



**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**

<b>Title of the project activity</b>	Improving Kiln Efficiency In The Brick Making Industry In Bangladesh
<b>Reference number of the project activity</b>	5125
<b>Version number of the monitoring report</b>	01
<b>Completion date of the monitoring report</b>	16/10/2014
<b>Registration date of the project activity</b>	18/08/2011
<b>Monitoring period number and duration of this monitoring period</b>	Second monitoring period : 01/09/2012 to 31/08/2014
<b>Project participant(s)</b>	<ol style="list-style-type: none"> <li>1. Industrial and Infrastructure Development Finance Company Ltd. (IIDFC) (Private entity), Bangladesh</li> <li>2. Ministry of Sustainable Development and Infrastructure, Luxembourg</li> <li>3. International Bank for Reconstruction and Development (IBRD) as Trustee of the Danish Carbon Fund (DCF); Danish Ministry of Climate and Energy/Danish Energy Agency; DONG Naturgas A/S; Maersk Olie og Gas AS; Nordjysk Elhandel A/S, Denmark</li> <li>4. BASF SE; KfW, Germany</li> <li>5. Goteborg Energi AB, Sweden</li> <li>6. Walloon Region: Walloon Air and Climate Agency; Bruxelles Environment - IBGE, Belgium</li> <li>7. Ruukki Metals Oy, Finland</li> <li>8. EDP - Energias de Portugal, S.A.; Endesa Generacion, S.A; Gas Natural SDG, S.A.; Hidroelectrica del Cantabrico, S.A.; Kingdom of Spain - Ministry of Agriculture, Food and Environment and Ministry of Economy and Competitiveness, Spain</li> <li>9. The Netherlands' Ministry of Infrastructure and the Environment, Netherlands</li> <li>10. Government of Italy - Ministry for the Environment, Land and Sea, Italy</li> <li>11. Kommunal Kredit Public Consulting GmbH,</li> </ol>

	<p>Austria</p> <p>12. Statoil ASA, Norway</p> <p>13. Fujifilm Corporation, Idemitsu Kosan Co., Ltd.; JX Nippon Oil &amp; Energy Corporation; The Okinawa Electric Power Corporation, Incorporated, Japan</p> <p>14. Schweizerische Ruckversicherungsgesellschafts AG (Swiss RE), Switzerland</p>
<b>Host Party(ies)</b>	Bangladesh
<b>Sectoral scope and selected methodology(ies), and where applicable, applied standardized baseline(s)</b>	<p>Sectoral Scope: 4: Manufacturing industries;</p> <p>Methodology: AMS-II.D - Energy efficiency and fuel switching measures for industrial facilities, version 12, EB 51</p>
<b>Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD</b>	89,312 t CO <sub>2</sub> e
<b>Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period</b>	48,139 t CO <sub>2</sub> e
<b>Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period up to 31 December 2012 (if applicable)</b>	5,998 t CO <sub>2</sub> e
<b>Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period from 1 January 2013 onwards (if applicable).</b>	42,141 t CO <sub>2</sub> e

## SECTION A. Description of project activity

### A.1. Purpose and general description of project activity

The purpose of the project was to construct six<sup>1</sup> new energy efficient kilns for reducing CO<sub>2</sub> emissions in Bangladesh. At present, brick making is a highly energy-intensive activity and is one of the largest sources of greenhouse gas (GHG) emissions in the country. 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 400,000 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 Bangladeshi financial institution, acts as the bundling agent for the six kiln owners. The construction of first kiln (Universal) under this project was started in 2006 and began its commercial operation in 2008. Other kilns (Diamond, Kapita and Banalata) started their construction and operation during 2009-2010. Sunflower and Haair brick kilns were the last kilns that came into operation in 2012. More details on operational timeline of each kiln are provided in section B.1.

The project was registered on 18/08/2011<sup>2</sup>. This report presents the emission reductions achieved for the period from 01/09/2012 to 31/08/2014. The total emission reported for this monitoring period is 48,139 t CO<sub>2</sub>e.

### A.2. Location of project activity

Locations of the six HHK facilities are furnished in the table 1 below.

**Table 1: Location of kilns**

HHK facility	Daily brick production	Host Party	Region / state / province	City / town / community	Latitude °N	Longitude °E
Universal Bricks Ltd. (Universal)	50,000	Bangladesh	Dhaka Division	Dhamrai	+23.58	+90.11
Haair Bricks Ltd. (Haair)	50,000	Bangladesh	Dhaka Division	Dhamrai	+23.58	+90.11
Diamond Auto Bricks Ltd. (Diamond)	100,000	Bangladesh	Dhaka Division	Narayanganj	+23.48	+90.34

<sup>1</sup> SSL Ceramic Bricks Ltd. (kiln 1 and kiln 2) were initially added in the bundle during registration of PDD. However, the SSL kiln 1 discontinued its operation from 01/07/2012 due to cracking issues in baked bricks. SSL kiln 2 is also not constructed due to the above issues. Hence, these two kilns are removed from PDD during Post Registration Changes (PRC). <http://cdm.unfccc.int/PRCCContainer/DB/prcp194084662/view>

<sup>2</sup> <http://cdm.unfccc.int/Projects/DB/DNV-CUK1313585039.34/view>

HHK facility	Daily brick production	Host Party	Region / state / province	City / town / community	Latitude N	Longitude E
Kapita Auto Bricks Ltd (Kapita)	100,000	Bangladesh	Dhaka Division	Dhamrai	+23.52	+90.01
Banalata Refractory Ltd. (Banalata)	50,000	Bangladesh	Rajshahi Division	Natore	+23.56	+90.14
Sunflower Bricks & Construction Materials Ltd. (Sunflower)	50,000	Bangladesh	Dhaka Division	Narayanganj	+23.48	+90.34

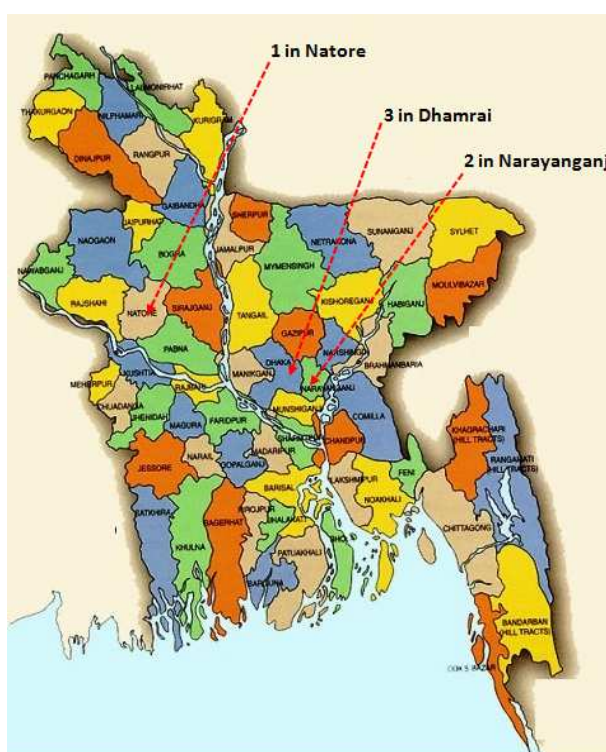


Figure 1: Map showing location of project kilns and the distribution of brick making activities

