kiln 2</td><td>3,987,899</td></tr><tr><td></td><td>EETA Kiln 3</td><td>NA</td></tr><tr><td></td><td>EETA Kiln 4</td><td>NA</td></tr><tr><td>2</td><td>Bricks 2010 Ltd</td><td>2,157,300</td></tr><tr><td></td><td>Bricks 2010 Kiln 1</td><td>2,157,300</td></tr><tr><td></td><td>Bricks 2010 Kiln 2</td><td>NA</td></tr></table> For the period 25/11/2013 to 19/08/2014, daily brick production values were used for CER estimation, as per registered PDD. For the period 20/08/2014 to 31/08/2014, cumulative brick production values were used for CER estimation, as per PRC PDD.
Monitoring equipment:	No equipment is used
Measuring/ Reading/ Recording frequency:	Every brick production day
Calculation method (if applicable):	The daily brick production is noted down by the technician in a daily log sheet maintained in the kiln. Supervisor verifies the log sheet at the end of each day. The data is provided to the CDM monitoring and compliance officer, who maintains the data gathered at the kiln or kiln head office. Monthly reports are prepared regularly by the CDM monitoring and compliance officer and are stored in electronic and paper modes.
QA/QC procedures:	The amount of bricks manufactured at the end of each monitoring period is cross checked with the invoices for the sale of bricks and the stock in the plant.
Purpose of data:	To calculate the baseline and project emissions
Additional comment:	The data will be archived for up to two years after the end of the crediting period. In the event that different size or types of bricks, such as holed brick are produced, the number of each type of brick produced will be recorded in the daily register.

Data / Parameter:	**$DMW_{HHK\ Bricks,di}$**
Unit:	kg/brick
Description:	Daily mean weight of baked HHK bricks in brick kiln i
Measured/ Calculated / Default:	Measured
Source of data:	On-site measurements by the operator in-charge
Value(s) of monitored parameter:	Annual average of daily mean brick weight values are given below: <table><tr><th>No.</th><th>Kiln name</th><th>kg/brick</th></tr><tr><td>1.</td><td>EETA and Tiles Ltd</td><td>3.456</td></tr><tr><td></td><td>EETA Kiln 1</td><td>3.459</td></tr><tr><td></td><td>EETA Kiln 2</td><td>3.453</td></tr><tr><td></td><td>EETA Kiln 3</td><td>NA</td></tr><tr><td></td><td>EETA Kiln 4</td><td>NA</td></tr><tr><td>2.</td><td>Bricks 2010 Ltd</td><td>3.417</td></tr><tr><td></td><td>Bricks 2010 Kiln 1</td><td>3.417</td></tr><tr><td></td><td>Bricks 2010 Kiln 2</td><td>NA</td></tr></table>
Monitoring equipment:	Digital weighing scale (used for both coal and brick weight measurement): <table><tr><th>No.</th><th>Kiln name</th><th>Make</th><th>Accuracy (± g)</th><th>Purchase date</th></tr><tr><td>1.</td><td>EETA and Tiles Ltd</td><td>Excel</td><td>2</td><td>11/09/2013</td></tr><tr><td>2.</td><td>Bricks 2010 Ltd</td><td>Mega king</td><td>1</td><td>03/05/2014</td></tr></table>
Measuring/	Daily

Reading/ Recording frequency:	
Calculation method (if applicable):	For the period of 25/11/2013 to 19/08/2014 (before PRC approval) The average weight of bricks is calculated using the simple random sampling as per the "General Guidelines for Sampling and Surveys for Small Scale CDM Project Activities (EB 50, Annex 3)". On each production day, a sample of 100 bricks is taken and weighed using the digital weighing scale and the mean weight is calculated. For the period of 20/08/2014 to 31/08/2014 (after PRC approval) The average weight of bricks is calculated as per the "Guidelines for sampling and surveys for CDM project activities and programme of activities, version 03.0, EB 75" using digital weighing scale and as per the monitoring plan in PRC PDD, version 08 dated 18/04/2014. In accordance to these, a minimum of 160 samples were taken from 20/08/2014 to 31/08/2014 and cumulative mean brick weight was estimated.
QA/QC procedures:	Since there is no proper institutional/laboratory set up available for easy processing of calibration, new weighing scales are purchased every year by the kilns to ensure the accuracy of measurements. This is also supported by the affordable cost of weighing scales.
Purpose of data:	To calculate the baseline and project emissions
Additional comment:	The data will be archived for two years after the crediting period