### 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
Luxembourg	Ministry of Sustainable Development and Infrastructure	Yes

Denmark	<ul style="list-style-type: none"> <li>• International Bank for Reconstruction and Development (IBRD) as Trustee of the Danish Carbon Fund (DCF)</li> <li>• Danish Ministry of Climate and Energy / Danish Energy Agency</li> <li>• DONG Naturgas A/S</li> <li>• Maersk Olie og Gas A/S</li> <li>• Nordjysk Elhandel A/S</li> </ul>	Yes
Germany	BASF SE; KfW	No
Sweden	Goteborg Energi AB	No
Belgium	<ul style="list-style-type: none"> <li>• Walloon Region: Walloon Air and Climate Agency</li> <li>• Bruxelles Environnement - IBGE</li> </ul>	Yes
Finland	Ruukki Metals Oy	No
Spain	<ul style="list-style-type: none"> <li>• EDP - Energias de Portugal, S.A.</li> <li>• Endesa Generacion, S.A.</li> <li>• Gas Natural SDG, S.A.</li> <li>• Hidroelectrica del Cantabrico, S.A.</li> <li>• Kingdom of Spain - Ministry of Agriculture, Food and Environment and Ministry of Economy and Competitiveness</li> </ul>	Yes
Netherlands	The Netherlands' Ministry of Infrastructure and the Environment	Yes
Italy	Government of Italy - Ministry for the Environment, Land and Sea	Yes
Austria	Kommunal Kredit Public Consulting GmbH	No
Norway	Statoil ASA	No
Japan	<ul style="list-style-type: none"> <li>• Fujifilm Corporation</li> <li>• Idemitsu Kosan Co., Ltd.</li> <li>• JX Nippon Oil &amp; Energy Corporation</li> <li>• The Okinawa Electric Power Corporation, Incorporated</li> </ul>	No
Switzerland	Schweizerische Ruckversicherungsgesellschafts AG (Swiss RE)	No

#### 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<sup>3</sup>,  
 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<sup>4</sup>; and*
- *Guidelines for Objective Demonstration and Assessment of Barriers, version 01.0, EB 50<sup>5</sup>*
- *General Guidelines for Sampling and Surveys for Small-Scale CDM Project Activities, version 01, EB 50, Annex 30<sup>6</sup> (as followed in registered PDD)*
- *Guidelines for sampling and surveys for CDM project activities and programme of activities, version 03.0, EB 75<sup>7</sup> (as followed in PRC PDD)*

#### **A.5. Crediting period of project activity**

Fixed crediting period of 10 years starting from 01/09/2011 to 31/08/2021 is chosen.

Monitoring period reported in this monitoring report starts from 01/09/2012 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](mailto: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.

SSL Ceramic Bricks Ltd. (kiln 1 and kiln 2) were initially added in the bundle during the registration of PDD. However, the SSL kiln 1 could not operate from 01/07/2012 due to cracking issues in baked bricks. SSL kiln 2 was also not constructed due to the above issue. Hence, these two kilns were removed from the PDD during Post Registration Changes (PRC).

As the technology is new to Bangladesh, technology services were largely imported from China by the brick kiln owners.

<sup>3</sup> [https://cdm.unfccc.int/filestorage/7/P/F/7PFK2TOWNXUI035ZRSBQLA9V1MD8E/EB51\\_repan16\\_AMS-II.D\\_ver12.pdf?t=Rml8bmJxZnVxfDBzc1fPIITPgKdj5235bGAU](https://cdm.unfccc.int/filestorage/7/P/F/7PFK2TOWNXUI035ZRSBQLA9V1MD8E/EB51_repan16_AMS-II.D_ver12.pdf?t=Rml8bmJxZnVxfDBzc1fPIITPgKdj5235bGAU)

<sup>4</sup> <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v2.pdf>

<sup>5</sup> [https://cdm.unfccc.int/EB/050/eb50\\_repan13.pdf](https://cdm.unfccc.int/EB/050/eb50_repan13.pdf)

<sup>6</sup> [http://cdm.unfccc.int/EB/050/eb50\\_repan30.pdf](http://cdm.unfccc.int/EB/050/eb50_repan30.pdf)

<sup>7</sup> [http://cdm.unfccc.int/filestorage/I/J/9/IJ9FVMQKZ2BU4YSE1RH370WXC6P8A/eb75\\_repan08.pdf?t=OGR8bmJxZzRofDCzQETd8qfpQYGrCH9YRZKS](http://cdm.unfccc.int/filestorage/I/J/9/IJ9FVMQKZ2BU4YSE1RH370WXC6P8A/eb75_repan08.pdf?t=OGR8bmJxZzRofDCzQETd8qfpQYGrCH9YRZKS)

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. Diamond brick kiln was not in operation between 01/03/2012 to 15/02/2013. Since there was heat loss in the kiln and leakage in the underground tunnel, the factory management had constructed an overhead tunnel and had replaced the blower. Issues are fixed and kiln is in operation now. The details of operational and shutdown duration of each kiln during this monitoring period (01/09/2012 to 31/08/2014) are 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 <sup>8</sup> ?	Operational days in the monitoring period	
						01/09/2012 to 31/08/2013	01/09/2013 to 31/08/2014
1.	Universal	20/11/2006	01/01/2008	09/01/2008	Yes	255	362
2.	Haair	20/05/2007	19/02/2012	01/03/2012	Yes	335	292
3.	Diamond	23/03/2008	17/12/2008	01/02/2009	No <sup>9</sup>	198	243
4.	Kapita	14/04/2009	11/04/2010	15/03/2010	Yes	336	236
5.	Banalata	13/10/2009	02/07/2010	01/06/2010	Yes	287	359
6.	Sunflower	01/10/2009	01/02/2012	01/03/2012	Yes	355	329

### Technology description

A kiln consisting of 18-22 doors has a production capacity of 50,000 bricks per day and is considered as single sized HHK. Universal, Haair, Banalata and Sunflower are single sized HHK kilns. A kiln consisting of 36-44 doors has a production capacity of 100,000 bricks per day and is considered as double sized HHK. Diamond and Kapita are double sized HHK 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 mill, 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, which 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.

<sup>8</sup> The kilns may be totally shut down for a period of 1-2 months annually to carry out maintenance activities.

<sup>9</sup> Kiln was not in operation between 01/03/2012 to 15/02/2013 due to maintenance issues.

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

During this monitoring period (01/09/2012 to 31/08/2014), the kilns were operating at 39 - 76% of their design brick production capacity. The reason for less brick production during the monitoring period is mainly due to the reduced market demand for bricks during the same period.