Data / Parameter:	**$SEC_{i,y}$**
Unit:	TJ/kg-brick
Description:	Specific energy consumption in brick kiln i
Measured/ Calculated / Default:	Calculated using the annual mass of brick production and annual energy consumption of coal as fuel
Source of data:	Calculation result using equation (Refer section E.2)
Value(s) of monitored parameter:	<table><tr><th>No.</th><th>Kiln name</th><th>x 10^6 TJ/kg-brick</th></tr><tr><td>1</td><td>EETA and Tiles Ltd</td><td>0.832</td></tr><tr><td>2</td><td>Bricks 2010 Ltd</td><td>1.131</td></tr></table>
Monitoring equipment:	No equipment is used.
Measuring/ Reading/ Recording frequency:	Recording frequency is annual.
Calculation method (if applicable):	The specific energy consumption per kg-brick is calculated once in a year based on the data of coal consumed and the total mass of bricks produced during the corresponding period.
QA/QC procedures:	The data is cross checked by comparing it with the quantity of bricks sold / in stock and coal purchased based on the purchase receipts and coal registers
Purpose of data:	To calculate the project emissions
Additional comment:	The data will be archived for two years after the crediting period.

Data / Parameter:	**N**
Unit:	days
Description:	Number of operational days of the kiln in a year
Measured/ Calculated / Default:	Measured
Source of data:	Recorded by the operator in-charge

Value(s) of monitored parameter:	<table><tr><th>No.</th><th>Kiln name</th><th>Days</th></tr><tr><td>1.</td><td>EETA Kiln 1</td><td>241</td></tr><tr><td>2.</td><td>EETA Kiln 2</td><td>198</td></tr><tr><td>3.</td><td>EETA Kiln 3</td><td>NA</td></tr><tr><td>4.</td><td>EETA Kiln 4</td><td>NA</td></tr><tr><td>5.</td><td>Bricks 2010 Kiln 1</td><td>114</td></tr><tr><td>6.</td><td>Bricks 2010 Kiln 2</td><td>NA</td></tr></table>
Monitoring equipment:	No equipment is used
Measuring/ Reading/ Recording frequency:	Daily
Calculation method (if applicable):	The operator in-charge keeps a record of the number of operational days of the kiln during the year based on the brick production from kilns.
QA/QC procedures:	The CDM monitoring and compliance officer verifies the recorded data.
Purpose of data:	To calculate the baseline and project emissions
Additional comment:	The data will be archived for two years after the crediting period

Data / Parameter:	**$FC_{Diesel,i,y}$**
Unit:	kl/yr
Description:	Quantity of diesel (fuel type) combusted in the process j during the year y
Measured/ Calculated / Default:	Measured
Source of data:	Measured using standard measuring cans
Value(s) of monitored parameter:	<table><tr><th>No.</th><th>Kiln name</th><th>kl/year</th></tr><tr><td>1</td><td>EETA and Tiles Ltd.</td><td>39.7</td></tr><tr><td>2</td><td>Bricks 2010 Ltd.</td><td>10.5</td></tr></table>
Monitoring equipment:	1/2/5 litre standard measuring cans
Measuring/ Reading/ Recording frequency:	Daily
Calculation method (if applicable):	The purchased diesel in drums is measured at the supplier end itself and is recorded in the purchase invoice. The diesel consumption at the kiln is measured using 1/2/5 litre standard measuring cans. The records are maintained at kiln office on the diesel purchase and consumption as obtained from the above measurements. Net consumption is calculated at the end of the monitoring period by tallying out the total purchase with the opening and closing stocks of diesel in that period.
QA/QC procedures:	The diesel stock at the end of each verification period is estimated and noted down in the annual report and the diesel stock register is used to cross check brick production. Every day consumption and stock records cross checked with purchase invoices show that the diesel consumed for kiln operations is only from the diesel purchased under the project. Since there is no proper institutional / laboratory set up available for easy processing of calibration, new measuring cans are purchased every year by the kilns to ensure the accuracy of measurements. This is also supported by the affordable cost of the measuring cans. The kilns purchased new weighing scans every year which avoided the necessity of adjusting the values with suitable errors.
Purpose of data:	To calculate project emissions
Additional comment:	Diesel is consumed by 1 or more generator for all 2 EETA and Tiles kilns. Hence the 2 EETA and Tiles kilns is treated as one.

	The data will be archived for two years after the crediting period

Data / Parameter:	**$EC_{i,y}$**
Unit:	MWh
Description:	Electricity consumption in kiln i per year
Measured/ Calculated / Default:	Measured
Source of data:	Electricity bill from the REB or the electricity supplier
Value(s) of monitored parameter:	<table><tr><th>No.</th><th>Kiln name</th><th>MWh</th></tr><tr><td>1</td><td>EETA and Tiles Ltd</td><td>748.7</td></tr><tr><td>2</td><td>Bricks 2010 Ltd</td><td>155.8</td></tr></table>
Monitoring equipment:	Energy meter <table><tr><th>No.</th><th>Kiln name</th><th>Make</th><th>Serial no</th><th>Accuracy Class</th><th>Year of make</th></tr><tr><td>1.</td><td>EETA and Tiles Ltd</td><td>Fitzall</td><td>13920616</td><td>0.2</td><td>2013</td></tr><tr><td>2.</td><td>Bricks 2010 Ltd</td><td>Itron</td><td>93199814</td><td>0.2</td><td>2013</td></tr></table>
Measuring/ Reading/ Recording frequency:	Monthly
Calculation method (if applicable):	Monthly electricity bill paid to Rural Electricity Board (REB) is used to calculate the total electricity consumption of the month and is noted down in the monthly report
QA/QC procedures:	Electricity consumption from the individual monthly electricity bills shall be cross checked with the electricity consumption calculated from the first and last month of the monitoring period. In case of energy meters, there is no practice of regular calibration in Bangladesh. A letter from Bangladesh DNA is provided as proof of evidence for the same.
Purpose of data:	To calculate project emissions
Additional comment:	The 2 EETA and Tiles kilns are served by 1 electricity meter. Therefore the 2 EETA and Tiles kilns are treated as one. The data will be archived for two years after the crediting period

D.3. Implementation of sampling plan

For the monitoring period between 25/11/2013 to 19/08/2014

The project proponent used the simple random sampling method to determine the mean daily value of the HHK brick weight for each kiln. The representative sample size was chosen ex-ante so as to achieve 90% confidence interval with +/-10% error margin. The sample size was calculated based on precision, confidence level and standard deviation. Since the standard deviation for the entire population was unknown, an estimate of standard deviation was used.

Sample size was calculated as,

Minimum Sample Size, $n_O = (Z^2 \times \sigma^2) / e^2$

Where,

Z = Z value (1.645 for 90% confidence level)
σ = 0.5 (standard deviation based on maximum expected variance)
e = 0.1 (margin of error for 10% precision)

Substituting the values in the above equation, the sample size required was calculated as,
$n_O = (1.645^2 \times 0.5^2) / 0.1^2 = 68$

However, as a conservative approach, 100 samples per day were taken for brick weight measurement. A sample of 100 bricks is randomly selected from the total bricks unloaded on every operational day from each kiln. The samples were collected from all the gates that were unloaded on a day so as to get a representative sampling. The bricks were weighed separately using weigh scale and the daily mean weight of brick produced was recorded by the operator in-charge.

To prove that the required precision is achieved, the sample weight measurement carried out on one kiln operation day of each brick kiln is analyzed. The analysis results are furnished in table 4.