## **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 revised PDD version 16, dated 08/04/2014 and was approved by UNFCCC through a Post Registration Change (PRC) request<sup>10</sup> (ref no: PRC-5125-001) on 01/07/2014. The main changes to the registered project were as follows:

- Direct monitoring of "Total consumption of coal" is implemented with the daily coal consumption measurement using 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 revised to purchase new weighing scale, every year
- Direct monitoring of "Quantity of diesel (fuel type) combusted in process" is implemented with daily diesel consumption measurement using standard measuring cans.
- 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.
- The revised PDD also clarifies that "In cases where a single electricity meter is used by two kilns and unless there is proper sub-meter installed and consumption is monitored, the total power consumption of the meter will be considered for each of the kilns."
- 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**

The project activity in the registered PDD comprised of eight HHK brick making units, whereas the revised PDD indicates the number of units to be six only. Of the two units removed, one of the units, SSL-1 Ceramics Bricks Limited (Kiln 1) was shut down due to technical problems and quality issues from 01/07/2012 onwards. The second unit, SSL-2 Ceramics Bricks Limited (kiln 2), was

<sup>10</sup> <https://cdm.unfccc.int/PRCContainer/DB/prcp194084662/view>



not implemented due to the technical problems faced in kiln 1 unit. The above corrections were reflected in revised PDD version 16, dated 08/04/2014 and was approved by UNFCCC through a Post Registration Change (PRC) request<sup>11</sup> (ref no: PRC-5125-001) on 01/07/2014.

### B.2.5. Changes to start date of crediting period

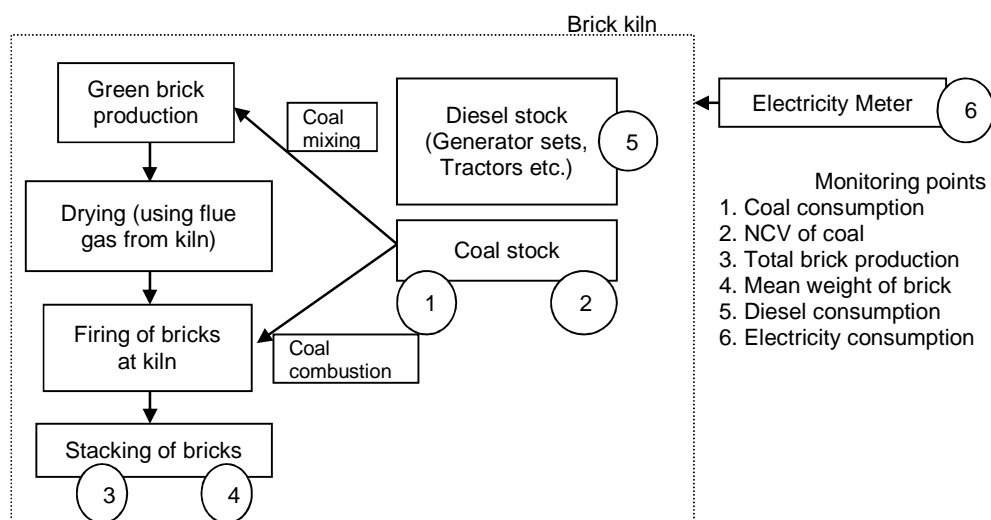
Not applicable.

### 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.



**Figure 2: Location points of data monitoring**

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 above figure, 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 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.

An annual audit was also carried out for 3 consecutive days, at each brick kiln by IIDFC to review the CDM compliance practices. The results were presented as a report to kilns. Improvements in

<sup>11</sup> <https://cdm.unfccc.int/PRCContainer/DB/prcp194084662/view>

monitoring system such as use of daily CDM log sheet to improve data recording were suggested. The details of the period of audit at each kiln are mentioned in table below:

**Table 3: Audit days of the kilns**

No.	Kiln name	Audit days for the period of	
		01/09/2012 to 31/08/2013	01/09/2013 to 31/08/2014
1.	Universal	26-28 August, 2013	16-18 August, 2014
2.	Haair	02-04 June, 2013	14-16 May, 2014
3.	Diamond	23-25 March, 2013	17-19 March, 2014
4.	Kapita	20-22 June, 2013	05-07 July, 2014
5.	Banalata	09-11 May, 2013	18-20 June, 2014
6.	Sunflower	21-23 August, 2013	05-07 June, 2014

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

**Table 4: 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 (CDM monitoring)	Training program as and when required	As and when required	IIDFC or their Consultants	IIDFC
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.)

<b>Data / Parameter:</b>	<b>CV<sub>coal, FCK</sub></b>
Unit:	TJ/kg
Description:	Net calorific value of coal used in FCK emission calculation
Source of data:	Coal specifications reported by Barapukuria Coal Mining Company Limited (BCMCL) ( <a href="http://www.bcmcl.org.bd/">http://www.bcmcl.org.bd/</a> )
Value(s) applied:	2.568 x 10 <sup>-5</sup> TJ/kg (or 6,135 kCal/kg)
Purpose of data:	To calculate baseline emissions
Additional comment:	Not applicable

<b>Data / Parameter:</b>	<b>CEF<sub>coal</sub></b>
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

<b>Data / Parameter:</b>	<b>CF</b>
Unit:	t CO <sub>2</sub> e/t C
Description:	Carbon to CO <sub>2</sub> conversion factor
Source of data:	Not applicable
Value(s) applied:	3.66
Purpose of data:	To calculate baseline emissions
Additional comment:	Not applicable

<b>Data / Parameter:</b>	<b>EF<sub>CO2, Elec</sub></b>
Unit:	t CO <sub>2</sub> e/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

<b>Data / Parameter:</b>	<b>SEC<sub>FCK, Bricks</sub></b>
Unit:	TJ/kg-brick
Description:	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 x 10 <sup>-6</sup>

Purpose of data:	To calculate the baseline emissions
Additional comment:	The value is the specific energy consumption per kg-brick in conventional FCK kilns. It has been fixed ex-ante. Calorific value of Barapukuria coal of 6,135 kCal/kg (as measured for this project) and the coal use of 24 tonnes per 100,000 bricks were utilized to calculate the specific energy consumption per kg-brick in the FCK technology.

<b>Data / Parameter:</b>	<b>SFC<sub>FCK, Bricks</sub></b>
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: <a href="http://pubs.pembina.org/reports/cdm_bangladesh_brickkilns.pdf">http://pubs.pembina.org/reports/cdm_bangladesh_brickkilns.pdf</a> 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 <sub>FCK, Bricks</sub> ) in conventional FCK kilns.

<b>Data / Parameter:</b>	<b>M<sub>FCK,brick</sub></b>
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 <sub>FCK, Bricks</sub> ) in conventional FCK kilns.

<b>Data / Parameter:</b>	<b>NCV<sub>Diesel,y</sub></b>
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.

<b>Data / Parameter:</b>	<b>Density<sub>Diesel,y</sub></b>
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.