Table 4: Analysis of weight measurements of 100 brick samples for one day alone during the operation of kilns for the period of 25/11/2013 to 19/08/2014

No.	Parameter[11]	EETA Kiln 1	EETA Kiln 2	Bricks 2010 Kiln 1
1.	Mean	3.519	3.515	3.436
2.	Standard deviation	0.050	0.048	0.060
3.	Sample variance	0.002	0.002	0.003
4.	Minimum	3.430	3.430	3.300
5.	Maximum	3.590	3.590	3.550
6.	Standard error	0005	0.004	0.006
7.	Confidence interval (max level / min level)	3.527	3.523	3.446
		3.510	3.507	3.426
8.	Precision (%)	0.24	0.23	0.29

From the above analysis, the lowest precision level of the brick weight measurement in the brick kilns was found to be 0.29% as against the required level of 10%. Hence, it is clear that the sampling results are in conformity with the CDM requirements. The details of analysis of sample brick weight measurements for each kiln are provided in “Brick sample analysis” sheet.

<u>For the monitoring period between 20/08/2014 to 31/08/2014(after PRC PDD)</u>

As per the revised monitoring plan in the PDD version 08, dated 18/04/2014, each kiln has to take a minimum sample of 150 bricks per year.

To achieve this:
- 40 samples (150 samples/4 months) must be selected from a month
- Taking 20 samples per day, 2 days shall be selected for a month

As per the above plan, a kiln operating for a minimum of 4 months will be able to achieve 160 (8 days x 20 samples) sample measurements which is above the minimum requirement of 150 samples.

[11] For 100 samples weighed for a respective production day of a kiln

However, the period of 20/08/2014 to 31/08/2014 during monitoring period refers to the revised monitoring plan as per the approved revised PDD (approved on 19/08/2014). Hence, a total of 160 samples were achieved within this period itself.

To prove that the required precision is achieved, the sample weight measurement carried out is analyzed. The analysis results are tabulated as below.

Table 5: Analysis of weight measurements of 160 brick samples during the operation of kilns for the period 20/08/2013 to 31/08/2013

No.	Parameter	EETA Kiln 1	EETA Kiln 2	Bricks 2010 Kiln 1
1.	Mean	3.456	3.516	3.451
2.	Standard deviation	0.063	0.042	0.053
3.	Sample variance	0.004	0.001	0.002
4.	Minimum	3.290	3.390	3.300
5.	Maximum	3.679	3.590	3.550
6.	Standard error	0.005	0.003	0.004
7.	Confidence interval (max level / min level)	3.465	3.522	3.458
		3.448	3.511	3.444
8.	Precision (%)	0.24	0.16	0.20

From the above analysis, the lowest precision level of the brick weight measurement in the brick kilns was found to be 0.24% as against the required level of 10%. Hence, it is clear that the sampling results are in conformity with the CDM requirements. The details of analysis of sample brick weight measurements for each kiln are provided in “Brick sample analysis” sheet.

Complete details of sampling and sample selection are given in Appendix 3.

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

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

The baseline emissions BE_y from the baseline activity, if the equivalent amount of bricks that were produced in the i^{th} kiln were to be produced by using FCK technology, are calculated as follows:

$$BE_y = \sum_{i=1}^{6} BE_{FCK\ i,\ y}$$

$[t\ CO_2/year]$

$$= 5{,}979.21 + 1{,}480.78$$

$$= 7{,}460\ t\ CO_2/year$$

Where,

$BE_{FCK\ i,\ y}$ = Baseline emissions per year for the i^{th} kiln

$[t\ CO_2/year]$

$$= TP_{Bricks,\ i\ ,y} \times SEC_{FCK,\ Bricks,\ y} \times CEF_{coal} \times CF$$

[kg-bricks(y)] [TJ/kg-brick] [t C/TJ] [t CO_2/t C]

Where,

$TP_{Bricks,i,y}$ = Total production of bricks per year in kiln i (kg-bricks/year)
$SEC_{FCK, Bricks,y}$ = Specific energy consumption in FCK technology (TJ/kg-brick)
CEF_{coal} = IPCC default carbon emission factor for fuel used (t C/TJ)
CF = Carbon to CO_2 Conversion Factor (t CO_2/t C)

Table 6: Estimation of baseline emission

No.	Kiln name	$TP_{Bricks, i, y}$ kg-bricks		$SEC_{FCK, Bricks, y}$ TJ/kg-brick		CEF_{coal} t C/TJ		CF t CO_2/t C		$BE_{FCK\ i, y}$ t CO_2/year
1.	EETA Kiln 1 & 2	29,793,144	x	2.125×10^{-6}	x	25.8	x	3.66	=	5,979.21
2.	Bricks 2010 Kiln 1	7,378,415								1,480.78

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

Total project emissions in y^{th} year, PE_y, by operations of N units of HHK kilns (N=6) are given by:

$$PE_y = \sum_{i=1}^{6} PE_{HHK\ i, y}$$

[t CO_2/year]

2,919.19+ 912.25

= 3,831.45 t CO_2/year

Where,

$PE_{HHK\ i, y}$ = Project emissions from operation of i^{th} kiln in year y
[t CO_2/year]

$$= SEC_{i,y} \times TP_{Bricks,i,y} \times CEF_{coal} \times CF + EC_{i,y} \times EF_{CO2,Elec} + PE_{FC,j,y}$$

[TJ/kg-brick(y)] [kg-bricks(y)] [t C/TJ] [t CO_2/t C] [MWh] [t CO_2/MWh] [t CO_2/year]

Where,

$SEC_{i,y}$ = Specific energy consumption in kiln i (TJ/kg-brick)
$TP_{Bricks,i,y}$ = Total production of bricks per year in kiln i (kg-bricks/year)
CEF_{coal} = IPCC default carbon emission factor for fuel used (t C/TJ)
CF = Carbon to CO_2 Conversion Factor (t CO_2/t C)
$EC_{i,y}$ = Electricity consumption in kiln i per year (MWh)
$EF_{CO2, Elec}$ = Estimated CO_2 emissions factor for grid electricity in Bangladesh (t CO_2/MWh)
$PE_{FC,j,y}$ = CO_2 emissions from fossil fuel combustion in year y (t CO_2/yr)

Table 7: Estimation of project emission

No.	Kiln name	$SEC_{i,y}$ TJ/kg-brick x 10^{-6}		$TP_{Bricks,i,y}$ kg-bricks		CEF_{coal} t C/TJ		CF t CO_2/t C		$EC_{i,y}$ MWh		$EF_{CO2,Elec}$ t CO_2/MWh		$PE_{FC,j,y}$ t CO_2/year		$PE_{HHK\ i,y}$ t CO_2/year
1.	EETA Kiln 1 & 2	0.834	x	29,793,144	x	25.8	x	3.66	+	748.7	x	0.62	+	108	=	2,919.19
2.	Bricks 2010 Kiln 1	1.130		7,378,415						155.8				29		912.25

From the monitored data, the specific energy consumption for the individual kilns is calculated using the following formula:

$SEC_{i, y}$	=	$TC_{Coal\ i,y}$	x	$NCV_{Coal\ i, y}$	/	$TP_{Bricks, i ,y}$
[TJ/kg-brick]		[tonnes(y)]		[TJ/kg(y)]		[kg-bricks (y)]

Where,

$TC_{Coal\ i,y}$	=	Total consumption of coal per year for kiln i (tonnes)
$NCV_{Coal\ i, y}$	=	Weighted average net calorific value of coal used in y^{th} year in kiln i (TJ/kg)
$TP_{Bricks,i ,y}$	=	Total production of bricks per year in kiln i (kg-bricks/year)

Table 8: Estimation of specific energy consumption

No.	**Kiln name**	**$TC_{Coal\ i,y}$ tonnes (y)**		**$NCV_{Coal\ i,y}$ TJ/kg (y) x 10^{-5}**		**$TP_{Bricks, i,y}$ kg- bricks (y)**		**$SEC_{i,y}$ TJ/kg-brick x10^{-6}**
1.	EETA Kiln 1 & 2	1,074	x	2.31	÷	29,793,144	=	0.834
2.	Bricks 2010 Kiln 1	304		2.74		7,378,415		1.130

Total production of bricks per year in a kiln is given by,

$TP_{Bricks,i,y}$	=	$\Sigma_{d=1}^{n} DP_{Bricks,di}$	x	$DMW_{HHK\ brick,di}$
[kg-bricks/year]		[nos]		[kg/brick]

Where,

$DP_{Bricks\ di}$	=	Daily production of bricks in kiln i (bricks/day)
$DMW_{HHK\ bricks,di}$	=	Daily Mean weight of HHK bricks in kiln i (kg/bricks)
n	=	Total no. of production days for kiln i in a year

For the period from 25/11/2013 to 19/08/2014, total production of bricks per year is calculated as a cumulative sum of mass of brick production on every brick production day using daily number of bricks produced and daily mean weight of bricks.