<b>Data / Parameter:</b>	<b>EF<sub>CO2, Diesel,y</sub></b>
Unit:	t CO <sub>2</sub> /TJ
Description:	Weighted average CO <sub>2</sub> 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 <sub>Coal,i,y</sub>																														
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 rowspan="2">No.</th><th rowspan="2">Kiln name</th><th colspan="2">tonnes/year</th></tr><tr><th>01/09/2012 to 31/08/2013</th><th>01/09/2013 to 31/08/2014</th></tr><tr><td>1.</td><td>Universal</td><td>991</td><td>1,233</td></tr><tr><td>2.</td><td>Haair</td><td>1,678</td><td>1,416</td></tr><tr><td>3.</td><td>Diamond</td><td>1,405</td><td>1,896</td></tr><tr><td>4.</td><td>Kapita</td><td>2,875</td><td>1,688</td></tr><tr><td>5.</td><td>Banalata</td><td>1,006</td><td>1,780</td></tr><tr><td>6.</td><td>Sunflower</td><td>1,674</td><td>1,728</td></tr></table>	No.	Kiln name	tonnes/year		01/09/2012 to 31/08/2013	01/09/2013 to 31/08/2014	1.	Universal	991	1,233	2.	Haair	1,678	1,416	3.	Diamond	1,405	1,896	4.	Kapita	2,875	1,688	5.	Banalata	1,006	1,780	6.	Sunflower	1,674	1,728
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Monitoring equipment:	Digital weighing scale (used for both coal and brick weight measurement): <table border="1"> <thead> <tr> <th>No.</th><th>Kiln name</th><th>Previous purchase date</th><th>Purchase during the monitoring year</th><th>Make</th><th>Accuracy (<math>\pm</math> g)</th></tr> </thead> <tbody> <tr> <td colspan="6">For period 01/09/2012 to 31/08/2013</td></tr> <tr> <td>1.</td><td>Universal</td><td>20/09/2012</td><td>18/09/2013</td><td>ACS</td><td>2</td></tr> <tr> <td>2.</td><td>Haair</td><td>25/02/2012</td><td>23/02/2013</td><td>KDC (Kitchen Scale)</td><td>3</td></tr> <tr> <td>3.</td><td>Diamond<sup>12</sup></td><td>19/06/2012</td><td>12/02/2013</td><td>ACS</td><td>2</td></tr> <tr> <td>4.</td><td>Kapita</td><td>19/07/2012</td><td>17/07/2013</td><td>ACS</td><td>2</td></tr> <tr> <td>5.</td><td>Banalata</td><td>20/09/2012</td><td>27/08/2013</td><td>ACS</td><td>2</td></tr> <tr> <td>6.</td><td>Sunflower</td><td>19/06/2012</td><td>16/06/2013</td><td>ACS</td><td>2</td></tr> <tr> <td colspan="6">For period 01/09/2013 to 31/08/2014</td></tr> <tr> <td>1.</td><td>Universal</td><td>18/09/2013</td><td>16/09/2014</td><td>TCS</td><td>5</td></tr> <tr> <td>2.</td><td>Haair</td><td>23/02/2013</td><td>20/02/2014</td><td>KDC (Kitchen Scale)</td><td>3</td></tr> <tr> <td>3.</td><td>Diamond</td><td>12/02/2013</td><td>10/02/2014</td><td>ACS</td><td>2</td></tr> <tr> <td>4.</td><td>Kapita</td><td>17/07/2013</td><td>16/07/2014</td><td>ACS</td><td>2</td></tr> <tr> <td>5.</td><td>Banalata</td><td>27/08/2013</td><td>25/08/2014</td><td>ACS</td><td>2</td></tr> <tr> <td>6.</td><td>Sunflower</td><td>16/06/2013</td><td>15/06/2014</td><td>ACS</td><td>2</td></tr> </tbody> </table>	No.	Kiln name	Previous purchase date	Purchase during the monitoring year	Make	Accuracy ( $\pm$ g)	For period 01/09/2012 to 31/08/2013						1.	Universal	20/09/2012	18/09/2013	ACS	2	2.	Haair	25/02/2012	23/02/2013	KDC (Kitchen Scale)	3	3.	Diamond <sup>12</sup>	19/06/2012	12/02/2013	ACS	2	4.	Kapita	19/07/2012	17/07/2013	ACS	2	5.	Banalata	20/09/2012	27/08/2013	ACS	2	6.	Sunflower	19/06/2012	16/06/2013	ACS	2	For period 01/09/2013 to 31/08/2014						1.	Universal	18/09/2013	16/09/2014	TCS	5	2.	Haair	23/02/2013	20/02/2014	KDC (Kitchen Scale)	3	3.	Diamond	12/02/2013	10/02/2014	ACS	2	4.	Kapita	17/07/2013	16/07/2014	ACS	2	5.	Banalata	27/08/2013	25/08/2014	ACS	2	6.	Sunflower	16/06/2013	15/06/2014	ACS	2
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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:	<p>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.</p> <p>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.</p> <p>The kilns purchased new weighing scale every year which avoided the necessity of calibration of existing weighing scales.</p>																																																																																										
Purpose of data:	To calculate the project emissions																																																																																										
Additional comment:	The data will be archived for two years after the crediting period																																																																																										

<b>Data / Parameter:</b>	<b>NCV<sub>Coal,i, y</sub></b>
Unit:	TJ/kg
Description:	Net calorific value of coal used in y <sup>th</sup> year in brick kiln i

<sup>12</sup> Used the same weighing scale of Sunflower from 19/06/2012 to 12/02/2013. Separate weighing scale was purchased after that.

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:	<table border="1"> <thead> <tr> <th rowspan="2">No.</th><th rowspan="2">Kiln name</th><th colspan="2"><math>\times 10^{-5}</math> TJ/kg</th></tr> <tr> <th>01/09/2012 to 31/08/2013</th><th>01/09/2013 to 31/08/2014</th></tr> </thead> <tbody> <tr><td>1.</td><td>Universal</td><td>2.64</td><td>2.52</td></tr> <tr><td>2.</td><td>Haair</td><td>2.90</td><td>2.76</td></tr> <tr><td>3.</td><td>Diamond</td><td>2.48</td><td>2.53</td></tr> <tr><td>4.</td><td>Kapita</td><td>2.97</td><td>2.77</td></tr> <tr><td>5.</td><td>Banalata</td><td>2.95</td><td>1.96</td></tr> <tr><td>6.</td><td>Sunflower</td><td>2.53</td><td>2.53</td></tr> </tbody> </table>	No.	Kiln name	$\times 10^{-5}$ TJ/kg		01/09/2012 to 31/08/2013	01/09/2013 to 31/08/2014	1.	Universal	2.64	2.52	2.	Haair	2.90	2.76	3.	Diamond	2.48	2.53	4.	Kapita	2.97	2.77	5.	Banalata	2.95	1.96	6.	Sunflower	2.53	2.53
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6.	Sunflower	2.53	2.53																												
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 crediting period.																														
Purpose of data:	To calculate project emissions																														
Additional comment:	The data will be archived for two years after the crediting period																														

<b>Data / Parameter:</b>	<b>DP<sub>Bricks,i</sub></b>																														
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:	<p>Cumulative daily production for the monitoring period in each kiln are given below:</p> <table border="1"> <thead> <tr> <th rowspan="2">No.</th><th rowspan="2">Kiln name</th><th colspan="2">No. of bricks</th></tr> <tr> <th>01/09/2012 to 31/08/2013</th><th>01/09/2013 to 31/08/2014</th></tr> </thead> <tbody> <tr><td>1.</td><td>Universal</td><td>7,448,000</td><td>9,288,000</td></tr> <tr><td>2.</td><td>Haair</td><td>13,144,600</td><td>11,578,400</td></tr> <tr><td>3.</td><td>Diamond</td><td>11,910,322</td><td>14,302,703</td></tr> <tr><td>4.</td><td>Kapita</td><td>21,584,126</td><td>14,179,986</td></tr> <tr><td>5.</td><td>Banalata</td><td>8,217,000</td><td>13,270,500</td></tr> <tr><td>6.</td><td>Sunflower</td><td>15,109,929</td><td>13,958,231</td></tr> </tbody> </table> <p>For the period 01/09/2012 to 30/06/2014, daily brick production values were used for CER estimation, as per registered PDD.</p> <p>For the period 01/07/2014 to 31/08/2014, cumulative brick production values were used for CER estimation, as per PRC PDD.</p>	No.	Kiln name	No. of bricks		01/09/2012 to 31/08/2013	01/09/2013 to 31/08/2014	1.	Universal	7,448,000	9,288,000	2.	Haair	13,144,600	11,578,400	3.	Diamond	11,910,322	14,302,703	4.	Kapita	21,584,126	14,179,986	5.	Banalata	8,217,000	13,270,500	6.	Sunflower	15,109,929	13,958,231
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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.