For the period of 20/08/2014 to 31/08/2014, total production of bricks per year is calculated as a product of sum of brick production on every brick production day and mean brick weight of sample bricks (160 nos.)

For elaborate calculation, refer to the attached the CER estimation file, sheet “Daily brick data”.

CO_2 emissions from fossil fuel combustion in year y is given by,

$PE_{FC,j,y}$	=	$FC_{Diesel,\ j,\ y}$	x	$COEF_{Diesel,\ y}$
[t CO_2/yr]		[kl/year]		[t CO_2/ kl]

Where,

$FC_{Diesel,\ j,y}$	=	Quantity of diesel (fuel type) combusted in process *j* during the year *y* (kl/yr)
$COEF_{Diesel,\ y}$	=	CO_2 emission coefficient of diesel (fuel type) in year *y* (t CO_2/ kl)

Table 9: Estimation of emissions from fossil fuel combustion

No.	Kiln name	$FC_{Diesel, j, y}$ kl/yr		$COEF_{Diesel, y}$ t CO_2/kl		$PE_{FC,j,y}$ t CO_2/yr
1.	EETA Kiln 1 & 2	39.7	x	2.7	=	108
2.	Bricks 2010 Kiln 1	10.5				29

E.3. Calculation of leakage

Not applicable.

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	7,460.00	3,831.45	0	3,628

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)	28,846	3,628

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

No increase was observed in the actual GHG emission reductions versus those estimated in the PDD. Instead, the value achieved is less than the PDD estimated value.
Also, most of the kilns are yet to fully stabilize their kiln operations and are still running at around 40% of their full brick production capacity. The main reason for reduced brick production is that HHK being a new technology, little or no skilled labour is available for efficient operations like raw material preparation for green bricks, proper coal feeding in kilns, effective equipment operation and maintenance, etc. However, these are being addressed and capacity building is carried so that the kilns can achieve a stabilized/improved production capacity in coming years.

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)	Not applicable	3,628

- - - - -

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	Industrial and Infrastructure Development Finance Company Ltd (IIDFC)
Street/P.O. Box	
Building	122-124
City	Motijheel C/A
State/Region	Dhaka
Postcode	1000
Country	Bangladesh
Telephone	+88-02-955 9311 -12
Fax	+88-02-956 8987
E-mail	
Website	www.iidfc.com
Contact person	
Title	Chairman
Salutation	Mr.
Last name	Matiul
Middle name	
First name	Islam
Department	
Mobile	+ 880 1716 304650
Direct fax	+ 8802-9568987
Direct tel.	+ 8802-9553387, + 8802-9559311-12
Personal e-mail	Chairman@iidfc.com

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for completing the CDM-MR-FORM
Organization name	Government of Denmark - Danish Ministry of Climate and Energy/The Danish Energy Agency
Street/P.O. Box	Amaliegade 44
Building	
City	Copenhagen
State/Region	
Postcode	1256
Country	Denmark
Telephone	+45 3392 6700
Fax	+45 3311 4743
E-mail	cma@ens.dk
Website	
Contact person	
Title	Senior Adviser
Salutation	Mr.
Last name	van Maarschalkerweerd
Middle name	

First name	Christian
Department	Climate Change and Energy Economics
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	cma@ens.dk

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for completing the CDM-MR-FORM
Organization name	International Bank for Reconstruction and Development (IBRD) as Trustee of the Danish Carbon Fund (DCF)
Street/P.O. Box	1818 H Street, NW
Building	
City	Washington DC
State/Region	District of Columbia
Postcode	20433
Country	USA
Telephone	+1 202-458-5051
Fax	+1 202-522-7432
E-mail	IBRD-carbonfinance@worldbank.org
Website	www.carbonfinance.org
Contact person	Jose Andreu
Title	Operations Team Lead
Salutation	Mr
Last name	Andreu
Middle name	
First name	Jose
Department	Climate and Carbon Finance Unit
Mobile	
Direct fax	+1 202-522-7432
Direct tel.	+1 202-458-5051
Personal e-mail	

Appendix 2

Details of kiln operation and shutdown periods

Kiln name	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Comments
EETA Kiln1	25/11/2013 - 31/08/2014										Kiln was in continuous operation except few holidays and maintenance breaks
EETA Kiln2				02/02/2014 - 31/08 2014							Kiln was in continuous operation except few holidays
Bricks 2010 Kiln1							05/05/2014 - 31/08 2014				Kiln was in continuous operation except few holidays

Appendix 3: Sampling plan (as per revised PDD for PRC approval)

In the following section the Sampling plan and its implementation procedure for brick weight measurement is discussed.

According to "Guidelines for sampling and surveys for CDM project activities and programme of activities, version 03.0, EB 75", The following sampling plan will be used to determine the Daily Mean Weight of HHK bricks in Kiln i during the crediting period.

Multistage sampling is a complex form of cluster sampling. Measuring all the elements in the selected clusters may be prohibitively expensive, or not even necessary. In multi-stage sampling, the cluster units are often referred to as the primary sampling units (PSU) and the elements within the clusters, as the secondary sampling units (SSU). In contrast to the cluster sampling, where all of the secondary units are measured, in multi-stage sampling, data are collected for only a random sample of the secondary units.

Since the quantity of brick production is high and the brick production from each day shall be considered as a cluster, multi-stage sampling is chosen for this project.

1. Requirements of multi-stage sampling

For the sample size calculations, the following details on the population are required:

(a) Variations in brick weight within a day
(b) Variations in brick weight between days
(c) Average mean brick weight within a day
(d) Overall average mean brick weight

The expected mean and standard deviation are calculated from brick weight measurements carried out at Kapita Auto Bricks Ltd. (kiln capacity - 100,000 bricks/day). The measurements were taken for 100 brick samples randomly selected from fired bricks produced on those respective days. The mean and standard deviations arrived from the above measurements are used for the multi-stage sampling estimations.

The estimation is based on measurements made from HHK-bundle 1 kilns, because, the bundle 2 kilns are not in operation yet.

The measurements were taken for 100 brick samples randomly selected from fired bricks produced on those respective days. The mean and standard deviations arrived from the above measurements are used for the multi-stage sampling estimations.

2. Assumptions

Following assumptions have been made with respect to the HHK brick kiln operations at Kapita brick kiln, for estimating the sample size:

- Primary sampling unit (PSU) = Each brick production day
- Secondary sampling unit (SSU) = All fired bricks output on a production day
- No. of bricks sampled per day = 10 (for initial analysis)
- Max. brick output on day = 100,000 (for Kapita brick kiln)
- Max. no. of brick production days = 365
- 90% confidence level and 10% precision as per small scale CDM requirement is taken.

3. Estimation of number of days to be selected

The following table gives the mean and standard deviation calculated for the 100 brick weight measurements from each of the 11 production days (randomly selected) during first monitoring period at Kapita brick kiln, which is typical for the other kilns in the bundle.

The number of days to be selected for sampling can be calculated using the following formula:

Day	Bricks produced per day	Mean Weight per brick (kg)	Total weight of bricks per day (kg)	Standard deviation within a day
1	47,137	3.018	142,250	0.044
2	69,841	3.008	210,105	0.015
3	32,104	3.026	97,157	0.028
4	73,646	3.031	223,209	0.015
5	71,318	3.013	214,897	0.027
6	90,324	3.056	276,059	0.084
7	67,075	3.036	203,639	0.033
8	56,754	3.031	172,029	0.022
9	59,037	3.021	178,342	0.049
10	66,065	3.024	199,783	0.024
11	67,672	3.034	205,335	0.027
Total bricks	**700,973**	-	-	-
Overall mean weight (brickmean) (kg)		**3.028**	-	-
Overall mean total weight of each day (daymean) (kg)			**193,946**	-
SD of total weight of days (SD_b)			**46,175**	-
Standard deviation within a day (SD_w)				**0.041**

$$c \geq \frac{\left(\frac{SD_B}{daymean}\right)^2 x\left(\frac{M}{M-1}\right)+\left(\frac{1}{u}\right)x\left(\frac{SD_W}{brickmean}\right)^2 x\left(\frac{N-u}{N-1}\right)}{\left(\frac{0.1}{1.645}\right)^2+\frac{1}{M-1}\left(\frac{SD_B}{daymean}\right)^2}$$