<b>Data / Parameter:</b>	<b>DMW<sub>HHK Bricks,di</sub></b>																																
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 border="1" data-bbox="587 1018 1339 1289"> <thead> <tr> <th rowspan="2">No.</th><th rowspan="2">Kiln name</th><th colspan="2">kg/brick</th></tr> <tr> <th>01/09/2012 to 31/08/2013</th><th>01/09/2013 to 31/08/2014</th></tr> </thead> <tbody> <tr> <td>1.</td><td>Universal</td><td>3.251</td><td>3.371</td></tr> <tr> <td>2.</td><td>Haair</td><td>3.194</td><td>3.195</td></tr> <tr> <td>3.</td><td>Diamond</td><td>3.599</td><td>3.599</td></tr> <tr> <td>4.</td><td>Kapita</td><td>3.084</td><td>3.054</td></tr> <tr> <td>5.</td><td>Banalata</td><td>2.966</td><td>2.998</td></tr> <tr> <td>6.</td><td>Sunflower</td><td>3.360</td><td>3.404</td></tr> </tbody> </table>			No.	Kiln name	kg/brick		01/09/2012 to 31/08/2013	01/09/2013 to 31/08/2014	1.	Universal	3.251	3.371	2.	Haair	3.194	3.195	3.	Diamond	3.599	3.599	4.	Kapita	3.084	3.054	5.	Banalata	2.966	2.998	6.	Sunflower	3.360	3.404
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Measuring/ Reading/ Recording frequency:	Daily																																																																																										
Calculation method (if applicable):	<p><u>For the period of 01/09/2012 to 30/06/2013 (before PRC approval)</u></p> <p>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.</p> <p><u>For the period of 01/07/2013 to 31/08/2013 (after PRC approval)</u></p> <p>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 16 dated 08/04/2014. In accordance to these, a minimum of 160 samples were taken from 01/07/2013 to 31/08/2013 and cumulative mean brick weight was estimated.</p>																																																																																										
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 <sub>i,y</sub>
Unit:	TJ/kg-brick
Description:	Specific energy consumption in brick kiln i

<sup>13</sup> Used the same weighing scale of Sunflower from 19/06/2012 to 12/02/2013. Separate weighing scale was purchased after that.

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 border="1"> <thead> <tr> <th rowspan="2">No.</th> <th rowspan="2">Kiln name</th> <th colspan="2">x 10<sup>-6</sup> TJ/kg-brick</th> </tr> <tr> <th>01/09/2012 to 31/08/2013</th> <th>01/09/2013 to 31/08/2014</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Universal</td> <td>1.083</td> <td>0.972</td> </tr> <tr> <td>2.</td> <td>Haair</td> <td>1.161</td> <td>1.057</td> </tr> <tr> <td>3.</td> <td>Diamond</td> <td>0.813</td> <td>0.931</td> </tr> <tr> <td>4.</td> <td>Kapita</td> <td>1.282</td> <td>1.080</td> </tr> <tr> <td>5.</td> <td>Banalata</td> <td>1.219</td> <td>0.804</td> </tr> <tr> <td>6.</td> <td>Sunflower</td> <td>0.835</td> <td>0.913</td> </tr> </tbody> </table>	No.	Kiln name	x 10 <sup>-6</sup> TJ/kg-brick		01/09/2012 to 31/08/2013	01/09/2013 to 31/08/2014	1.	Universal	1.083	0.972	2.	Haair	1.161	1.057	3.	Diamond	0.813	0.931	4.	Kapita	1.282	1.080	5.	Banalata	1.219	0.804	6.	Sunflower	0.835	0.913
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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.																														

<b>Data / Parameter:</b>	<b>N</b>																														
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 border="1"> <thead> <tr> <th rowspan="2">No.</th> <th rowspan="2">Kiln name</th> <th colspan="2">Days</th> </tr> <tr> <th>01/09/2012 to 31/08/2013</th> <th>01/09/2013 to 31/08/2014</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Universal</td> <td>255</td> <td>362</td> </tr> <tr> <td>2.</td> <td>Haair</td> <td>335</td> <td>292</td> </tr> <tr> <td>3.</td> <td>Diamond</td> <td>198</td> <td>243</td> </tr> <tr> <td>4.</td> <td>Kapita</td> <td>336</td> <td>236</td> </tr> <tr> <td>5.</td> <td>Banalata</td> <td>287</td> <td>359</td> </tr> <tr> <td>6.</td> <td>Sunflower</td> <td>355</td> <td>329</td> </tr> </tbody> </table>	No.	Kiln name	Days		01/09/2012 to 31/08/2013	01/09/2013 to 31/08/2014	1.	Universal	255	362	2.	Haair	335	292	3.	Diamond	198	243	4.	Kapita	336	236	5.	Banalata	287	359	6.	Sunflower	355	329
No.	Kiln name			Days																											
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6.	Sunflower	355	329																												
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																														

<b>Data / Parameter:</b>	<b>FC<sub>Diesel,i, y</sub></b>																														
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 border="1"> <thead> <tr> <th rowspan="2">No.</th><th rowspan="2">Kiln name</th><th colspan="2">kl/yr</th></tr> <tr> <th>01/09/2012 to 31/08/2013</th><th>01/09/2013 to 31/08/2014</th></tr> </thead> <tbody> <tr> <td>1.</td><td>Universal</td><td>32.9</td><td>34.8</td></tr> <tr> <td>2.</td><td>Haair</td><td>30.8</td><td>18.6</td></tr> <tr> <td>3.</td><td>Diamond</td><td>20.0</td><td>33.6</td></tr> <tr> <td>4.</td><td>Kapita</td><td>68.9</td><td>48.8</td></tr> <tr> <td>5.</td><td>Banalata</td><td>25.0</td><td>43.8</td></tr> <tr> <td>6.</td><td>Sunflower</td><td>34.0</td><td>33.6</td></tr> </tbody> </table>	No.	Kiln name	kl/yr		01/09/2012 to 31/08/2013	01/09/2013 to 31/08/2014	1.	Universal	32.9	34.8	2.	Haair	30.8	18.6	3.	Diamond	20.0	33.6	4.	Kapita	68.9	48.8	5.	Banalata	25.0	43.8	6.	Sunflower	34.0	33.6
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6.	Sunflower	34.0	33.6																												
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:	<p>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.</p> <p>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.</p> <p>In case of any delay in procuring new measuring cans after one year, the suitable error shall be applied on the measured readings for the period until new equipment are procured. The error value shall be estimated based on actual conditions during the verification in discussion with the verifying DOE.</p> <p>The kilns purchased new weighing scans every year which avoided the necessity of adjusting the values with suitable errors.</p>																														
Purpose of data:	To calculate project emissions																														
Additional comment:	The data will be archived for two years after the crediting period																														

<b>Data / Parameter:</b>	<b>EC<sub>i,y</sub></b>
Unit:	MWh
Description:	Electricity consumption in kiln i per year
Measured/ Calculated /	Measured

Default:																																															
Source of data:	Electricity bill from the REB or the electricity supplier																																														
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Monitoring equipment:	Energy meter  <table border="1"> <thead> <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> </thead> <tbody> <tr><td>1.</td><td>Universal</td><td>Fitzall</td><td>06920082</td><td>0.5</td><td>2006</td></tr> <tr><td rowspan="2">2.</td><td rowspan="2">Haair</td><td>Fitzall</td><td>06920082<sup>14</sup></td><td>0.5</td><td>2006</td></tr> <tr><td>Itron</td><td>87906634<sup>15</sup></td><td>0.2</td><td>2014</td></tr> <tr><td>3.</td><td>Diamond</td><td>Fitzall</td><td>08920138</td><td>0.5</td><td>2009</td></tr> <tr><td>4.</td><td>Kapita</td><td>Fitzall</td><td>09920299</td><td>0.5</td><td>2009</td></tr> <tr><td>5.</td><td>Banalata</td><td>Fitzall</td><td>11920913</td><td>0.5</td><td>2011</td></tr> <tr><td>6.</td><td>Sunflower</td><td>Fitzall</td><td>08920138<sup>16</sup></td><td>0.5</td><td>2009</td></tr> </tbody> </table>	No.	Kiln name	Make	Serial no.	Accuracy Class	Year of make	1.	Universal	Fitzall	06920082	0.5	2006	2.	Haair	Fitzall	06920082 <sup>14</sup>	0.5	2006	Itron	87906634 <sup>15</sup>	0.2	2014	3.	Diamond	Fitzall	08920138	0.5	2009	4.	Kapita	Fitzall	09920299	0.5	2009	5.	Banalata	Fitzall	11920913	0.5	2011	6.	Sunflower	Fitzall	08920138 <sup>16</sup>	0.5	2009
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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:	<p>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.</p> <p>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.</p>																																														
Purpose of data:	To calculate project emissions																																														
Additional comment:	<p>From start of kiln and until 03/02/2014, Haair brick kiln did not have a separate connection from the electricity distributor. It received the power for its operations from the electricity connection obtained by Universal Brick Kiln. Since there was no sub-metering to measure exact power consumption of individual kilns, for CER estimation, the total power consumption was considered for both kilns for the period of 01/09/2012 to 03/02/2014. This is conservative. From 04/02/2014, Haair got a separate electricity connection and electricity meter installed. So, the measured values of electricity consumption are considered after that in CER calculation.</p> <p>Similarly, Sunflower brick kiln has not received electricity connection from the electricity distributor. It receives power for its operations from the electricity connection obtained by Diamond brick kiln. Since there is no sub-metering to measure exact power consumption of individual kilns, for CER estimation, the total power consumption is considered for both kilns. This is conservative.</p>																																														

<sup>14</sup> Used the same electricity connection and meter of that Universal kiln until 03/02/2014. Separate electricity meter was installed in the kiln after that.

<sup>15</sup> From 04/02/2014 onward.

<sup>16</sup> Uses the same electricity connection and meter of Diamond kiln

	The data will be archived for two years after the crediting period
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### D.3. Implementation of sampling plan

For the monitoring period between 01/09/2012 to 30/06/2013

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,

$$\text{Minimum Sample Size, } n_0 = (Z^2 \times \sigma^2) / e^2$$

Where,

Z = Z value (1.645 for 90% confidence level)

$\sigma$  = 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,

$$n_0 = (1.645^2 \times 0.5^2) / 0.1^2 = 68$$

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 tabulated as below.

**Table 5: Analysis of weight measurements of 100 brick samples for one day alone during the operation of kilns for the period of 01/09/2012 to 30/06/2014**

No.	Parameter <sup>17</sup>	Universal	Haair	Diamond	Kapita	Banalata	Sunflower
1.	Mean	3.235	3.201	3.580	3.035	2.974	2.974
2.	Standard deviation	0.089	0.068	0.115	0.0445	0.028	0.135
3.	Sample variance	0.008	0.005	0.013	0.002	0.001	0.018
4.	Minimum	3.090	3.050	3.390	2.962	2.920	2.800
5.	Maximum	3.490	3.346	3.880	3.190	3.010	3.230
6.	Standard error	0.009	0.007	0.011	0.004	0.003	0.013

<sup>17</sup> For 100 samples weighed for a respective production day of a kiln

No.	Parameter <sup>17</sup>	Universal	Haair	Diamond	Kapita	Banalata	Sunflower
7.	Confidence interval (max level / min level)	3.250	3.212	3.599	3.042	2.979	2.997
		3.220	3.190	3.561	3.028	2.969	2.952
8.	Precision (%)	0.46	0.35	0.53	0.24	0.16	0.75

From the above analysis, the lowest precision level of the brick weight measurement in the brick kilns was found to be 0.75% 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 sampling analysis” excel file.

After revision of sampling plan through PRC (01/07/2014 to 31/08/2014)

As per the revised monitoring plan in the PDD version 16, dated 08/04/2014, 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.

However, only around 2 months (01/07/2014 to 31/08/2014) of this monitoring period refers to the revised monitoring plan as per the approved revised PDD (approved on 30/06/2014). Hence, a minimum of 160 samples were achieved within this 2 months 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 6: Analysis of weight measurements of minimum 160 brick samples during the operation of kilns for the period 01/07/2014 to 31/08/2014**

No.	Parameter	Universal	Diamond	Kapita	Sunflower
1.	Mean	3.908	3.586	3.168	3.593
2.	Standard deviation	0.084	0.101	0.067	0.108
3.	Sample variance	0.007	0.010	0.004	0.011
4.	Minimum	3.540	3.390	3.025	3.390
5.	Maximum	4.100	3.880	3.360	3.880
6.	Standard error	0.006	0.003	0.005	0.004
7.	Confidence interval (max level / min level)	3.918	3.598	3.176	3.600
		3.898	3.579	3.159	3.586
8.	Precision (%)	0.25	0.18	0.28	0.19

Haair and Banalata were not in operation during July and August 2014. From the above analysis, the lowest precision level of the brick weight measurement in the brick kilns was found to be 0.28% 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 sampling analysis" excel file.