Where,

c = No. of days to be selected
M = Total number of days
N = Average number of bricks per day
u = Number of bricks to be sampled per day
1.645 = Represents the 90% confidence required
0.1 = Represents the required 10 % precision

SD_B = Standard deviation of weight of each day
SD_W = Standard deviation within a day
brickmean = Overall mean brick weight (kg)
daymean = Overall mean of total brick weight of each day (kg)

Number of samples is estimated as follows:

$$c \geq \frac{\left(\frac{46{,}175}{193{,}946}\right)^2 x\left(\frac{365}{365-1}\right)+\left(\frac{1}{10}\right)x\left(\frac{0.041}{3.028}\right)^2 x\left(\frac{100{,}000-10}{100{,}000-1}\right)}{\left(\frac{0.1}{1.646}\right)^2+\frac{1}{365-1}\left(\frac{46{,}175}{193{,}946}\right)^2}$$

Therefore, the number of days to be sampled,

c = 15.

Here, the required number of days to be selected per year is 15. The following table gives the calculation carried out for all the kilns and their sample size estimation.

No.	Kiln	Brick Mean (kg)	Std. deviation within a day (SD_w)	SD of total weight of days (SD_b)	Sample size per day	No. of days to be selected	Total samples required
1	Kapita	3.03	0.04	46,175	10	15	150
2	Diamond	3.60	0.11	17,289	10	3	30
3	Sunflower	3.59	0.10	13,218	10	2	20
4	Banalata	3.06	0.11	9,438	10	4	40
5	Haair	3.18	0.05	22,064	10	13	130
6	Universal	3.25	0.07	15,886	10	7	70

From the above table, it is inferred that the sample size depends very much upon the standard deviation within a day (SD_w) and standard deviation of total weight of days (SD_b). The maximum number of samples to be selected is 150 for Kapita brick kiln.

4. Selection of sample bricks from each gate

A list of number of sample bricks per day and the corresponding estimation of number of days per year has been generated based on above calculation.

No. of samples per day	No. of days to be selected
1	14.81
5	14.77
10	14.76
15	14.76
20	14.76

No. of samples per day	No. of days to be selected
25	14.76
30	14.76

From the above table, it is observed that the required days per year does not vary much with the samples selected per day.

Required sampling as per cluster sampling

From the above estimations, the minimum required sample size for all kilns = 10 bricks per day x 15 days = 150 brick samples per year.

It is observed that the kilns operate in a wide range of periods from a minimum of 4 months to one year. Hence, the number of samples per day and selection of number of days must be estimated such that even at the minimum operating period of 4 months, the kilns are able to achieve the required sample size of 150 bricks. To achieve this:

- 40 samples (150 samples/4 months) must be selected from a month
- Taking 20 samples per day, 2 days shall be selected for a month

As per the above plan, a kiln operating for a minimum of 4 months will be able to achieve 160 (8 days x 20 samples) sample measurements which is above the minimum requirement of 150 samples.

Therefore, below are the sampling numbers required as per the multi-stage sampling procedure:

- Stage 1 (PSU) - no of days to be selected per year : 24 (2 per month)
- Stage 2 (SSU) - no of bricks to be sampled in each day : 20 (fixed)
- Total bricks to be sampled per year : 480
- 2 days shall be randomly selected from every operational month based on the production pattern
- 20 bricks will be taken for every type of brick (solid, 3 holed, 6 holed, etc.) produced on a day
- Sample selection within a day shall also be carried out by random.

However, the total Number of bricks to be sampled per year (480) is not fixed for all kilns and the total number of brick samples may vary based on the number of operational months of an individual kiln. For example, if a kiln operates for only 6 months of year, then it will have, 6 months x 2 days/month x 20 samples/day = 240 samples only while a kiln operating for 12 months will have 480 samples.

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).
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