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:

01/09/2012 to 31/08/2013

$$\begin{aligned}
 BE_y &= \sum_{i=1}^6 BE_{FCK\ i, y} \\
 [t\ CO_2/year] &= 4,857.6 + 8,425.93 + 8,603.41 + 13,359.38 + 4,892.12 + 10,185.41 \\
 &= 50,323.87\ t\ CO_2/year
 \end{aligned}$$

01/09/2013 to 31/08/2014

$$\begin{aligned}
 BE_y &= \sum_{i=1}^6 BE_{FCK\ i, y} \\
 [t\ CO_2/year] &= 6,405.02 + 7,424.13 + 10,330.01 + 8,704.62 + 8,703.55 + 9,599.73 \\
 &= 51,167.07\ t\ CO_2/year
 \end{aligned}$$

Where,

$$\begin{aligned}
 BE_{FCK\ i, y} &= \text{Baseline emissions per year for the } i^{th} \text{ kiln} \\
 [t\ CO_2/year] &= TP_{Bricks, i, y} \times SEC_{FCK, Bricks, y} \times CEF_{coal} \times CF \\
 &\quad [kg-bricks(y)] \quad [TJ/kg-brick] \quad [t\ C/TJ] \quad [t\ CO_2/t\ C]
 \end{aligned}$$

Where,

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

Table 7: Estimation of baseline emission

No.	Kiln name	TP <sup>Bricks, i, y</sup> kg-bricks		SEC <sup>FCK, Bricks, y</sup> TJ/kg-brick		CEF <sup>coal</sup> t C/TJ		CF t CO <sub>2</sub> /t C		BE <sup>FCK i, y</sup> t CO <sub>2</sub> /year
For the period 01/09/2012 to 31/08/2013										
1.	Universal	24,204,456	x	2.125 x 10 <sup>-6</sup>	x	25.8	x	3.66	=	4,857.62
2.	Haair	41,984,593								8,425.93
3.	Diamond	42,868,934								8,603.41
4.	Kapita	66,566,929								13,359.38
5.	Banalata	24,376,377								4,892.12
6.	Sunflower	50,751,736								10,185.41
For the period 01/09/2013 to 31/08/2014										
No.	Kiln name	TP <sup>Bricks, i, y</sup> kg-bricks		SEC <sup>FCK, Bricks, y</sup> TJ/kg-brick		CEF <sup>coal</sup> t C/TJ		CF t CO <sub>2</sub> /t C		BE <sup>FCK i, y</sup> t CO <sub>2</sub> /year
1.	Universal	31,914,852	x	2.125 x 10 <sup>-6</sup>	x	25.8	x	3.66	=	6,405.02
2.	Haair	36,992,861								7,424.13
3.	Diamond	51,472,214								10,330.01
4.	Kapita	43,373,275								8,704.62
5.	Banalata	43,367,926								8,703.55
6.	Sunflower	47,833,406								9,599.73

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

Total project emissions in y<sup>th</sup> year, PE<sub>y</sub>, by operations of N units of HHK kilns (N=6) are given by:

01/09/2012 to 31/08/2013

$$\begin{aligned}
 PE_y &= \sum_{i=1}^6 PE_{HHK\ i, y} \\
 [t\ CO_2/year] &= 2,990.67 + 5,111.06 + 3,586.16 + 8,874.44 + 3,110.63 + 4,332.66 \\
 &= 28,005.62\ t\ CO_2/year
 \end{aligned}$$

01/09/2013 to 31/08/2014

$$\begin{aligned}
 PE_y &= \sum_{i=1}^6 PE_{HHK\ i, y} \\
 [t\ CO_2/year] &=
 \end{aligned}$$



$$= 3,372.50 + 4,005.69 + 4,855.90 + 4,998.05 + 3,657.01 + 4,456.61$$

$$= 25,345.76 \text{ t CO}_2/\text{year}$$

Where,

$$PE_{HHK, i, y} \text{ [t CO}_2/\text{year]} = \text{Project emissions from operation of } i^{\text{th}} \text{ kiln in year } y$$

$$= SEC_{i, y} \text{ [TJ/kg-brick(y)]} \times TP_{Bricks, i, y} \text{ [kg-bricks(y)]} \times CEF_{coal} \text{ [t C/TJ]} \times CF \text{ [t CO}_2/\text{t C]} +$$

$$EC_{i, y} \text{ [MWh]} \times EF_{CO_2, Elec} \text{ [t CO}_2/\text{MWh]} + PE_{FC, j, y} \text{ [t CO}_2/\text{year]}$$

Where,

$$SEC_{i, y} = \text{Specific energy consumption in kiln } i \text{ (TJ/kg-brick)}$$

$$TP_{Bricks, i, y} = \text{Total production of bricks per year in kiln } i \text{ (kg-bricks/year)}$$

$$CEF_{coal} = \text{IPCC default carbon emission factor for fuel used (t C/TJ)}$$

$$CF = \text{Carbon to CO}_2 \text{ Conversion Factor (t CO}_2/\text{t C)}$$

$$EC_{i, y} = \text{Electricity consumption in kiln } i \text{ per year (MWh)}$$

$$EF_{CO_2, Elec} = \text{Estimated CO}_2 \text{ emissions factor for grid electricity in Bangladesh (t CO}_2/\text{MWh)}$$

$$PE_{FC, j, y} = \text{CO}_2 \text{ emissions from fossil fuel combustion in year } y \text{ (t CO}_2/\text{yr)}$$

Table 8: Estimation of project emission

No.	Kiln name	$SEC_{i,y}$ TJ/kg-brick $\times 10^{-6}$		$TP_{Bricks,i,y}$ kg-bricks		$CEF_{coal}$ t C/TJ		CF t CO <sub>2</sub> /t C		$EC_{i,y}$ MWh		$EF_{CO_2,Elec}$ t CO <sub>2</sub> /MWh		$PE_{FC,j,y}$ t CO <sub>2</sub> /year		$PE_{HHK i,y}$ t CO <sub>2</sub> /year
For the period 01/09/2012 to 31/08/2013																
1.	Universal	1.083		24,204,456						686.9				90		2,990.67
2.	Haair	1.161		41,984,593						686.9				84		5,111.06
3.	Diamond	0.813		42,868,934						382.7				55		3,586.16
4.	Kapita	1.282	x	66,566,929	x	25.8	x	3.66	+	1,013.9	x	0.62	+	188	=	8,874.44
5.	Banalata	1.219		24,376,377						379.7				68		3,110.63
6.	Sunflower	0.835		50,751,736						382.7				93		4,332.66
For the period 01/09/2013 to 31/08/2014																
1.	Universal	0.972		31,914,852						561.7				95		3,372.50
2.	Haair	1.057		36,992,861						422.5				51		4,005.69
3.	Diamond	0.931		51,472,214						384.3				92		4,855.90
4.	Kapita	1.080	x	43,373,275	x	25.8	x	3.66	+	713.4	x	0.62	+	133	=	4,998.05
5.	Banalata	0.804		43,367,926						390.6				120		3,657.01
6.	Sunflower	0.913		47,833,406						384.3				92		4,456.61

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

$$\text{SEC}_{i,y} = \frac{\text{TC}_{\text{Coal } i,y} \times \text{NCV}_{\text{Coal } i,y}}{\text{TP}_{\text{Bricks, } i,y}}$$

[TJ/kg-brick]      [tonnes(y)]      [TJ/kg(y)]      [kg-bricks(y)]

Where,

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

**Table 9: Estimation of specific energy consumption**

No.	Kiln name	TC <sub>Coal i,y</sub> tonnes(y)		NCV <sub>Coal i,y</sub> TJ/kg(y) x 10 <sup>-5</sup>		TP <sub>Bricks, i,y</sub> kg- bricks(y)		SEC <sub>i,y</sub> TJ/kg-brick x10 <sup>-6</sup>
For the period 01/09/2012 to 31/08/2013								
1.	Universal	991	x	2.64	÷	24,204,456	=	1.083
2.	Haair	1,678		2.90		41,984,593		1.161
3.	Diamond	1,405		2.48		42,868,934		0.813
4.	Kapita	2,875		2.97		66,566,929		1.282
5.	Banalata	1,006		2.95		24,376,377		1.219
6.	Sunflower	1,674		2.53		50,751,736		0.835
For the period 01/09/2013 to 31/08/2014								
1.	Universal	1,233	x	2.52	÷	31,914,852	=	0.972
2.	Haair	1,416		2.76		36,992,861		1.057
3.	Diamond	1,896		2.53		51,472,214		0.931
4.	Kapita	1,688		2.77		43,373,275		1.080
5.	Banalata	1,780		1.96		43,367,926		0.804
6.	Sunflower	1,728		2.53		47,833,406		0.913

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

$$\text{TP}_{\text{Bricks, } i,y} = \sum_{d=1} \text{DP}_{\text{Bricks, } di} \times \text{DMW}_{\text{HHK brick, } di}$$

[kg-bricks/year]      [nos]      [kg/brick]

Where,

$\text{DP}_{\text{Bricks } di}$  = Daily production of bricks in kiln i (bricks/day)  
 $\text{DMW}_{\text{HHK bricks, } di}$  = 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 01/09/2012 to 30/06/2014, 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 01/07/2014 to 31/08/2013, 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 during that period.

For elaborate calculation, refer to the attached the CER estimation file, sheet "Daily brick data 2012-13" and "Daily brick data 2013-14".

CO<sub>2</sub> emissions from fossil fuel combustion in year  $y$  is given by,

$$PE_{FC,j,y} = FC_{Diesel,j,y} \times COEF_{Diesel,y}$$

[t CO<sub>2</sub>/yr]                      [kl/year]                      [t CO<sub>2</sub>/ 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<sub>2</sub> emission coefficient of diesel (fuel type) in year  $y$  (t CO<sub>2</sub>/ kl)

**Table 10: Estimation of emissions from fossil fuel combustion**

No.	Kiln name	FC <sub>Diesel, j, y</sub> kl/yr		COEF <sub>Diesel, y</sub> t CO <sub>2</sub> /kl		PE <sub>FC,j,y</sub> t CO <sub>2</sub> /yr
For the period 01/09/2012 to 31/08/2013						
1.	Universal	32.9	x	2.7	=	90
2.	Haair	30.8				84
3.	Diamond	20.0				55
4.	Kapita	68.9				188
5.	Banalata	25.0				68
6.	Sunflower	34.0				93
For the period 01/09/2013 to 31/08/2014						
1.	Universal	34.8	x	2.7	=	95
2.	Haair	18.6				51
3.	Diamond	33.6				92
4.	Kapita	48.8				133
5.	Banalata	43.8				120
6.	Sunflower	33.6				92

**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 <sub>2</sub> e)	Project emissions or actual net GHG removals by sinks (t CO <sub>2</sub> e)	Leakage (t CO <sub>2</sub> e)	Emission reductions or net anthropogenic GHG removals by sinks (t CO <sub>2</sub> e)
Total	101,490.9	53,351.4	0	48,139

**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 <sub>2</sub> e)	89,312	48,139

**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.

During this monitoring period (01/09/2012 to 31/08/2014), the kilns were operating at 39 - 76% of their design brick production capacity. The reason for less brick production during the monitoring period is mainly due to the reduced market demand for bricks during the same period.

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

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards
Emission reductions or GHG removals by sinks (t CO <sub>2</sub> e)	5,998	42,141

- - - - -

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

<b>Project participant and/or responsible person/ entity</b>	<input checked="" type="checkbox"/> Project participant <input checked="" type="checkbox"/> Responsible person/ entity for completing the CDM-MR-FORM
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## Appendix 2

## Details of kiln operation and shutdown periods

## 1. Monitoring period 2012-13


Kiln name	Sep-12	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Comments
Universal	25/09/2012 to 27/04/2013										20/07/2013 - 31/08/2013		~ 01 - 24 Sep 2012 - shut down for maintenance ~ 28 Apr - 19 Jul 2013 - shut down for maintenance
Haair		01/10/2012 to 31/08/2013											~ 01 - 30 Sep 2012 - shut down for maintenance
Diamond						15/02/2013 - 31/08/2013						~ 01 Sep 2012 - 14 Feb 2013 - Kiln shutdown due to blower replacement	
Kapita	01/09/2012 - 13/05/2013									07/06/2013 - 31/08 2013		~ 14 May - 06 Jun 2013 - shut down for maintenance and few holidays	
Banalata		01/10/2012 to 15/07/2013											~ 01 - 30 Sep 2012 - shut down for maintenance ~ 16 Jul - 31 Aug 2013 - shut down for maintenance
Sunflower	04/09/2012 - 31/08/2013												~ 25 Feb - 03 Mar 2013 - shut down for maintenance

 Full months when kiln not in operation  
(shutdown period less than a month are included in the comments column instead)



## 2. Monitoring period 2013-14

Kiln name	Sep-13	Oct-13	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Comments
Universal	01/09/2013 to 31/08/2014												Kiln was in continuous operation except few holidays
Haair	01/09/2013 - 30/06/2014												~ 10 - 31 Oct 2013 - Eid vacation ~ 01 Jul - 31 Aug 2014 - Shut down for maintenance
Diamond	01/09/2013 to 08/04/2014									01/06/2014 - 31/07/2014			~ 20 Sep - 14 Oct 2013 - Shut down for maintenance ~ 14 Feb - 26 Feb 2014 - Shut down for maintenance ~ 09 Apr - 31 May 2014 - Shut down for maintenance ~ 01 - 31 Aug 2014 - Shut down for maintenance
Kapita	01/09/2013 to 02/02/2014							23/04/2014 - 20/07/2014				~ 03 Feb - 22 Apr 2014 - shut down for maintenance ~ 21 Jul - 31 Aug 2014 - shut down for maintenance	
Banalata	01/09/2013 to 31/08/2014												~ 27 - 31 Jul 2014 - Eid vacation
Sunflower	01/09/2013 to 31/08/2014												~ 01 - 06 Jan 2014 - shut down for maintenance ~ 11 Apr - 03 May 2014 - shut down for maintenance ~ 21 - 31 Jul 2014 - shut down for maintenance

 Full Months when kiln not in operation  
(shutdown period less than a month are  
included in the comments column instead)

### 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.

#### 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	<b>700,973</b>	-	-	-
Overall mean weight (brickmean) (kg)		<b>3.028</b>	-	-
Overall mean total weight of each day (daymean) (kg)			<b>193,946</b>	-
SD of total weight of days ( SD <sub>b</sub> )			<b>46,175</b>	-
Standard deviation within a day (SD <sub>w</sub> )				<b>0.041</b>

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

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 <sub>B</sub>	=	Standard deviation of weight of each day
SD <sub>w</sub>	=	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:

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

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 <sub>w</sub> )	SD of total weight of days (SD <sub>b</sub> )	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	Banolata	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<sub>w</sub>) and standard deviation of total weight of days (SD<sub>b</sub>). 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
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	<p>Revisions to:</p> <ul style="list-style-type: none"> <li>• Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0));</li> <li>• Include provisions related to standardized baselines;</li> <li>• Add contact information on a responsible person(s)/entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1;</li> <li>• Change the reference number from <i>F-CDM-MR</i> to <i>CDM-MR-FORM</i>;</li> <li>• Editorial improvement.</li> </ul>
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.
Decision Class: Regulatory Document Type: Form Business Function: Issuance Keywords: monitoring report		